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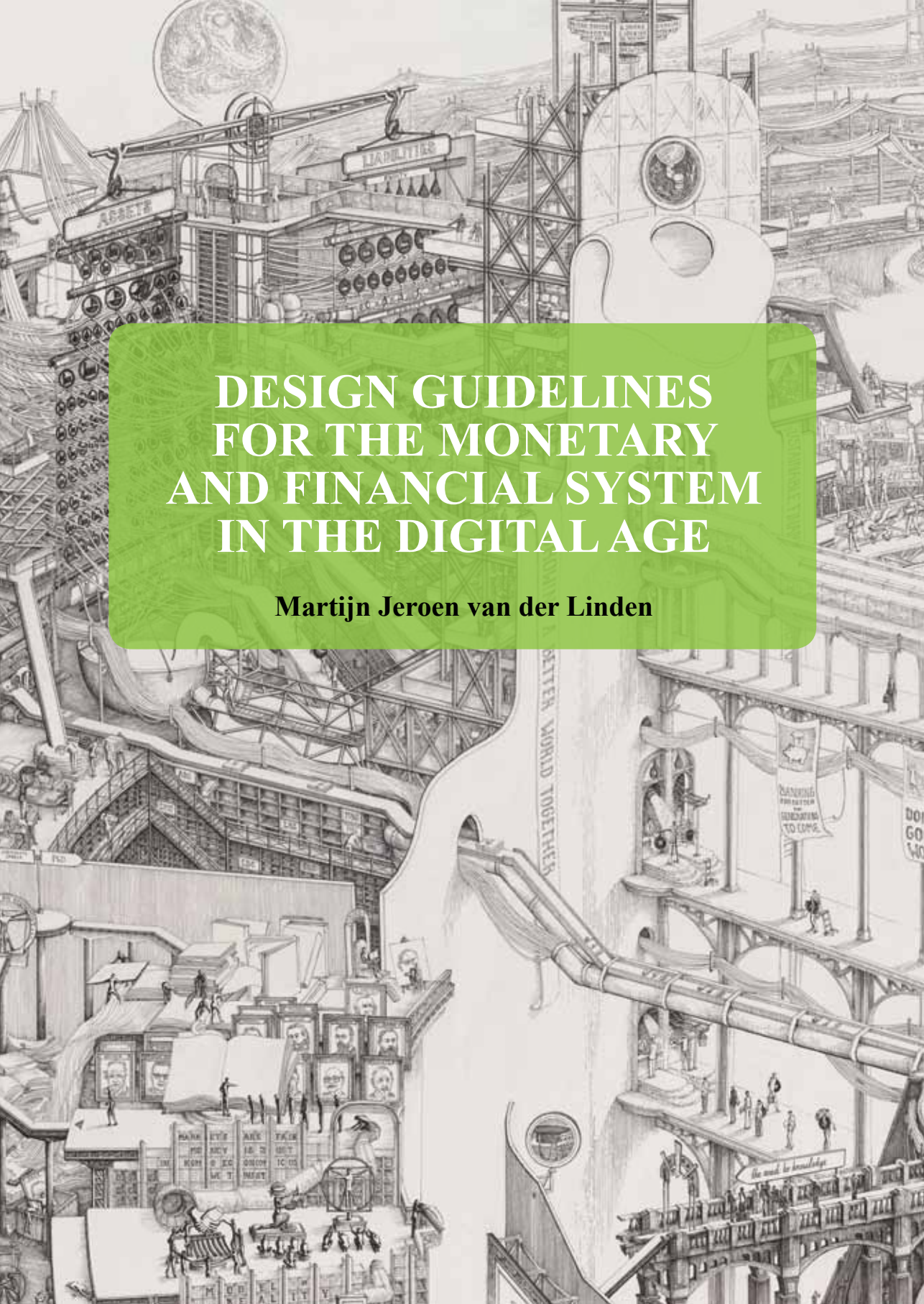
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DESIGN GUIDELINES FOR THE MONETARY AND FINANCIAL SYSTEM IN THE DIGITAL AGE

Martijn Jeroen van der Linden

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for the monetary and financial system in the digital age**

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Summary

In the aftermath of the systemic financial crises of 2007-9, several scholars argued that the problem of systemic financial crises is not well understood. At the same time, the introduction of digital technologies led to new threats and opportunities for the design of the monetary and financial system. For example, thousands of private cryptocurrencies have been implemented and hundreds of research papers on the (possible) introduction of public digital currencies have been published. It is often not explained why these new forms of digital money are needed and which (systemic) problems they (can) solve. In addition, the literature does not provide requirements nor guidelines to shape the development of the monetary and financial system in the digital age.

This thesis applies *design science* to the monetary and financial system as a whole. The application of this novel methodology offers new possibilities to examine this complex system. The contribution of this thesis is threefold. First, different theories on money, banking and systemic financial crises have been researched through an extensive literature review and balance sheets. Second, those theories have been used to develop design requirements and guidelines. Finally, the consensus and pivotal dissensions about the systemic problem(s) of the current monetary and financial system, requirements and guidelines among experts have been identified through semi-structured interviews. This research process results in widely supported requirements that demarcate the design space and widely supported guidelines that aim to give direction within the design space, that is, to the future development of the monetary and financial system.

This thesis consists of two parts. In part I, four research questions on *reference foundations* – (monetary) economic theories, concepts, principles, and reform proposals – are examined to find clear definitions and design features of different (theoretical) monetary systems, and to improve the understanding of the functioning of the current monetary and financial system:

- a. Which taxonomy of money can be used to analyse different past, current and future monetary systems?
- b. Which design lesson(s) can be derived from two opposing theories on the nature and origin of money – theories focussing on the market and the function as medium of exchange versus theories focussing on the state and the function as unit of account?

- c. What are the main design features of the current monetary and financial system (fractional reserve banking) and two proposed alternative systems (full reserve banking and free banking)?
- d. How does the current monetary and financial system function?

In part II, three *design science* research questions about the problem of systemic financial crises and the development of requirements and guidelines are examined:

- e. What causes and what are the social consequences of systemic financial crises?
- f. What are the (minimal) generic design requirements on the monetary and financial system?
- g. What are the (minimal) generic design guidelines for the monetary and financial system in the digital age?

There is consensus among interviewees that recurrent systemic financial crises are a systemic problem, and that contractual liquidity is a main cause. Interviewees have fundamentally different views on two topics related to the problem analysis. Firstly, views differ as to why systemic financial crises occur: some claim because ‘the regulation of the market failed’, whilst others believe these crises result from ‘a lack of market discipline’ in the current monetary and financial system. Secondly, some argue that there are other (more) important systemic problems than recurrent systemic financial crises, such as financial exclusion and unsustainable development.

Generic design requirements (GDRs) and guidelines (GDGs) are developed to contribute to solving the problems of recurrent systemic financial crises and the dynamics of protecting and constraining banks by governments. Based on the research into *reference foundations*, initial sets of GDRs and GDGs are drafted. These initial sets are evaluated and refined via semi-structured interviews. This results in seven widely supported requirements and three widely supported guidelines. The main artifact of this research are these three guidelines:

- GDG 1: Develop and gradually introduce public digital money.
- GDG 2: Move the financial system towards funding based on securities offering market liquidity.
- GDG 3: Move financial regulation towards transparency.

Moreover, in the analysis of the interviews, seven futures scenarios are identified that can be used as instruments to (better) understand future developments as well as the three developed GDGs: 1) continue on the current path; 2) more guidance

by central banks; 3) add public digital money as a means of payment; 4) add public digital money as means of payment and store of value; 5) full reserve banking; 6) transform central banks into monetary authorities without balance sheets, and; 7) free banking (abolish central banks).

Finally, three practical recommendations are given: 1) structurally use the three generic design guidelines to inform and evaluate policies, regulations and (monetary) reform proposals; 2) start empirical experiments with public digital money and the underlying technologies, and; 3) explore further if the scenario of transforming central banks into monetary authorities without balance sheets is the most desirable scenario in the long run.

Samenvatting

In de nasleep van de financiële systeemcrises van 2007-9 hebben verschillende wetenschappers gesteld dat het probleem van financiële systeemcrises niet goed wordt begrepen. Tegelijkertijd leidde de introductie van digitale technologieën tot nieuwe bedreigingen en kansen voor de inrichting van het monetair en financieel systeem. Zo zijn er duizenden private cryptomunten geïmplementeerd en honderden onderzoeken over de (mogelijke) introductie van publieke digitale munten gepubliceerd. Vaak wordt niet uitgelegd waarom deze nieuwe vormen van digitaal geld nodig zijn en welke (systeem)problemen ze (kunnen) oplossen. Daarnaast omvat de literatuur geen eisen en richtlijnen om de ontwikkeling van het monetair en financieel systeem in het digitale tijdperk vorm te geven.

Dit proefschrift past *design science* toe op het monetair en financieel systeem als geheel. De toepassing van deze nieuwe methodologie biedt nieuwe mogelijkheden om dit complexe systeem te onderzoeken. De bijdrage van dit proefschrift is driedelig. Ten eerste zijn verschillende theorieën over geld, bankieren en financiële systeemcrises onderzocht middels een uitgebreide literatuurstudie en balansen. Ten tweede zijn deze theorieën gebruikt om ontwerpeisen en -richtlijnen op te stellen. Tot slot zijn de consensus en belangrijkste geschilpunten over de systeemproblemen van het huidige monetair en financieel systeem, eisen en richtlijnen onder experts geïdentificeerd middels semigestructureerde interviews. Dit onderzoeksproces resulteert in breed gedragen eisen die de ontwerpruimte afbakenen en breed gedragen richtlijnen die tot doel hebben richting te geven binnen de ontwerpruimte, ofwel, aan de toekomstige ontwikkeling van het monetair en financieel systeem.

Dit proefschrift bestaat uit twee delen. In deel I worden vier onderzoeksvragen over *reference foundations* – (monetair) economische theorieën, concepten, principes en hervormingsvoorstellen – onderzocht om duidelijke definities en ontwerpkenmerken van verschillende (theoretische) monetaire systemen te vinden, en om het begrip van de werking van het huidige monetair en financieel systeem te verbeteren:

- a. Welke taxonomie van geld kan worden gebruikt om verschillende historische, huidige en toekomstige monetaire systemen te analyseren?
- b. Welke ontwerples(sen) is (zijn) af te leiden uit twee contraire theorieën over de aard en oorsprong van geld – theorieën gericht op de markt en de functie als ruilmiddel versus theorieën gericht op de staat en de functie als rekeneenheid?

- c. Wat zijn de belangrijkste ontwerpkenmerken van het huidige monetair en financieel systeem (fractioneel reserve bankieren) en twee voorgestelde alternatieve systemen (vol reserve bankieren en vrij bankieren)?
- d. Hoe functioneert het huidige monetair en financieel systeem?

In deel II worden drie *design science* onderzoeksvragen over het probleem van financiële systeemcrises, eisen en richtlijnen onderzocht:

- e. Wat zijn de oorzaken en de sociale consequenties van financiële systeemcrises?
- f. Wat zijn de (minimale) generieke designeisen voor het monetair en financieel systeem?
- g. Wat zijn de (minimale) generieke designrichtlijnen voor het monetair en financieel systeem in het digitale tijdperk?

Er is consensus gevonden onder geïnterviewden dat terugkerende financiële systeemcrises een systeemprobleem zijn en dat contractuele liquiditeit een hoofdoorzaak is. Geïnterviewden hebben fundamenteel verschillende opvattingen over twee onderwerpen die verband houden met de probleemanalyse. Ten eerste hebben ze verschillende visies op de oorzaak van financiële systeemcrises: sommigen beweren dat ‘de regulering van de markt faalde’, terwijl anderen denken dat deze crises het gevolg zijn van ‘een gebrek aan marktdiscipline’ in het huidige monetair en financieel systeem. Ten tweede menen sommigen dat er andere belangrijke(re) systeemproblemen zijn dan terugkerende financiële systeemcrises, zoals financiële uitsluiting en onduurzame ontwikkeling.

Generieke ontwerp-eisen (GDRs) en -richtlijnen (GDGs) zijn ontwikkeld om bij te dragen aan het oplossen van de problemen van terugkerende financiële systeemcrises en de dynamiek van beschermen van beperken van banken door overheden. Op basis van het onderzoek naar *reference foundations* zijn initiële lijsten van GDRs en GDGs opgesteld. Deze initiële lijsten zijn geëvalueerd en verfijnd middels semigestructureerde einterviews. Dit resulteert in zeven breed gedragen eisen en drie breed gedragen richtlijnen. De belangrijkste uitkomst van dit onderzoek zijn deze drie richtlijnen:

- GDG 1: Ontwikkel en voer geleidelijk publiek digitaal geld in.
- GDG 2: Beweeg het financiële systeem richting financiering op basis van effecten die marktliquiditeit bieden.
- GDG 3: Beweeg financiële regelgeving richting transparantie.

Bovendien zijn er in de analyse van de interviews zeven toekomstscenario's geïdentificeerd die kunnen worden gebruikt als instrument om toekomstige veranderingen alsmede de drie ontwikkelde GDGs (beter) te begrijpen: 1) doorgaan op het bestaande pad; 2) meer begeleiding door centrale banken; 3) publiek digitaal geld toevoegen als betaalmiddel; 4) publiek digitaal geld toevoegen als betaalmiddel en opspottmiddel; 5) vol reserve bankieren; 6) centrale banken omvormen tot monetaire autoriteiten zonder balansen, en; 7) vrij bankieren (afschaffen centrale banken).

Ten slotte worden drie praktische aanbevelingen gegeven: 1) gebruik de drie generieke ontwerprichtlijnen structureel om beleid, regelgeving en (monetaire) hervormingsvoorstellen op te baseren en te evalueren; 2) start empirische experimenten met publiek digitaal geld en de onderliggende technologieën, en; 3) onderzoek verder of het scenario van het transformeren van centrale banken tot monetaire autoriteiten zonder balansen op lange termijn het meest wenselijke scenario is.

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Abbreviations

ABS:	asset-backed security
BIS:	Bank of International Settlements
CB:	central bank
CBDC:	central bank digital currency
CDO:	credit debt obligation
CDS:	credit default swap
CLO:	collateralized loan obligation
CPMI:	Bank of International Settlements Committee on Payments and Market Infrastructures
DIS:	deposit insurance scheme
DLT:	distributed ledger technology
EBA:	European Banking Authority
GDR:	generic design requirement
GDG:	generic design guideline
GPT:	general purpose technology
IMF:	International Monetary Fund
KYC:	know your customer
LOLR:	lender-of-last-resort
MA:	monetary authority
MBS:	mortgage-backed security
MMF:	money market fund
MFI:	monetary financial institution
NGO:	non-governmental organization
OMO:	open market operation
QE:	quantitative easing
SIV:	special investment vehicle
SPV:	special purpose vehicle
TBTF:	too-big-to-fail
TARP:	Troubled Asset Relief Program
VIE:	variable interest entities

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Glossary

Commercial bank: a financial institution creating bank deposits that are on demand at par exchangeable into cash.

Contractual money: a form of money that is the result of a contract between a lender (a bank) and a borrower.

Contractual liquidity: this form of liquidity is the result of a contractual obligation, the issuer promises on demand fixed-rate convertibility (parity) into another form of money.

Design science: an approach focussing on the development of artifacts to improve the functioning of complex systems (to solve problems) and to develop knowledge.

Design space: space demarcated by design requirements.

Digital technologies: technologies as internet technologies, information and communications technology, mobile devices, distributed ledger technology and smart contracts. In this thesis, these digital technologies are considered as a group a general purpose technology.

Fractional reserve banking: a monetary system in which private banks are allowed to create contractual money (bank deposits) and cover contractual money only with a fraction of cash and/or central bank reserves.

Free banking: a monetary system without a public monetary authority in which private banks are free to issue their own currency and in which there are no public insurances for privately created contractual liquidity.

Full reserve banking: a monetary system in which private banks cover demand deposits fully with cash and/or central bank reserves and in which there are no public insurances for privately created contractual liquidity.

Generic design guidelines: instructions that aim to give direction to the development of a system within the design space. Generic means that the developed guidelines can be used for the monetary and financial systems in different contexts (of different countries).

Generic design requirements: specifications that describe how a system must or should function and demarcate the design space. Generic means that the developed requirements can be used for the monetary and financial systems in different contexts (of different countries).

Inherent money: a form of money that is the result of a (sovereign or public) decree.

Market economy: an economic system in which private entrepreneurs and enterprises have the freedom and the responsibility to make most decisions about the production of goods and services, pricing and investments.

Maturity transformation: the funding of long-term debts (loans as mortgages) with short-term debt (contractual money).

Repo: a collateralized sale of an asset combined with an agreement to purchase this specific asset back at a later moment.

Security: a tradable financial asset.

Shadow bank: a financial institution creating money market instruments that are on demand at par exchangeable into bank deposits.

Systemic financial crisis: a financial crisis threatens the whole monetary and financial system and the real economy and forces a government to intervene at a large scale.

Research motivation

This thesis has its roots in: 1) the financial crisis of 2007-9; 2) the expectation that the design of the monetary and financial system will become a societal-political topic coming decade(s) because of the threats and opportunities offered by (relatively new) digital technologies; 3) the search of economist Hyman Minsky for the ‘right’ monetary and financial institutions, and; 4) the encouragements of others to challenge vested economic ideas.

Firstly, this thesis is part of the reform following the financial crisis of 2007-9. In reaction to the crisis, central banks and governments intervened significantly in the monetary and financial system to avoid a collapse of this system and the economy. The crisis led to a questioning of many aspects of economic theory, the design of the current monetary and financial system and monetary policy. For some economists, this was not new. For example, Minsky (1994c: 2) claimed that “we still have not gotten our monetary and financial institutions ‘right’.” In the aftermath of the financial crisis of 2007-9, there was more momentum to get our monetary and financial institutions ‘right’. Nonetheless, according to several scholars, structural reforms were still not implemented (e.g., Cochrane 2014; Ricks 2016; King 2016; Buiter 2018).

Secondly, this thesis anticipates parliaments to alter the design of the monetary and financial system in the coming decade. What Lagarde (2017, see also Lagarde 2018) expected is already happening: “If privately issued virtual currencies remain risky and unstable, citizens may even call on central banks to provide digital forms of legal tender.” Over the past ten years, citizens’ initiatives in Iceland, Switzerland¹ and the Netherlands² have obligated their parliaments to investigate the validity of the current monetary and financial system design and monetary reform proposals (KPMG 2016). Moreover, monetary reform legislation has been introduced to the parliaments of the United Kingdom (U.K.) and the United States (U.S.) (Di Muzzio and Robbins 2017: 117). The roots of these proposals can be traced back to *The Chicago Plan for Banking Reform* in the 1930s in the U.S (Knight *et al.* 1933 in Phillips 1995: 191-9) – also known as full reserve banking. Two years after the beginning of this research, central banks and international monetary and financial institutions started to publish about central bank digital currency (CBDC). One of the first publication was Barrdear and Kumhof (2016), other examples are Ahmat and Basir (2017) and He *et al.* (2017).

1 In June 2018 in Switzerland citizens voted in a referendum against a monetary reform proposal called Vollgeld. <https://vollgeld-initiative.com/>

2 I co-initiated the Dutch initiative *Ons Geld* in 2015. <http://burgerinitiatiefongeld.nu/>

Researchers of the Sveriges Riksbank (2017: 38, 5) emphasized that current laws must be updated to the digital age because digitalisation “was not relevant when the current legislation was passed” and state that “whether or not the e-krona should be legal tender are ultimately matters for legislators to decide.”

Thirdly, the work of economist Minsky laid the foundations for this thesis. Minsky investigated financial instability in capitalist economies and emphasized the importance of getting the institutions of the monetary and financial system ‘right’. Only after the financial crisis of 2007-9, his financial instability hypothesis became well-known (Minsky 1982a, 1982b, 1986a, 1992a). However, it is the papers he wrote in the years prior to his demise which influenced this thesis most (Minsky 1994a, 19994b, 1994c, 1994d, 1994e, 1995a). Instead of describing and understanding financial instability, he searched in these papers for the institutions that could prevent systemic financial instability. This thesis continues this search.

Fourthly, this thesis is a result of the encouragement of other authors to challenge existing economic ideas. For example, Arnon (2011), King (2016), and Turner (2016) stimulated researchers to think further intellectually and to challenge conventional economic theories.³ Earlier in history, three of the most influential economists of the twentieth century, Keynes, Hayek, and Friedman, emphasized the importance of ideas in economic thinking (Burgin 2012: 217; Hayek 1990; Friedman 1962: xiv; Keynes 1936: 383–4). King (2016) and Ricks (2016) explicitly relate the financial crisis of 2007-9 and the reforms implemented in its aftermath to ideas, per King (2016: 3): “The crisis was a failure of a system, and the ideas that underpinned it, not of individual policy-makers or bankers, incompetent and greedy though some of them undoubtedly were. There was a general misunderstanding how the world economy worked.” Ricks (2016) specifically argues that the ideas underlying financial stability reforms in the U.S (and abroad) in the aftermath of the financial crisis of 2007-9 are inaccurate. As a result of such inaccurate problem analysis, the root cause of systemic financial crises has in the view of Ricks (2016) not been solved.

3 Arnon (2011: 400) states that “. . . crisis can play an important role in sharpening critical faculties. One may hope that the current crisis will also produce innovative ideas on managing and banking. Indeed, if not, the future of prosperity of humanity is in danger.” Per King (2016: 369-370, italics added): “For many centuries, money and banking were financial alchemy, seen as a source of strength when in fact they were the weak link of a capitalist economy. A long-term programme for the reform of money and banking and the institutions of the global economy will be driven only by an intellectual revolution. Much of that will have to be the task of the next generation. But we must not use that as an excuse to postpone reform” Turner (2016: 242) emphasizes the importance of ideas: “Ideas matter. They strongly influence the assumptions with which policymakers approach practical policy choices. They define other ideas as unsound, not worth considering, taboo. So, it is vital not only to pursue different policies but also to challenge the assumptions, theories and methodologies that underpin them.”

This thesis builds on many existing economic ideas. These are reviewed and analysed, resulting in new ideas: design guidelines for the monetary and financial system in the digital age and knowledge about these guidelines. To be clear, the guidelines developed in this thesis are not completely new ideas but, paraphrasing Mark Twain, a “new and curious combination” of old ideas (and theories):

There is no such thing as a new idea. It is impossible. We simply take a lot of old ideas and put them into a sort of mental kaleidoscope. We give them a turn and they make new and curious combinations. We keep on turning and making new combinations indefinitely; but they are the same old pieces of colored glass that have been in use through all the ages. (Twain in Paine 2017)



1

Introduction

1. Introduction

1.1 Background

Most of today's monetary legislation and the mandates of central banks were formulated and enacted before the emergence of the Internet, information and communications technology (ICT), mobile devices, distributed ledger technology (DLT) and smart contracts. Together, these technologies are called digital technologies and considered as a general purpose technology (GPT) in this thesis. GPTs drive technological progress and affect the development of the whole economic system (Bresnahn and Trajtenberg 1992; Helpman 1998).

Similarly, most economic theories have been developed by economists whose conceptualizations were related to material processes, that is in the case of money, to material forms of money and material transactions. For example, Adam Smith, John Maynard Keynes, and Irving Fisher did neither have access to computers nor to the Internet. Other economists, who did have access to digital technologies, already predicted in the 1990s the disruptiveness of those technologies for the design of the monetary and financial system (e.g., Minsky 1994a; Friedmann 1999⁴).

Over the last three decades, digital technologies have changed the monetary and financial system significantly. For example, thousands of private cryptocurrencies have been introduced. Today, there are fundamentally different views on the definition and the potential of those currencies. On the one hand, several supervisors argue that cryptocurrencies are not money, because, in the words of Carstens (2018), they “do not fulfil any of the three purposes of money. They are neither a good means of payment, nor a good unit of account, nor are they suitable as a store of value” – see also Lagarde (2018) and Mersch (2018). On the other hand, several scholars argue that DLT, the technology underlying cryptocurrencies, is a new GPT (e.g., MacDonald *et al.* 2016: 283⁵) that “can be used to underpin an entirely new means of payment” (He *et al.* 2017: 24).

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- 4 Minsky (1994a: 14) stated that because of radical changes in technology, computing, and communication “it is time to go back to the drawing board and determine what the monetary, financial and financing arrangement should be in the 21st century”. Friedman (1999) stated in an interview: “The one thing that’s missing, but that will soon be developed, it’s a reliable e-cash. A method where buying on the internet you can transfer funds from A to B, without A knowing B or B knowing A. The way in which I can take a 20 dollar bill and hand it over to you and there’s no record of where it came from. And you may get that without knowing who I am. That kind of thing will develop on the internet . . .”
- 5 MacDonald *et al.* 2016: 283) states that “blockchains are better understood as a new ‘general purpose technology’ in the form of a highly transparent, resilient and efficient distributed public ledger (i.e., decentralized database).”

In today's monetary and financial system, bank deposits issued by commercial banks and money market instruments issued by shadow banks dominate. Examples of money market instruments are repurchase agreements, Eurodollars (dollars on accounts at banks outside the U.S.), asset-backed commercial paper and money market fund shares. Bank deposits and money market instruments are the result of a contract between two agents – a borrower and a private (shadow) bank – and are therefore called contractual money in this thesis. Cash (material banknotes and coins) is issued by central banks operating on behalf of the government. Cash exists purely by agreement (law or consensus, *nomos* in Greek⁶; and is therefore generally called fiat money) and is defined as inherent money in this thesis.

A pivotal development in the current monetary and financial system relevant to this thesis is the gradual digitalization of the quantity of money over the last three decades. In several countries, the non-bank private sector increasingly uses (or is 'forced' to use) contractual money (digital bank deposits and money market instruments) instead of inherent money (material cash) to pay and store value. For example, Sweden is, according to the Sveriges Riksbank (2017: 11), moving rapidly towards a cashless society due to new technologies, new consumption patterns and channels, and a negative spiral in cash acceptance (negative network externalities). Two consequences of the digitalization of the quantity of money are the privatization of the quantity of money and the increasing dependence on contractual money.

In the aftermath of the systemic financial crisis of 2007-9, the debate and measures implemented focussed on stabilizing the current design; among others with an extremely low base interest rate, the use of unconventional monetary policy instruments as quantitative easing and liquidity swap lines between large central banks. These policies are on the one hand exceptional. An example of the exceptionality is the base interest rate of the Bank of England. For the first time in its history since 1694, the Bank of England set the base interest rate below two percent in 2009, and since then the interest rate has been at 0.5 per cent (King 2016: 335). On the other hand, the measures taken in the aftermath of 2007-9 can also be considered 'conventional' and an example of path dependency. Path dependency means that institutions and actors are limited in their current choices by previous events and previous institutional design choices. The same path is not a law of nature. For example, in the aftermath of the Great Crash of 1929 changing paths was considered a realistic option in the U.S. In the

6 Aristotle states in *Nicomachean Ethics*: "... money has become by convention a sort of representative need; and this is why it has the name 'money' (*nomisma*) — because it exists not by nature but by law (*nomos*) and it is in our power to change it and make it useless" (1133a28-31).

1930s, the design of the monetary and financial system was debated extensively, and several economists proposed, and politicians supported *The Chicago Plan for Banking Reform* (Knight *et al.* 1933 in Phillips 1995: 191-9). In the aftermath of 2007-9, in contrast, an alternate path was not considered seriously, despite fundamentally new digital technologies being available and monetary policy becoming ‘unconventional’.

Since 2016 numerous central banks and international monetary and financial institutions are researching a more significant change in the design of the monetary and financial system. The Bank of England (Barrdear and Kumhof 2016; Meaning *et al.* 2018; Kumhof and Noone 2018), the Sveriges Riksbank (2017, 2018), the Norges Bank (2018), the People’s Bank of China (Yao 2018), the BIS (2018) and the IMF (e.g., He *et al.* 2017) investigated, amongst others, central bank (issued) digital currency (CBDC) – sometimes slightly different terms as ‘central bank cryptocurrency (CBCC)’ (Bech and Garrat 2017), ‘universal central bank reserves’ (Cœuré 2018), ‘electronic central bank money’ (Berentsen and Schär 2018), ‘e-krona’ (the Riksbank (2017, 2018), ‘FedAccounts’ (Ricks *et al.* 2018) and ‘Citizen Central Banking’ (Hocket 2019) are used. According to IMF researchers, the idea of a CBDC is to introduce a new means of payment and store of value (He *et al.* 2017: 26). In most proposals, the idea is to give the non-bank private sector agents access to the central bank balance sheet. Moreover, there have been proposals similar to CBDC. For example, Ricks (2016) proposes ‘r-currency’, Dyson and Hodgson (2016) and Wortmann (2016, 2017) ‘digital cash’, Bech and Garrat (2017, based on Tobin 1987) ‘deposited currency’, WRR (2019) ‘a safe haven’, Buitink and van der Linde (2019) ‘a deposit bank’, Levine (2019) ‘a narrow bank’, Alkaya (2018) ‘a public digital safe’ and Adrian and Mancini-Griffoli (2019b) ‘a synthetic CBDC’. All these proposals aim to realize (directly or indirectly access to) safe (credit risk-free) public digital money for non-bank economic agents.

Most current proposals for CBDC and several other monetary reform proposals have four shortcomings. A first shortcoming is that they often do not explicitly define why a CBDC, or monetary reform is needed. In other words, it is unclear which (systemic) problem(s) these proposals solve and therewith also what their added value is. This clarity is necessary to be able to evaluate proposals. The Norges Bank (2018: 11) and Ricks *et al.* (2018: 26) are two of the few who explicitly discuss this shortcoming. If digital technologies are GPTs that affect the functioning of systems, they can possibly be used to solve systemic problems.

A second shortcoming is that the current literature does not provide requirements nor guidelines for the monetary and financial system. According to several scholars, requirements for the monetary and financial system have never been formulated in a structured and extensive way (Bholat *et al.* 2015; Ricks 2016; Wortmann 2016; Birch 2020).⁷ Also a review of the economic scientific literature – using Google Scholar, JSTOR and Wiley and the words ‘requirement’, ‘design’, ‘principle’, ‘guideline’ in combination with ‘monetary system’, ‘financial system’ or ‘monetary and financial system’ – did not yield any relevant result. To my best knowledge, developing requirements and guidelines for the monetary and financial system have thus never been done before. In the past, concrete proposals have been developed to change the design of the monetary and financial system. Examples are *The Chicago Plan for Banking Reform* (discussed in section 4.4.1) and *The Denationalisation of Money* (Hayek 1990, discussed in section 4.4.2). Compared to those concrete proposals, the guidelines developed in this research are more abstract and can be implemented in different ways. There are several possible reasons that requirements and guidelines have never been developed before: the current system was not designed but evolved, design science and design approaches did not exist when the current system emerged, and design science as a research methodology is rarely applied in economic science and is rarely part of economics education. More generally, in economic science, there is a lack of attention to the design of the monetary and financial system. The reason is likely the dominance of neoclassical economics. In the aftermath of the financial crisis of 2008-9, several scholars questioned dynamic stochastic general equilibrium (DSGE) models that play a central role in neoclassical economics because these models did not take into account money, credit, banks and securitization (e.g., Goodhart 2009; Stiglitz 2011, 2017b; Romer 2016; King 2016; Keen 2017; Stiglitz 2017a, 2017b; Focardi 2018; Skidelsky 2018; Gorton 2019). In neoclassical economics, the main function of money is the function of unit of account because this function is essential to express prices. Others criticized the connected money is neutral assumption (Ravn 2015: 96; Keen 2017: 74-9; Lawson 2016; Skidelsky 2018). The money is neutral assumption underlying neoclassical economics predicates on a general equilibrium view where all markets clear. Critiques on this view can be traced back to among others Stiglitz and Weiss (1982), Hahn (1965) and Schumpeter (1934). In essence, those scholars argue that credit money is rationed, and equilibrium does not exist in capitalist economies because the continuous creation of new credit money for innovative entrepreneurs enables “the carrying out of new combinations”

7 For example, Ricks (2016: 12) states that “the basic legal-institutional design considerations that are pertinent to the establishment of a monetary system have never been well articulated”; and Birch (2020: 135) notices that digital technologies have been unavailable until now and that now we have to use them “to design our new system from first principles (rather than by emulating the money we have now).”

(Schumpeter 1934: 74). In this view, economies evolve, and entrepreneurs disturb equilibrium “by buying and using resources to change one of the ‘parameters’ of the economic system” (Anderson 2009: 64). This thesis views the design of the monetary and financial system pivotal to economic development.

A third shortcoming of most CBDC proposals is that the current design is taken as a starting point. This limits the design options. For example, the suggested designs generally start with the balance sheet of the central bank (e.g., Barrdear and Kumhof 2016; BIS 2021). In general, proposals do not consider fundamentally different designs. By developing a taxonomy of different forms of money and monetary system designs (chapter 2) and identifying different scenarios, design interventions and design variables (part II), this thesis explores those often-neglected design options.

A fourth shortcoming is related to the first and the third. Most current proposals focus on the short-term and do not have a long-term view on the design of the monetary and financial system. Most CBDC research focusses on maintaining access to public money, financial inclusion and/or stability of the payments system (e.g., DNB 2020). In this thesis, digital technologies are thus considered GPTs with the potential to solve systemic problems of the monetary and financial system in the long run.

In short, the current literature lacks a clear analysis of the systemic problem(s) of the current monetary and financial system, an overview of requirements on the monetary and financial system, and guidelines for the monetary and financial system in the digital age. This explorative thesis aims to contribute to filling this gap by applying design science for the first time to the monetary and financial system.

1.2 Design science

According to Hevner and Chatterjee (2010: 5), design science research is “a research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artifacts, thereby contributing new knowledge to the body of scientific evidence.” An artifact⁸ is something artificial, created by humans, as opposed to something natural (Simon 1996). The starting point of design science research is generally a problem, and its aim is describing, explaining, and predicting the world, and making and building to create new worlds (Johannesson and Perjons 2014: 7). According to several scholars, design science is about solving problems in novel ways (Hevner *et al.* 2004: 11; De Marco 2010: 157; Piirainen *et al.* 2010: 103). The activity of solving problems is generally considered as “a learning process in itself” (Marco

8 Artifact and not artefact is used in this thesis because artifact is generally used in the design science literature.

et al. 2010: 158) and consists of two core activities: 1) building the artifact, and; 2) evaluating the artifact (Hevner *et al.* 2004: 6).

Johannesson and Perjons (2014: 29) distinguish between four possible types of artifacts: constructs, models, methods, and instantiations (representations). Goldkuhl and Lind (2010: 50) distinguish the same types but add generic (or abstract) and situational design knowledge. Offerman *et al.* (2010: 83) distinguish eight possible types of artifacts: system design, method, language/ notation, algorithm, guideline, requirements, pattern, and metric. This research into the design of the monetary and financial system in the digital age aims to develop requirements and guidelines. Moreover, the developed design knowledge is generic (or abstract) in the terminology of Goldkuhl and Lind (2010: 50). This means that the developed knowledge can be used for the monetary and financial systems in different contexts. Generic design requirements are statements about systems like: A particular system must have some property X (Offerman *et al.* 2010: 83). Design guidelines do not “provide readily available solutions to design problems”, but “are meant to give direction” (Bharosa and Janssen 2015: 472). Design guidelines can be defined as “normative, reusable and directive guidelines” (*Ibid.*). They can be considered “rules of thumb that guide the choices and actions of engineers” (Gibb 1997). In short, the objective of this thesis is to develop *generic design requirements* (GDRs) that describe how the monetary and financial system must function – these requirements demarcate the design space that provides boundaries for searching for future directions – and to develop generic design guidelines (GDGs) that aim to give direction to the development of the monetary and financial system within the design space. The guidelines can be used to inform the development of (monetary) reform proposals, policies, and regulations, and in other research to develop other artifacts, for example, design principles.⁹

According to several scholars, design science is a powerful methodology to create new knowledge (e.g., De Marco *et al.* 2010; Johannesson and Perjons 2014). By making knowledge explicit and systematic, design science contributes to the reuse and extension of knowledge. Johannesson and Perjons (2014: 8) emphasize that the artifact, as well as the developed knowledge, should be generalizable for use by others – this is a key difference with design only – and that both should always be communicated to (management-oriented) practitioners as well as (technology-oriented) researchers (*Ibid.*; Hevner *et al.* 2004: 11, 24). Sometimes design science results are “of such broad interest that it is worthwhile to communicate them to the general public” (Johannesson and Perjons 2014: 151). This is the case for this research,

⁹ Design principles are stronger than design guidelines.

according to several central bankers and economists (e.g., Graeber 2011; McMillan 2014; King 2016; Moutot 2017; Panetta 2018; Cochrane 2019). For example, Panetta (2018) emphasizes that the design of the monetary and financial system is a technical issue and a societal issue: “All in all, this [CBDC] is hardly going to be a purely technical decision. Society as a whole, through its political bodies, will need to be involved.” Cochrane (2019) adds that “we voters need to tell our politicians which kind of central bank we want.”¹⁰

Although design science generally focuses on ICT and information systems, the principles underlying it apply to many other areas (Johannesson and Perjons 2014: 7; Hevner *et al.* 2004). Johannesson and Perjons (2014: 12) distinguish between technical artifacts and socio-technical systems. Technical artifacts are material artifacts. Socio-technical systems include technical artifacts “as well as humans and the laws, rules, and norms that govern their actions” (Johannesson and Perjons 2014: 12). Johannesson and Perjons emphasize that “socio-technical systems are also artifacts in that they have been purposely designed to address a practical problem or enable some human endeavour. However, they are, at the same time, emergent phenomena that evolve due to spontaneous and unforeseen interactions among the humans in the systems” (*Ibid.*). The monetary and financial system can be considered a socio-technical system that has partly been purposely designed (e.g., the implementation of the function of lender-of-last-resort and deposit insurance schemes), but also emerged due to individual (business) innovations on different levels (e.g., new products and new institutions). The rise of shadow banking and cryptocurrencies are examples of such emergent phenomena influencing the monetary and financial system. Designing the monetary and financial system (a socio-technical system) differs obviously from designing a product as, for example, a table, and from designing an IT-system (both technical artifacts). Hence, the outcomes of this research into a socio-technical system should not be too deterministic and will focus on guidelines that aim to give direction.

Design science is a suitable methodology for this research for four reasons. First, design science is often applied in other fields to deal with complex and novel topics – the design of the monetary and financial system in the digital age is such a topic. Second, the application of digital technologies in the monetary and financial system makes this system more similar to IT and information systems. With the help of design

10 Other examples are: “Money has no essence. It’s not “really” anything; therefore, its nature has always been and presumably always will be a matter of political contention” (Graeber 2014: 372); “The organization of the financial system is the result of human deliberation. It has always and everywhere been a matter of politics” (McMillan 2014: 5); “Banking is always part of a political process due to the nature of money, which is a public good” (Moutot 2017: 10). King (2016: 217) emphasizes that “the choice of which money to use is a political act.”

science, design variables allowed by digital technologies can be explored. Third, the first step in design science is defining the problem. This is a crucial step to understand the idiosyncratic nature of the monetary and financial system. The systemic problems of the current monetary and financial system, and especially the cause(s) of systemic financial crises, are hard to grasp with statistical analyses. Fourth, design science uses reference theories – theories serving as a foundation for the construction of artifacts –, is interdisciplinary and is at the same time practice-oriented. The development of the design guidelines relies on existing reference theories “that are applied, tested, modified, and extended through the experience, creativity, intuition, and problem solving capabilities of the researcher” (Hevner *et al.* 2004: 2). In contrast to design scientists, economic scientists generally use the term theory only for cause-and-effect reasoning. Therefore, the term reference foundations is introduced and used in this thesis. Reference foundations are broader than reference theories and include also (monetary) economic concepts, principles, and reform proposals. The reference foundations examined in this thesis are:

- i. the functions of money;
- ii. existing taxonomies on money;
- iii. principle of market economies;
- iv. two groups of theories on the nature and origin of money – theories focussing on the market and the function as medium of exchange, and theories focussing on the government and function as a unit of account;
- v. the (theoretical) systems of fractional reserve banking, full reserve banking and free banking;
- vi. path dependency;
- vii. three theories on the functioning of the fractional reserve banking system – the financial intermediation theory of banking, the money multiplier theory of banking and the credit creation theory of banking;
- viii. two theories of systemic financial crises – the debt cycle theory and the bank run theory;
- ix. network externalities, and;
- x. articles and reports on CBDC.

The developed problem explication, requirements and guidelines are practice-oriented and accessible for researchers with non-economic backgrounds, policymakers, and the general public. This is important because the design of the monetary and financial system is a multi-disciplinary topic. Design science ensures that many people can understand, assess, criticize, and improve the logic. Moreover, an explicit aim of part II of this thesis is to understand the commonalities and differences between different streams of monetary thinking, and to identify different future scenarios.

Johannesson and Perjons (2014: 76) distinguish between five main activities in design science research: (1) explicate the problem; (2) define requirements; (3) design and develop an artifact; (4) demonstrate the artifact; and (5) evaluate the artifact. They emphasize that most design sciences researchers “do not undertake all of the five activities of the method framework in depth. Instead, they may focus on one or two of the activities, while the others are treated more lightly” (2014: 79). In the case of the monetary and financial system, designing and developing an artifact (3), demonstration (4) and evaluation (5) are rather difficult. Developing, demonstrating, and testing an alternative monetary and financial system and related hypotheses in economic practice is too complex; there are too many variables and uncertainties and for this reason, these activities are not feasible. This problem is related to the research object of economic science. The economy is shaped every day by the individual and collective actions of billions of human beings. This results in high complexity, and therefore testing and modelling of alternative designs of a monetary and financial system are hard.

The main artifact of this thesis are generic design guidelines for the design of the monetary and financial system in the digital age. Because of complexity, these generic design guidelines can thus not be demonstrated (activity 4) and evaluated in practice (activity 5). The initial generic design guidelines will be developed based on the reference foundations and will be evaluated and refined via two rounds of semi-structured interviews with experts. Chapter 9 explains the structure and process of the interviews.

Hevner *et al.* (2004) describe three main issues in design science research: a) environment; b) knowledge base; and c) evaluation. The environment determines the problem space. The knowledge base consists of existing theories and instruments (methodologies). Developed artifacts in design science research are evaluated by applying empirical and qualitative methodologies. Hevner and Chatterjee (2010: 16) distinguish three design science research cycles among these three main issues: 1) the relevance cycle; 2) the rigor cycle; 3) the design cycle. The relevance cycle connects the environment and design science. The rigor cycle connects design science with the existing theories and instruments. The design cycle refers to the process of developing and evaluating at the core of design science.

Figure 1-1 presents the research framework for this thesis based on Hevner *et al.* (2004). The environment consists of recurrent systemic financial crises, experts with different backgrounds (who will be selected for interviews), legislation and (relatively new) digital technologies. The knowledge base consists of the reference foundations and three research instruments – a literature review, balance sheets and semi-structured interviews. Design science research consists of defining the problem, developing requirements and guidelines, and evaluation and refinement of the problem definition, the requirements, and the guidelines.

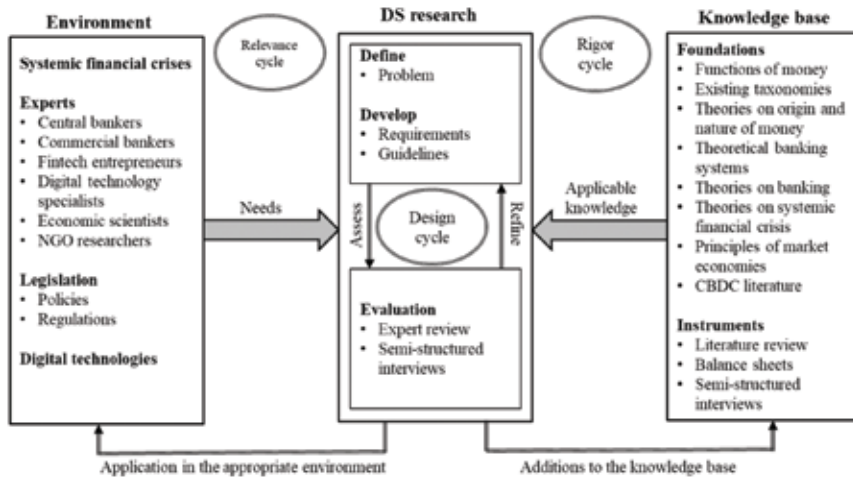


Figure 1-1: Research framework of Hevner *et al.* 2004 translated to this research

A paradox underlying design science research is that it assumes that the monetary and financial system is designable, but also admits that it is rather difficult to design in practice because of complexity and short-term rigidity. Change of the design requires time and the consequences of design interventions only become effective and visible in the long-term. This is recognized by experts. For example, Carney (2019: 5, underline original) states that policymakers need “to reshuffle the deck” in the medium term and need “to change the game” in the long-term. The focus of this research is predominantly the latter. Moreover, it should be noted that, in complex systems, there is a continuous interplay between developing technologies, behaviour of economic agents, new regulations and other design interventions. In general, design interventions are reactions to developments in systems.

In sum, the novelty of this research approach is that design science is used to explore a monetary topic – the design of the monetary and financial system in the digital age. This novel approach allows a new way of examining the problems of the current monetary and financial system and aims to solve the identified problems by developing guidelines for the monetary and financial system as a whole. This research opted for generic design guidelines due to the complex nature of the monetary and financial system. This thesis uses reference foundations as input and the output of this thesis (identified systemic problems and scenarios and developed requirements and guidelines) can be used as input in other research and to formulate (monetary) reform proposals, policies, and regulations.

1.3 Objective and research questions

The overall objective of this thesis is to develop generic design guidelines that aim to give direction to the development of the monetary and financial system in the digital age. To accomplish this objective, seven research questions will be investigated. Four research questions related to reference foundations to find clear definitions and design features of different (theoretical) monetary systems, and to improve the understanding of the functioning of the current monetary and financial system. By investigating reference foundations knowledge is developed that will be used to investigate three design science research questions – 1) explicate the problem; 2) define requirements, and; 3) design and develop guidelines.

A first challenge is that there is no (shared) taxonomy of money in economic science and other social sciences (Schumpeter 1954; Davidson 1972, 1994; King 2016), let alone a taxonomy to analyse different past, current and future monetary systems. The lack of a shared taxonomy hinders research and policy discussions. Therefore, the first research question is:

- a. Which taxonomy of money can be used to analyse different past, current and future monetary systems?*

A second challenge is that there are fundamental disagreements on the nature(s) of money (Schjacht 1967; Marx 1970; Phillips 1995; Carruthers and Babb 1996; Huber 2014; Dodd 2014; Askari and Krichene 2016; WRR 2019: 21-24). Two groups of theories can be distinguished that trace money back to different origins and nominate opposing natures of money (Schumpeter 1917; Goodhart 1998; Ingham 2004; Dodd 2014). The first group focuses on the market and the function as medium of exchange. The second group focuses on the state and the function as unit of account. The second research question aims to understand and to derive design lessons from both groups of theories:

- b. Which design lesson(s) can be derived from two opposing theories on the nature and origin of money – theories focussing on the market and the function as medium of exchange versus theories focussing on the state and the function as unit of account?*

A third challenge is that there is a lack of knowledge of the historical development of the main design features of the current fractional reserve banking system and its main (theoretical) alternatives – full reserve banking and free banking. The third research question aims to define the main design features – characteristics that are typical for a specific design – of these (theoretical) systems:

- c. What are the main design features of the current monetary and financial system (fractional reserve banking) and two proposed alternative systems (full reserve banking and free banking)?*

A fourth challenge is that there is a widespread ‘monetary illiteracy’ – meaning that most people do not sufficiently know how the current monetary and financial system functions (Cobden 2010; Dods 2014; Nietlisbach 2015; Motivaction International and Sustainable Finance Lab 2016; Dods 2017). According to several economists (Werner 2012: 7; Turner 2013; Häring 2013: 2; Coe and Pettifor 2014: 2; Cliffe and Brosens 2014: 10, 2018; Wray 2015b: 6, 9; Hockett and Omarova 2016; Stiglitz 2017a: 8; Di Muzio and Noble 2017: 105; Raworth 2017: 86; Focardi 2018: 17) and central bankers (McLeay *et al.* 2014a, 2014b; Jakab and Kumhof 2015, 2019; Kumhof and Jakab 2016; Bundesbank 2017; Tucker 2019a) ‘conventional’ textbooks do ambiguously deal with the question how the current monetary and financial system functions. In the literature three (conflicting) banking theories are often distinguished: 1) the financial intermediation theory of banking; 2) the money multiplier theory of banking, and; 3) the credit creation theory of banking (McLeay *et al.* 2014b; Werner 2014a, 2016; Jakab and Kumhof 2015; Hockett and Omarova 2016). Moreover, shadow banking and money market instruments are generally ignored in explanations of money and banking (e.g., Ricks 2016: 234; Gorton 2019: 26). Because of monetary illiteracy, the existence of different banking theories and the ignorance of shadow banking, the fourth research question is:

- d. How does the current monetary and financial system function?*

The fifth research question concerns the first activity in design science research – explicate the problem. A well-known problem of the current monetary and financial system are recurrent systemic financial crises. According to several scholars, this

problem is not well understood (Rolnick and Weber 1985; Lo 2012; Thakor 2015; Ricks 2016: 122-142; Bernanke 2018; Gorton 2019). For example, Ricks (2016: xii) argues that, since the financial crisis of 2007-9, “we have moved forward based on vague ideas about the nature of the underlying problem” and Gorton (2019: 28) states: “The idea that ‘the problem’ [of systemic financial crises] has been fixed requires knowing what the problem is. This does not appear to be the case.” For these reasons, the fifth research question is:

- e. What causes and what are the social consequences of systemic financial crises?*

Whereas the previous questions provide the theoretical foundation, background and problem explication, the next questions are prescriptive. The sixth research question concerns the second activity in design science research – define requirements – and is needed to demarcate the design space:

- f. What are the (minimal) generic design requirements on the monetary and financial system?*

The seventh research question is the main research question and concerns the third activity in design science research – design guidelines. This research questions aims to give direction within the design space:

- g. What are the (minimal) generic design guidelines for the monetary and financial system in the digital age?*

1.4 Research framework

Table 1-1 relates the research questions to the research framework of this thesis. Part I of this thesis is based on an extensive literature review of and desk research into reference foundations (chapter 2-5). In Part II design science is used as a methodology to define the problem, and to develop requirements and design guidelines (chapter 6-10).

Table 1-1: Research questions and research framework

Research questions	Reference foundations	Instruments/ Methods	Outcomes
Part I			
<i>a) Which taxonomy of money can be used to analyse different past, current and future monetary systems?</i>	*Functions of money *Existing taxonomies	*Literature review *Desk research	*Taxonomy to describe different past, current and future monetary systems
<i>b) Which design lesson(s) can be derived from two opposing theories on the nature and origin of money – theories focussing on the market and the function as medium of exchange versus theories focussing on the state and the function as unit of account?</i>	*Theories focussing on the market origins of money and the function as a medium of exchange *Theories focussing on the state origins of money and the function as a unit of account	*Literature review *Desk research	*Design lesson(s) *Knowledge about and interpretation of both groups of theories.
<i>c) What are the main design features of the current monetary and financial system (fractional reserve banking) and two proposed alternative systems (full reserve banking and free banking)?</i>	*Fractional reserve banking *Full reserve banking theory *Free banking theory *Principle of market economies *Path dependency	*Literature review *Desk research	*Design lesson(s) *Knowledge about the three (theoretical) banking systems.
<i>d) How does the current monetary and financial system function?</i>	*The financial intermediation theory of banking *The money multiplier theory of banking *The credit creation theory of banking	*Literature review *Desk research *Balance sheets	*Improved monetary literacy *Knowledge about (the accuracy of) the three banking theories

Part II			
<i>e) What causes and what are the social consequences of systemic financial crises?</i>	*The debt cycle theory *The bank run theory *Principle of market economies	*Literature review *Desk research *Design science *Expert review *Semi-structured interviews *Qualitative data analysis	*Problem positioning *Problem formulation *Problem justification *Root cause analysis
<i>f) What are the (minimal) generic design requirements on the monetary and financial system?</i>	*Functions of money *Fractional reserve banking * Full reserve banking theory *Free banking theory *Principle of market economies *Network externalities	*Literature review *Desk research *Design science *Expert review *Semi-structured interviews *Qualitative data analysis	*Requirement definition *Requirement justification *Design space *Evaluation of current system *Identification of dissensions among interviewees
<i>g) What are the (minimal) generic design guidelines for the monetary and financial system in the digital age?</i>	*CBDC literature *Fractional reserve banking * Full reserve banking theory *Free banking theory *Principle of market economies	*Literature review *Desk research *Design science *Expert review *Semi-structured interviews *Qualitative data analysis	*Design guideline definition *Design variables description *Scenarios

1.5 Contribution

1.5.1 Scientific relevance

Section 1.1. explained that a clear analysis of the systemic problem(s) of the current monetary and financial system, an overview of design requirements on the monetary and financial system, and design guidelines for the monetary and financial system in the digital age are currently lacking. This thesis aims to contribute to start filling this gap by applying design science to the monetary and financial system. This methodology is applied to a monetary topic and the application of this novel methodology results in the identification of commonalities and different views on the systemic problems of the current systems, future scenarios, and the development of widely supported generic design requirements and generic design guidelines.

1.5.2 Societal relevance

After the financial crisis of 2007-9 and with the rise of cryptocurrencies and DLT, the design of the monetary and financial system has gradually become a societal-political topic. As explained in the motivation, the design of the monetary and financial system will likely become a societal-political topic in the coming decade(s) because of the threats and opportunities offered by (relatively new) digital technologies. Well-informed politicians, policymakers and citizens are a precondition for a nuanced discussion about and decisions on the design of the monetary and financial system in the digital age (Admati 2016; Taibi 2009). This thesis aims to contribute to informed discussions by improving monetary and financial literacy, identifying commonalities and differences between different streams of monetary thinking, outlining different scenarios, and formulating widely supported requirements and guidelines.

1.6 Structure of this thesis

Chapter 2 examines research question *a) Which taxonomy of money can be used to analyse different past, current and future monetary systems?* First, it examines the often-used functions of money, the monetary aggregates used by central banks, the distinction between two different kinds of money, monetary systems and payments systems made by different scholars, and four existing taxonomies. Subsequently, based on this examination, a taxonomy consisting of four characteristics is developed: 1) *legal-economic basis* (inherent or credit); 2) *issuer* (public or private); 3) *form* (material or non-material), and; 4) *accessibility* (universal or limited). This taxonomy is used in the remainder of this thesis to examine and derive design lessons from reference foundations, to examine the problem of recurrent systemic financial crises and to develop requirements and guidelines.

Chapter 3 examines research question *b) Which design lesson(s) can be derived from two opposing theories on the nature and origin of money – theories focussing on the market and the function as medium of exchange versus theories focussing on the state and the function as unit of account?* First, both groups of theories are explained. Thereafter, the developed taxonomy is used to reflect on both theories. Finally, two design lessons are derived.

Chapter 4 examines research question *c) What are the main design features of the current monetary and financial system (fractional reserve banking) and two proposed alternative systems (full reserve banking and free banking)?* First, it explains the development of coinage, the gradual development of fractional reserve banking and the implementation of two public protection mechanisms – the central bank as lender-of-last-resort and deposit insurance schemes. Thereafter, proposals for full reserve banking and free banking are examined and design lessons are derived.

Chapter 5 examines research question *d) How does the current monetary and financial system function?* First, three theories of banking – the financial intermediation theory, the money multiplier theory, and the credit creation theory – are described. Thereafter, the functioning of the current monetary and financial system – commercial banking, central banking, and shadow banking – is explained with the help of balance sheets. Finally, it reflects on the adequateness of the three theories of banking and draws conclusions.

In chapter 6, the previous chapters and additional literature are used to examine research question *e) What causes and what are the social consequences of systemic financial crises?* First, the difference between non-systemic and systemic financial crises is described. Second, the debt cycle theory and bank run theory of systemic financial crises are examined. Subsequently, the contractual liquidity theory of systemic financial crises is developed. Thereafter, the systemic financial crisis of 2007-9 is revisited and the social consequences of systemic financial crises are examined. It is explained that one of the consequences has become a systemic problem in itself: the systemic protecting and constraining of banks by governments. Finally, the influence of digital technologies on the two identified systemic problems and conflicting views in the literature are examined.

In chapter 7, the previous chapters and additional literature are used to examine research question *f) What are the (minimal) generic design requirements on the monetary and financial system?* First, two in economic science widely accepted

principles are explained. Thereafter, eight initial requirements are formulated. Finally, it is explained how the drafted initial requirements relate to the problems explicated in chapter 6.

In chapter 8, the previous chapters and additional literature are used to examine research question g) *What are the (minimal) generic design guidelines for the monetary and the financial system in the digital age?* It is explained that digital technologies offer the possibility to introduce a new form of money – public digital money, have significantly increased market liquidity in recent decades and could be used to realize instant and full disclosure of financial and non-financial data. Based on these insights, three initial guidelines are drafted.

In chapter 9, the semi-structured interviews used to evaluate and refine the problem analysis, initial requirements and guidelines are explained. First, the development of the interview protocols, the expert selection criteria, and the invitation process are clarified. Thereafter, the characteristics of the interviewees are presented. Finally, it is explained how the interviews are analysed and used to write chapter 10.

In chapter 10, the analysis of the interviewees' views on the systemic problems of the current monetary and financial system, the requirements and guidelines are reported. First, their views on the systemic problems are discussed and different scenarios are outlined. Second, the initial requirements are evaluated and refined. Third, the guidelines are evaluated and refined, and identified arguments and design variables are presented. Finally, the main findings are summarized.

Finally, in chapter 11, conclusions are drawn. Moreover, the research methodology and the role of the researcher are evaluated, and recommendations are given.



PART I



A taxonomy of money

2. A taxonomy of money

2.1 Introduction

In this chapter, research question a) *Which taxonomy of money can be used to analyse different past, current and future monetary systems?* is examined. Today, a hindrance in researching the design of the monetary and financial system is the lack of a (shared) taxonomy of money in economic science and other social sciences. There are hundreds of terms referring to (different kinds of) money¹¹ and there are fundamental disagreements on the nature(s) of money – this will be analysed in chapter 3. In the past, several economists noticed the problem of a lack of shared taxonomy (e.g., Schumpeter 1954: 289; Davidson 1972: 101, 1994: 86; King 2016: 78). The taxonomy developed in this chapter will be used in the remainder of this thesis to understand and to analyse the characteristics, advantages, and disadvantages of past, current, and future forms of money and different monetary system designs.

The structure of this chapter is as follows. Section 2.2 discusses the functions of money used by academic economists and section 2.3 the monetary aggregates used by central banks. Section 2.4 examines the distinctions different scholars make between different forms of money, payments systems and monetary systems. Section 2.5 reviews the taxonomies of the committee on payments and market infrastructures of the Bank of International Settlements (BIS CPMI 2015), and scholars Ricks (2016), Bjerg (2017) and Bech and Garratt (2017). Section 2.6 reviews the hierarchy of money of Merhling (2012a, 2012b). Section 2.7 develops a more advanced taxonomy of money. Section 2.8 summarizes the developed taxonomy in a table.

2.2 Functions of money

Most economic approaches to money describe what money is through its functions; that is, in the words of Hicks (1967: 1): “Money is what money does. Money is defined by its functions.” In the literature, different scholars distinguish slightly different functions of money and use slightly different terminology. Four functions predominantly attributed to money are: 1) unit of account; 2) medium of exchange; 3) store of value, and; 4) means of payment. The first three functions can be traced back to Aristotle who mentioned them implicitly in *The Nicomachean Ethics*. Aristotle wrote:

11 An example is the various terms scholars and practitioners use to refer to the money on the liability side of the balance sheet of a commercial bank: bank deposits, deposit money, demand deposits, customer deposits, functional money, pseudo money, current accounts, inside money, bank money, bank-created money, commercial bank money, private bank money, broad money, money claims, high-powered money, endogenous money, debt money, credit money, fountain pen money and credit.

. . . all things that are exchanged must be somehow comparable [unit of account]. It is for this end that money has been introduced, and it becomes in a sense an intermediate [medium of exchange]; for it measures all things, and therefore the excess and the defect – how many shoes are equal to a house or to a given amount of food. (1133a18-22)

And for future exchange – that if we do not need a thing now we shall have it if ever we do need it – money is as it were our surety [store of value]; for it must be possible for us to get what we want by bringing the money. (1133b11-13)

More than 2,000 years later, Jevons (1875) defined the functions of money explicitly. Jevons (1875) defines four functions: medium of exchange, common denominator (also called common measure of value by Jevons), standard of value and store of value.¹² Today, instead of the function as standard of value, most scholars define a function as (general) means of (final) payment – for example, Lawson (2016: 966), Norges Bank (2018: 12) and Ingham (2004: 3).

The description of money through its functions can be used to understand money conceptually. Bank deposits, banknotes, money market funds shares, cryptocurrencies, gold, cattle, bottles of wine and art can all be used as a medium of exchange, a store of value, a means of payment and as a unit of account. In economic practice, almost everything is and can be used as a store of value. Economic agents store value among other in bank deposits, cryptocurrencies, gold, and art. This is an individual choice and depends on risk and liquidity preferences. To function as a unit of account, most economic agents must use it. In a monetary economy, efficient coordination occurs when economic agents “speak the same money language” (Issing 1999: 17, see also King 2016: 285). A language is more useful when more individuals speak it. This is also the case for the monetary language, i.e., the unit of account. To function as a means of payment and medium of exchange at least two economic agents must agree that something is a means of payment and/ or medium of exchange. To function as a means of tax payments, the government must accept it. The decision and the enactment in laws to collect taxes in a specific means of payment increases the willingness of economic agents to accept this means of payment and encourages and forces citizens to value in the unit of account of this means of payment; that is, to use this money language. The functions of money are thus useful to understand money conceptually and will be used in part II to develop requirements (chapter 7 and 10)

12 Four decades later, Milnes (1919: 55) summarized these functions succinctly: “Money’s a matter of functions of four, A Medium, a Measure, a Standard, a Store.”

and to identify scenarios (chapter 10). In the remainder of this thesis, money is not viewed as a single ‘thing’ with a key function, but the view taken is that different monetary instruments fulfil different monetary functions for different economic agents in different communities.

2.3 Monetary aggregates

Central banks generally distinguish between three or four monetary aggregates: M0, M1, M2 and M3. This section explains these aggregates by using the definitions of the European Central Bank (ECB). The ECB (2012: 110) defines the monetary aggregates as “liabilities of the money-issuing sector and central government and certain post office liabilities with a monetary character held by the money-holding sector”. The ECB (*Ibid.*) defines seven types of liabilities:

- a. currency in circulation;
- b. overnight deposits;
- c. deposits with an agreed maturity of up to 2 years;
- d. deposits redeemable at notice of up to 3 months;
- e. repurchase agreements;
- f. MMF shares/units; and
- g. debt securities issued by MFIs with a maturity of up to 2 years.

Currency in circulation (a) consists of banknotes and coins in the economy; that is, outside the central bank. Deposits (b, c, d) are issued by and liabilities of commercial banks. Repurchase agreement (e) and money market fund (MMF) shares/units (f) are generally issued by and liabilities of shadow banks. Debt securities issued by monetary financial institutions (MFIs) with a maturity of up to 2 years are issued by and liabilities of commercial banks and shadow banks. The latter three types of liabilities (e, f, g) are generally called ‘cash equivalents’, ‘quasi moneys’ or ‘near moneys’ (Ricks 2016).

The ECB categorizes these seven liabilities in three monetary aggregates:

$$M1 = a + b$$

$$M2 = M1 + c + d$$

$$M3 = M2 + e + f + g$$

M1 is generally called ‘the narrow money supply’, M2 ‘the intermediate money supply’ and M3 ‘the broad money supply’. Some other central banks also report the monetary aggregate M0. The Bank of England (2018) defines M0 as “notes and coins in circulation outside the Bank of England (including those held in banks’ and

building societies' tills), and banks' operational deposits [central bank reserves] with the Bank of England.”

The monetary aggregates of central banks are useful and relevant for monetary policy purposes. They were not developed to explore and to understand the characteristics of different forms of money and different monetary system designs, and therefore not so useful for this purpose. Chapter 5 will explain in detail how the above-mentioned forms of money function.

2.4 Existing taxonomies

To understand the difference between long-standing forms of money as bank deposits and bank notes and new forms of money as money market instruments, cryptocurrencies, and central bank digital currencies (CBDCs), four scholars developed taxonomies of money recently: BIS CPMI (2015), Bjerg (2017), Bech and Garratt (2017) and Ricks (2016). This section examines their taxonomies.

BIS CPMI (2015) aims to understand the novelty of cryptocurrencies and identifies three characteristics of money: 1) whether or not peer-to-peer; 2) whether or not electronic, and; 3) whether or not the liability of anyone. Cryptocurrencies as bitcoin are novel because they are peer-to-peer, electronic and not the liability of anyone. Peer-to-peer means that no trusted third party as a (central) bank is required to transfer the money. Before bitcoin, peer-to-peer transactions were only physically possible. Electronic means that the form is non-material. Not the liability of anyone means that the money is not registered as a liability on a balance sheet. CPMI (2015) defines cash (currency in circulation) as a liability of central banks. Only cryptocurrencies as bitcoin and commodity moneys (as gold and silver coins) are not defined as a liability. A shortcoming of this taxonomy is the overlap between peer-to-peer and not the liability of anyone.

Bjerg (2017) aims to understand new characteristics of central bank digital currencies and identifies three characteristics of money: 1) whether or not central bank issued; 2) whether or not electronic, and; 3) whether or not universally accessible. Universally accessible means that all economic agents can have access easily. Bech and Garratt (2017: 5) visualized the taxonomies of BIS CPMI (2015) and Bjerg (2017).

Two taxonomies of new forms of currency

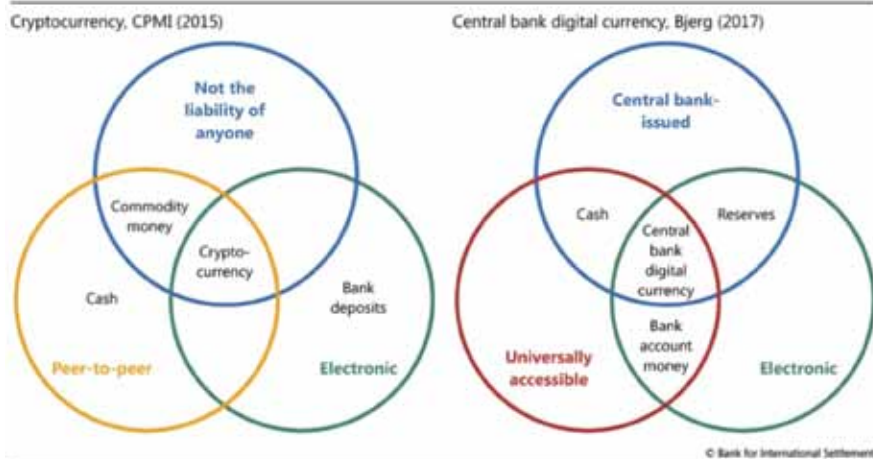


Figure 2-1: Two taxonomies of new forms of currency (Bech and Garratt 2017: 5)

The left part of Figure 2-1 summarizes the characteristics identified by BIS CPMI (2015) – not the liability of anyone, electronic and peer-to-peer – and shows how some forms of money – cryptocurrency, cash, commodity money and bank deposits – relate to these characteristics. The right part of Figure 2-1 summarizes the characteristics identified by Bjerg (2017) – whether or not central bank issued, whether or not electronic, and whether or not universally accessible – and shows how some forms of money – central bank digital currency, cash, reserves, and bank account money (bank deposits) – relate to these characteristics. The taxonomies of BIS CPMI (2015) and Bjerg (2017) are not exhaustive because they do not include all forms of money. For example, money market instruments as repurchase agreements and money market fund shares, and private currencies as regional currencies and barter systems do not fit in their taxonomy. Bech and Garratt (2017) elaborated the taxonomies of BIS CPMI (2015) and Bjerg (2017) to understand the options for central bank digital currencies. Bech and Garratt (2017: 59) define four properties of money: 1) issuer (central bank or other); 2) form (electronic or physical); 3) accessibility (universal or limited), and; 4) transfer mechanism (centralised or decentralised). Figure 2-2 illustrates the taxonomy of Bech and Garrett (2017) and is in the literature referred to as the money flower.

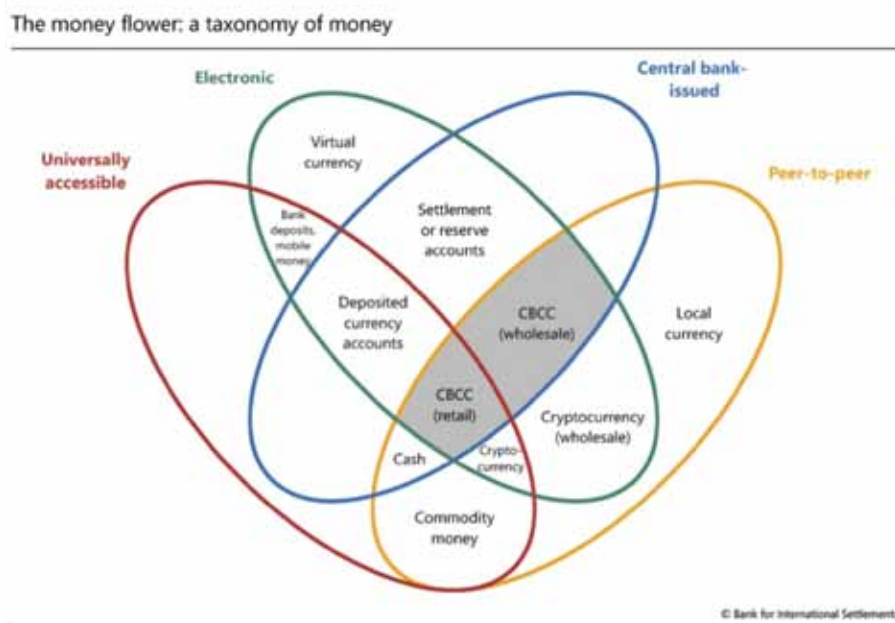


Figure 2-2: The money flower: a taxonomy of money (Bech and Garratt 2017: 6)

The coloured circles in Figure 2-2 represent each one property of money. Blue represents the issuer: forms of money inside the blue circle are currently or could be issued in the future by the central bank; and forms outside the circle are issued or could be issued by others. Yellow represents the transfer mechanism: forms of money inside the yellow circle can be transferred decentral (peer-to-peer); and forms of money outside the circle use a central ledger. Green represents the form: forms of money inside the green circle are electronic; and forms of money outside the circle material (physical). Red represents the accessibility: forms of money inside the red circle are universally accessible; and forms of money outside the circle have limited access. The taxonomy of Bech and Garret (2017) is more exhaustive because it includes historical forms of money as commodity money, current forms of money as bank deposits, cash and cryptocurrencies, and possible future forms of money as a central bank cryptocurrency and deposit currency accounts – as proposed by Tobin (1985, 1987) and which is to a large extent similar to today’s proposals for a central bank digital currency. The taxonomy could be improved in two ways. First, the taxonomy could be expanded. Some current forms of money as money market instruments are not included and some proposed forms of new money as public digital forms of money that “no longer connects two balance sheets” (McMillan 2014: 144) cannot be categorized properly in taxonomy. Second, section 2.3 explained that most scholars

focus on a different legal-economic or accounting basis. Bech and Garret (2017) refer only to transfer mechanism (peer-to-peer or not) while a different legal-economic or accounting basis has further (economic, legal, institutional, social, etc.) consequences.

Finally, Ricks (2016: 8) takes money market instruments into account and categorizes existing monetary instruments into three categories: physical currency, bank deposits and cash equivalents (money market instruments). In addition, Ricks (*Ibid.*) distinguishes two legal-institutional attributes: privileged issuance versus non-privileged issuance and sovereign status versus private status. Ricks (*Ibid.*: 9) defines bank deposits under deposit insurance sovereign and above deposit insurance private. The taxonomy of Ricks (2016) is, on the one hand, a step forward, because it includes money market instruments. On the other hand, it cannot be used to analyse past monetary systems and to explore all options for the design of the monetary and financial system in the digital age. The next section discusses another, hierarchical, way to view different forms of money and section 2.7 aims to develop a broader and more detailed taxonomy of money to explore different historical and future forms of money and monetary system designs.

2.5 Different kinds of money, monetary systems, and payments systems

In the literature, most scholars do not classify different forms of money; they just use ‘money’, ‘cash’ and ‘bank deposits’. Some scholars, however, add adjectives to different forms of money to emphasize specific characteristics. This section examines scholars – with different backgrounds (central banking, economics, anthropology, law, sociology, etc.) – who distinguish two different kinds of money, two monetary systems and/ or two payment systems. Table 2-1 presents a selection of scholars and the distinctions they make to show different definitions of different forms of money.

Table 2-1: Two kinds of money, monetary systems, and payments systems.

Scholar(s)	Background	Distinction	
Hancock and Humphrey (1998)	Central banking, economics	Cash payments	Non-cash payments
Kahn and Roberds (2009)	Economics	Store-of-value systems	Account-based systems
Graeber (2009, 2011)	Anthropology	Physical commodity money	‘Virtual’ credit money
Geva (2011)	Law	Monetary object	Monetary value
Benes and Kumhof (2012)	Central banking	Debt-free government-issued money	Debt-based private money
Mehrling (2012a, 2013, 2020)	Economics	Outside money	Inside or credit money

Wolf (2014)	Journalism, economics	Government-created non-debt money	Debt-created money
Dodd (2014)	Sociology	Token money	Credit money
Huber (2013b, 2014)	Economic sociology, NGO	Debt-free money	Debt money
Kumhof (Bank of England 2015)	Central banking	Token-based money	Credit-based money
Bollier and Conaty (2015)	NGO	Shared equity	Money as debt
King (2016)	Central banking, economics	Public money creation	Private money creation
Mellor (2016)	Economics	A debt-free, democratically controlled money system	A privatized money system based on debt
Turner (2016)	Supervisor, economics	Government fiat money creation	Private credit and money creation
Ricks (2016)	Law	Cash	Money claims
Low and Teo (2016)	Law	Corporeal money	Incorporeal money
Wortmann (2017)	Law, NGO	State issued sovereign money	Privately issued credit money
He <i>et al.</i> (2017)	Central banking	Token-based	Account-based
Klein (2017)	Economics	Asset (“value-based”)	Liability (“account-based”)
Ahman and Bashir (2017)	Central banking	Value/token-based design	Account-based design
Van ‘t Klooster (2017)	Philosophy	Settlement asset	Credit money
Meaning <i>et al.</i> (2018)	Central banking	Token-based	Account-based
Sveriges Riksbank (2017, 2018)	Central banking	Value-based	Account-based
Landau and Gernais (2019)	Policy, economics	Token-based	Account-based

In the distinctions summarized in Table 2-1, three lines can be discovered. The first is the legal-economic or the accounting basis of a monetary system. Hancock and Humphrey (1998: 1580) emphasize that one of the characteristics of cash is that “it represents final payment.” Kahn and Roberds (2009) distinguish between two kinds of payment systems: ‘store-of-value systems’ and ‘account-based systems’ and focus on the way money is transferred and the way of verification and identification. Similarly, Landau and Genais (2019: 53) distinguish two technical differences between token-based money and account-based money: 1) the way of achieving finality; and 2) the way of identification. When an obligation is settled irrevocable and unconditional in a

legal sense, finality is achieved (BIS 2021: 92). Identification is about verification of the payer. Kahn and Roberds (2009: 6) define the “Platonic ideal” for store-of-value systems as “spot trades using perfectly liquid assets” and for account-based systems “pure, costless credit”. In the first case, the payee identifies the payer and finality is achieved on the spot. In the second case, a third party identifies the payer and finality is achieved in the bookkeeping of the third party. Klein (2017) pays attention to the accounting difference between assets and liabilities. A payment with non-cash, a liability or with an account-based payment system settles a transaction but creates at the same moment a new relationship between the receiver and the register of the account. Other scholars point in slightly different terminology to a different accounting basis. Several economists, sociologists and anthropologists distinguish between non-debt (or debt-free) money and debt money (Benes and Kumhof 2012; Wolf; Huber 2013b, 2014; Bollier and Conaty 2015; Mellor 2016) or non-credit money and credit money (Graeber 2009, 2011; Dodd 2014; Turner 2016; Wortmann 2016; van ‘t Klooster 2017). Mehrling (2012a:1) distinguishes “*money* (the means of final settlement) from *credit* (a promise to pay money, or means to delaying final settlement).” In a later work, Mehrling (2020: 13) distinguishes between outside money and inside or credit money. Based on Gurley and Shaw (1960), Mehrling (*Ibid.*) notes that this distinction “is not a fact about the world” but “an analytical device” to emphasize that “government money is superior to bank money in the domestic hierarchy of money and credit. This insight is pivotal for the remainder of this thesis. Mehrling’s hierarchy will be discussed in detail in section 2.6.

Legal scholars tend to focus on another aspect of the accounting basis. They distinguish between ‘monetary object’ and ‘monetary value’ (Geva 2011), ‘cash’ and ‘money claims’ (Ricks 2016), ‘corporeal money’ and ‘incorporeal money’ (Low and Teo 2016). The difference in legal terms is that “rights to corporeal money [cash, monetary objects] are protected by the law through *in rem* rights” while “rights to incorporeal money [money claims, money values] are debts owing by the relevant financial institution and hence indisputably protected by *in personam* rights” (Low and Teo 2016: 228, italics original; see also Kim 2014). *In rem* rights are rights in relation to things (absolute rights) and *in personam* rights are rights in relation to persons (relative rights). In this classification, a bank deposit is a right to repayment from a particular bank (Low and Teo 2016: 229). Cash, in contrast, is a possession. When the non-bank private sector deposits cash with a bank, the legal *in rem* rights “to *that* money is transferred to the bank in exchange for an *in personam* claim against the bank” (*Ibid.* 238, italics original).

Also, scholars developing monetary reform proposals mention a different accounting basis (McMillan 2014; Ricks 2016; Wortmann 2016, 2017). McMillan (2014: 144) states that “the defining criterion for a financial asset is that it connects two distinct balance sheets”. A financial asset gives the owner the right to receive a part of future cash flows. McMillan (2014: 144) proposes to introduce a new form of digital money that does not fall under this definition; that is, a form of money that “no longer connects two balance sheets.” In Kumhof’s terminology, such a medium of exchange does no longer represent a debt, it is just money (Bank of England 2015). McMillan notices that money can still “be interpreted as holding a claim against society”, but no longer appears “on the liability side of anybody’s balance sheet” (2014: 144, see also WRR 2019: 27). The first relevant distinction is thus the accounting basis or the legal-economic basis.

A second line that can be discovered in Table 2-1 is the issuer. Kumhof defines two historical characteristics of a medium of exchange: technology and trust (Bank of England 2015). Technology is related to the accounting basis; Kumhof distinguishes ‘token-based money’ and ‘credit-based money’. The two alternatives for generating trust are, according to Kumhof (Bank of England 2015), ‘sovereign power’ and ‘private arrangements’. In an earlier working paper, Benes and Kumhof (2012) distinguished between ‘government control’ and ‘private control’ over money issuance. Several other economists mention public/ government issuance and private/ bank issuance (Mehrling 2012a; Wolf 2014; Turner 2016; King 2016; Mellor 2016; Wortmann 2017). Scholars often connect the accounting basis to the issuer. For example, Benes and Kumhof (2012: 12) argue that “government-issued money” is “irredeemable” and should be considered “equity in the commonwealth rather than debt”. Bollier and Conaty (2015) use the term “shared equity”. Huber (2013b: 49) argues that “modern money can both be debt money (if issued through creation of primary bank credit) and debt-free money (if created by sovereign fiat and spent, not loaned, into circulation).” The second relevant distinction is thus the difference between public and private issuers.

A third line that can be discovered in Table 2-1 is the form. Graeber (2009, 2011) adds a distinction between ‘physical’ and ‘virtual’ to respectively commodity money and credit money. With ‘virtual’ Graeber refers to money that exists only in accounting systems. In this definition, virtual is thus not equal to digital. Virtual money can be registered in physical ledgers. In the current literature, some scholars refer to the digital/ electronic form of bank deposits and cryptocurrencies and the material form of cash (e.g., Sveriges Riksbank 2017, 2018). In the literature on central bank digital currency, the digital form is pivotal. The third distinction concerns the form of money. In short, three lines can be discovered in the distinctions summarized in Table 2-1: legal-economic basis, issuer, and form.

2.6 The hierarchy of money

Mehrling (2012a: 1, see also 2012b) categorizes forms of money in a different way, in a hierarchical way because monetary systems are “always and everywhere” hierarchical. The hierarchy of money is not fixed but develops over time. Figure 2-3 visualizes the hierarchy of money and credit under a gold standard in a simple way.

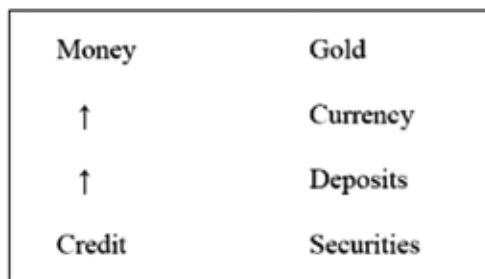


Figure 2-3: A simple hierarchy (Mehrling 2012a: 1)

Gold is on the top of the hierarchy because under a gold standard gold is the ultimate means of payment in international transactions; currency is defined as a form of credit, that is, a promise to pay gold; deposits are promises to pay currency on demand, and; securities “are promises to pay currency (or deposits) over some time horizon in the future, so they are even more attenuated promise to pay” (*Ibid.*: 2). Figure 2-4 visualizes the hierarchy in the current system.

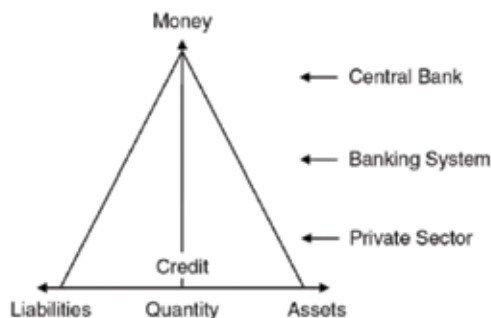


Figure 2-4: The hierarchy of money and credit (Mehrling 2012b: 8)

The central bank is at the top of the hierarchy, the non-bank private sector at the bottom and the banking system in between. Mehrling (2012b: 7) explains that “in booms, credit becomes more moneylike, while in contractions the differentiation reasserts itself.” In other words, the pyramid widens during booms and narrows during busts. Mehrling (2012a: 1) does not use static definitions of money and credit but argues that “money at one level of the system looks like credit from the standpoint of the level

above”, that is, what is money and credit depends from “your point of view” (*Ibid.*: 3). However, for the non-bank private sector, bank deposits are at the same time money (that can be used as means of payment) and a form of credit (the holder can ask the bank to exchange immediately into cash).

Merhling (2012a: 9) calls the hierarchical character of the system “inherent” to emphasize that “the hierarchy is not something simply imposed from the outside, e.g. by the power of government, or the force of law.” A question is if the political decisions to implement a CBDC – as China and Nigeria did – or accept a private currency for tax payments – as El Salvador did with bitcoin – could not be considered attempts of government to change the hierarchy from the outside. In the case of a CBDC, the hierarchy could significantly alter because the non-bank private sector gets more easily access to the top of the hierarchy. Moreover, it is unclear if a pyramid is a proper visualization of such a system.

Mehrling’s hierarchies and visualizations create conceptual clarity but could be improved. Mehrling defines securities as credit but the key difference with forms of money higher in the hierarchy is that securities are tradable on markets, that is, they offer market liquidity. In this thesis, three forms of liquidity and prices are distinguished: inherent liquidity (determined by law), contractual liquidity (parity) and market liquidity (market prices).¹³ Figure 2-5 visualizes these forms of liquidity.

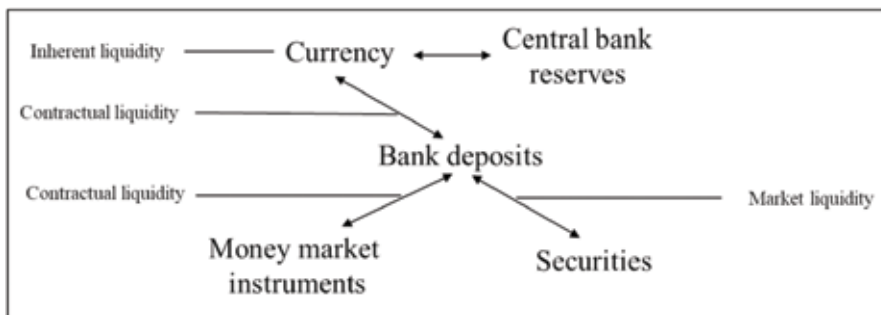


Figure 2-5: The relationship between different forms of liquidity

On the top of the hierarchy are forms of money issued by the (public) monetary authority, that is, currency (including central bank digital currency) and central bank

¹³ Mehrling (*Ibid.* 9-10) considers financial institutions as market dealers and defines three prices of money under a gold standard: “the exchange rate (the price of currency in terms of gold), par (the price of deposits in terms of currency), and the interest rate (the price of securities in terms of deposits or currency, assuming par)”. Mehrling does not define the prices of money in a system without a gold standard as we have today.

reserves. Those forms of money offer inherent liquidity within a currency area. Bank deposits are issued by commercial bank and are used as means of payment by the private sector. Moreover, they offer contractual liquidity to the private sector. The private sector can ask banks to exchange bank deposits on demand at par into currency. Money market instruments and securities are issued by the non-chartered banks and other non-bank private sector agents. The key difference between them is that money markets instruments (including stablecoins) offer contractual liquidity and securities (including cryptocurrencies as bitcoin) market liquidity, that is, they can be traded on markets. Securities can also be defined as credit money without contractual liquidity.

2.7 Different characteristics of monetary systems

Based on the lines discovered in the review of the distinctions made by different scholars of different moneys, monetary systems, and payments systems (section 2.3) and existing taxonomies (section 2.4), this section develops a taxonomy of four characteristics to describe different forms of money and to explore options for the design of the monetary and financial system in the digital age. The four characteristics are: 1) *legal-economic basis* (inherent or credit); 2) *issuer* (public or private); 3) *form* (material or non-material), and; 4) *accessibility* (universal or limited). The next subsections explain these characteristics, differentiate them further and discuss the influence of digital technologies.

2.7.1 Legal-economic basis

The first characteristic of a monetary system is its legal-economic basis. There is a distinction between monetary systems based on inherent money and monetary systems based on credit money. A monetary system based on inherent money can be conceptualized as a register with two columns: one column with identifiers of economic agents (individuals, firms, and institutions); and one column with (non-negative) amounts of inherent money (see Figure 2-6).

A	Inherent money
B	Inherent money
C	Inherent money
etc.	etc.

Figure 2-6: A monetary system based on inherent money

Economic agents can use inherent money in peer-to-peer transactions. No intermediary or trusted third party is required to verify payments. It is a pure asset, an object of ownership (an absolute right). Inherent money is not the liability of anyone nor a claim on the issuer. It is in legal terms a “payment object” (Kahn and Roberds 2009) and a “monetary object” (Geva 2011). Inherent money is by design not connected to an investment portfolio, that is, a balance sheet. Examples of inherent money are past coins of precious metals and some cryptocurrencies (especially bitcoin). Cash in circulation also fits in this definition. Today, central banks define currency in circulation as a liability (e.g., ECB 2012: 110) and several scholars do the same (e.g., Boonstra 2018: 62). A question is whether or not central banks are today liable in the case of banknotes and coins (material inherent money) in circulation. Before the abolishment of the gold standard, banknotes were promissory notes. They could be redeemed into gold and therefore banknotes were defined as a liability. However, already for decades redemption into gold is no longer possible. For example, in the U.K., notes and coins are no longer convertible into gold since 1931 (McLeay *et al.* 2014a: 5; Boonstra 2018: 95). In the Netherlands, convertibility was abolished in 1948. It took several decades before laws were updated. In 1998, the Dutch lawmaker declared that banknotes are monetary objects. In Germany, this happened in 1993 (Wortmann 2018: 2). Banknotes are thus no longer promissory notes because the owner cannot demand redemption of the central bank; that is, nothing can be claimed. Buiter (2018: 5) defines central bank money as “irredeemable” and “an asset to the holder but not in any meaningful sense a liability to the issuer” (see also WRR 2019: 149-150).¹⁴ Today, banknotes are fiat money. Fiat money exists by *nomos* – decree, order, unilateral act, agreement – and cannot be redeemed into something else.¹⁵ Wortmann (2018: 1) gives the example of a ‘disappeared issuer’ and explains that in the (unfortunate) case, a central bank bankrupts the owner of banknotes has no claims, just banknotes. Wortmann (*Ibid.*) emphasizes that this “is not necessarily a bad thing because these notes might still embody the currency and retain purchasing power, after the issuer disappeared.” In line with this, Goodhart (1999: 347) states that fiat money does not depend “on the (capital) strength of the CB [central bank], but on the strength and taxing power of the government behind it.” The reason that central banks still register ‘currency in circulation’ as a liability on their balance is practical

14 Some other scholars argue that it is ‘misleading’ that central banks still register issued banknotes as a debt on their balance sheet (e.g., de Vries 2020: 272).

15 Aristotle states in *Nicomachean Ethics* (discussed in detail in section 3.3.): “. . . money has become by convention a sort of representative need; and this is why it has the name ‘money’ (nomisma) — because it exists not by nature but by law (nomos) and it is in our power to change it and make it useless. (1133a28-31)” and “There must, then, be a unit, and that fixed by agreement (for which reason it is called money); for it is this that makes all things commensurate, since all things are measured by money” (1133b 21-23).

and historical. It is an accounting convention (Focardi 2018: 128-131). The accounts ‘currency in circulation’ are registrations for future banknotes deposits. However, for economic analyses, currency in circulation can better be understood and defined as inherent money. The holder of cash owns an asset that can be used in peer-to-peer transactions; it offers inherent liquidity because of an agreement (*nomos*).

Inherent money can be categorized further into two categories: inherent money with (some) intrinsic value – past coins of precious metals – and inherent money without intrinsic value – today’s banknotes, coins, and cryptocurrencies. Inherent money without intrinsic value is purely based on an agreement; that is, on *nomos*. If inherent money is based purely on intrinsic value, its value is determined by supply and demand (the market price). If inherent money is also based on *nomos*, it offers inherent liquidity as well as a market value. In this case, the nominal value differs from the intrinsic value. In both cases, there is no promise to convert by the issuer.

In the terms of Mehrling’s (2012a, 2012b) hierarchy, inherent money is the form of money at the top of the hierarchy or forms of money outside or at the bottom of the hierarchy. Examples of the latter are private cryptocurrencies as bitcoin and ethereum. Those forms of money cannot be run but can only be traded on markets. Last decade showed that market prices of those cryptocurrencies fluctuate significantly but there is no complete collapse of the system as could happen in the case of a run on shadow banks and commercial banks.

The basis of a monetary system based on credit money is a balance sheet (Figure 2-7). Credit money is the liability of the issuer.

Assets	Liabilities
	A: Credit money
	B: Credit money
	C: Credit money
	etc.

Figure 2-7: A monetary system based on credit money

In case of a payment with credit money an intermediary or trusted third party verifies the payment. Credit money is thus by design connected to a balance sheet. It is a relative right; that is, a right in relation to a legal person. Examples of credit money are bills of exchange, tally sticks, bank deposits, money market instruments and central bank reserves.

A distinction can be made between two forms of credit money: credit money covered by all assets and credit money covered by specific assets. Bank deposits and stablecoins are covered by all assets and money market instruments are generally covered by specific assets. Moreover, there is a more pivotal distinction between credit money that can be exchanged on demand at par into another form of money – this form offers (*unconditional*) contractual liquidity (McMillan 2014) and is defined as contractual money in this thesis – and credit money that cannot be exchanged into another form of money on demand this form can offer *conditional* contractual liquidity or market liquidity. In the latter case, it is more like a security; this form of money is called investment money by Adrian and Mancini-Griffoli (2019a: 3-4). In case of contractual money, the issuer of money promises on demand fixed-rate convertibility (parity) into another form of money. If it is unconditional, exchange should happen immediately. According to Brunnermeier *et al.* (2019: 3), convertibility serves two purposes: 1) it contributes to maintaining the value of contractual money; and 2) it allows replications. A disadvantage of replication and fixed on demand convertibility is the creation of systemic risk which will be examined in detail in part II of this thesis.

The influence of digital technologies on the characteristic legal-economic basis is significant. Bitcoin shows that also digital forms of money can be inherent. Till recently all forms of digital money were digitally registered claims on the issuer; that is, credit money. Bitcoin is not a claim, not connected to a balance sheet and not covered with assets. It is an asset that can be used as a means of payment to settle transactions instantly over long distances without a central agent like a (central) bank and can be used to store settlement power or purchasing power. Settlement power is more accurate because money is used to purchase goods and services (to settle transactions) *and* to settle debt obligations. However, it could also be argued that the network in the case of bitcoin and some other cryptocurrencies is itself an intermediary and that those networks can be manipulated, and prices of those currencies can be manipulated. Also, in the case of updates, a limited number of specialists decides. Several new governance models are currently being explored to solve those problems, for example decentralized autonomous organizations (DAO's).

Nakamoto (2008: 1), the founder of the first cryptocurrency bitcoin, emphasizes that a pivotal feature of bitcoin is that it allows any two willing parties to “transact directly with each other without the need for a trusted third party.”¹⁶ Several scholars notice the novelty of this digital form of inherent money. For example, Klein (2017: 2) states that “in contrast to the current money system, cryptocurrencies come into existence as assets [inherent money] and not as liabilities [credit money] and are not created as additional debt since nobody has to go into debt by taking out a loan from a bank.” Similarly, Landau and Genais (2019: 2) call cryptocurrencies “new monetary objects” (a new form of inherent money) that have no backing and “are not a claim on any natural or legal entity” (as credit money is) (see also Böhme *et al.* 2015). However, cryptocurrencies are there in many forms and, for example, stablecoins are not monetary objects but claims on central issuers and connected to balance sheets. In other words, several cryptocurrencies are not that novel.

2.7.2 Issuer

The second characteristic of a monetary system is the issuer. In accordance with many scholars (section 2.4) and existing taxonomies (section 2.5), this thesis distinguishes between *public issuance* and *private issuance*. Public money is based on legitimate power. Private money is based on private contracts. Examples of publicly issued forms of money are cash (banknotes and coins) and central bank reserves. Both are issued by central banks operating on behalf of the government. Examples of privately issued moneys are cryptocurrencies, bank deposits and money market instruments. In the case of private cryptocurrencies, networkcurrencies as bitcoin and currencies with a central issuer as in the case of stablecoins as Tether can be distinguished.

Public issuers can be classified into ‘sovereign legitimate’ issuers and ‘public legitimate’ issuers. The main difference between both is that the power of public legitimate issuers is based on elections and the power of sovereign legitimate issuers is not. Examples of sovereign legitimate issuers are past rulers as emperors and kings. Examples of public legitimate issuers are today’s democratically elected governments and mandated central banks. Although central banks generally started as private banks, today, they are generally public institution. The Fed is sometimes mentioned as an example of a private central bank because Federal Reserve Banks are private corporations. However, the Fed is a creature of Congress and the board of governors is a government agency (Wray 2012: 9; Menand 2022: 94).

¹⁶ Because of the absence of a trusted third party, some scholars call bitcoin therefore “trustless” (e.g., MacDonald *et al.* 2016: 283; see also Mills *et al.* 2016).

Privately issued money can be classified into insured and uninsured. Commercial banks issue bank deposits. These bank deposits are expressed in the public unit of account (e.g., euro), are convertible on demand at par in cash (public money) and are till a certain amount insured by obligatory deposit insurance schemes (DIS) backed by states (governments) – DIS will be examined in more detail in chapter 4 and 6. Moreover, commercial banks have access to the central bank. Money market instruments do not fall under DIS and their issuers generally do not have access to the central bank. A difference between money market instruments and stablecoins on the one hand, and private (crypto)currencies on the other hand, is that the latter have their own unit of account. Examples of the latter are bitcoin (a cryptocurrency) and sardex (a complementary currency).

Digital technologies influence this characteristic. Before the emergence of bitcoin only kings, emperors, states, and groups connected to a specific region successfully issued inherent money. Generally, they did this by unilateral act based on sovereign power. Last decade thousands of private (community-based) initiatives have used digital technologies to do the same. In the past governments and other rulers were able to prohibit large private currency schemes because of the physical form of money; prohibiting digital currencies is much harder if not impossible. However, there are barriers to the widespread adoption of cryptocurrencies (and other purely private currencies). The main barrier is that the largest counterparties in the world, governments, do not accept them.¹⁷ Citizens must pay taxes, fees and fines in moneys using the public unit of account (cash, bank deposits). For this reason, state theorists of money argue that cryptocurrencies are not money. In their definition, a currency is money when it is connected to the fiscal system (this will be discussed in more detail in the next chapter). As said, this thesis observes that different economic agents use different monetary instruments to fulfil different monetary functions. Digital technologies thus enable private agents to issue currencies on a large scale, but the connection between money and the (national) fiscal system is still relevant in the digital age.

2.7.3 Form

The third characteristic of a monetary system is the form. This thesis distinguishes between *material money* and *non-material money*. Material money is physical, tangible. Banknotes and coins are examples. Non-material money is intangible. Bank deposits and cryptocurrencies are examples. To understand the opportunities offered by digital technologies, non-material money should be differentiated further.

¹⁷ An exception is El Salvador. In June 2021, this country announced that bitcoin would become legal tender.

Non-material money already existed before the emergence of digital technologies and is, according to some scholars, the original form of money. For example, Graeber (2009, 2011) describes the history of money and debt in terms of ‘virtual’ credit money and ‘physical’ commodity money (inherent money). According to Graeber, the history starts with the ‘virtual’ money in central monetary accounting systems registered on clay tablets in Mesopotamia 3,000 B.C (discussed in more detail in chapter 3). In Graeber’s definition, ‘virtual’ refers, as explained, to bookkeeping money, that is, money that only exists in ledgers. Another form of ‘virtual’ money is bank deposits. Before the digital age, bank deposits only existed in the material ledgers of commercial banks. After the digitalization of these ledgers, bank deposits exist in IT-systems of banks. One of the consequences of the digitalization of bank deposits is that payments no longer must be processed manually. To understand different designs, differentiating between material ledgers and digital ledgers is thus useful. Digital ledgers can subsequently be differentiated into central ledgers (of banks and stable coins for example) and decentralised ledgers (of some cryptocurrencies).

2.7.4 Accessibility

The fourth characteristic is accessibility. Bjerg (2017) and Bech and Garret (2017) identified this characteristic. Access can be universal or limited. The best example of universally accessible money is cash. Everyone can just start to use this form of money. Examples of limited accessible money are central bank reserves and private complementary currencies. Only banks have access to central bank reserves. The non-bank private sector does not have access. In most CBDC-proposals the non-bank private sector also gets access to the central bank. In the case of private complementary currencies, only members have access and membership is often restricted to a specific regional area (van der Linden and van Beers 2017). Bank deposits are difficult to categorize; in theory, all economic agents can open a bank account but in practice, many economic agents are unbanked (see for example, Baradaran 2015). Also, not all economic agents have access to cash equivalents. Therefore, this thesis also distinguishes between ‘consciously limited access’ and ‘unconsciously limited access’. Consciously limited means that there are rules which agents have access to a form of money, and which do not. For example, central bank reserves are consciously limited to commercial banks. As said, since the financial crisis of 2007-9 also several shadow banks have access. Unconsciously limited means that a form of money is not accessible to all agents because of barriers such as high costs or not having all legal documents. Bank deposits and cash equivalents are examples of forms of money that are unconsciously limited. For example, if you don’t have a postal address, you cannot open a bank account.

2.8 Summary

This chapter developed a taxonomy of money consisting of four characteristics to describe different forms of money and to explore past, current, and future monetary system designs. Table 2-2 summarizes the taxonomy.

Table 2-2: A taxonomy of money for exploring different monetary system designs

I. Legal-economic basis	Inherent money	With (some) intrinsic value
		Without intrinsic value
	Credit money	Without contractual liquidity (security)
		Offering conditional contractual liquidity
		Offering unconditional contractual liquidity (contractual money)
II. Issuer	Public	Sovereign legitimate
		Public legitimate
	Private	Insured
		Uninsured
III. Form	Material	
	Non-material	Material central ledger
		Digital central ledger
		Digital distributed ledger
IV. Accessibility	Universal	
	Limited	Consciously limited
		Unconsciously limited

In the remainder of part I, the taxonomy will be used to understand and to derive lessons from the two opposing theories on the origin and nature of money (chapter 3), the historical development of money (chapter 3 and 4), the systems of fractional reserve banking, full reserve banking and free banking (chapter 4) and the functioning of the current monetary and financial system (chapter 5). In part II of this thesis, the taxonomy will be used to examine some of the systemic problems of the current design of the monetary and financial system and to develop requirements and guidelines.

3. Design lessons from theories on the origin and nature of money

3.1 Introduction

In this chapter, research question *b) Which design lesson(s) can be derived from two opposing theories on the nature and origin of money – theories focussing on the market and the function as medium of exchange versus theories focussing on the state and the function as a unit of account?* is examined. Today, an exploration of alternative designs is sometimes obstructed by discussions between scholars about the nature and origin of money. Several scholars refer to widespread confusion about the meaning and definition of money (Schjacht 1967: 8; Marx 1970: 64; Phillips 1995; Carruthers and Babb 1996; Huber 2014; Dodd 2014; Askari and Krichene; WRR 2019: 21-24). In the literature, two groups of theories tracing money back to a different origin and nominating a different nature of money can be distinguished (Schumpeter 1917; Goodhart 1998; Ingham 2004; Dodd 2014). The first group focuses on the market and the function as medium of exchange. The second group focuses on the state and the function as unit of account. The objective of this chapter is threefold: 1) to apply the taxonomy developed in chapter 2 to understand both (opposing) theories on money; 2) to examine reference foundations, and; 3) to derive design lessons from both theories.

This chapter is structured as follows. Section 3.2 examines the theories of scholars emphasizing the market and the function as a medium of exchange. Section 3.3 examines the theories of scholars who emphasize the state and function as unit of account. Section 3.4 reflects on both theories. Section 3.5 draws some conclusions and derives two design lessons.

3.2 Theories focussing on the market and the function as medium of exchange

The first group of theories focuses on the market and the function as medium of exchange. To this group belong commodity theorists, Metallists, and barter exchange, market, and Mengerian theories on the origin of money. This group includes economic scholars who lived in the 17th, 18th, and 19th century such as John Locke, David Hume, Adam Smith, Karl Marx, William Stanley Jevons, and Carl Menger. Also, several contemporary scholars and economic practitioners adhere and presume this theory (e.g., Greenbaum *et al.* 2016; Skingsley 2016¹⁸).

18 “The invention of money minimized the need for barter trade and thereby increased commercial transactions and trade” (Greenbaum *et al.* 2016: 58). “In the beginning, we traded with one another simply by swapping goods and services. However, the barter system is not so practical, as it means that you have to find someone who has what you want and who also wants what you have. . . . Money means that we can improve the traditional barter system” (Skingsley 2016: 2).

Aristotle is of particular interest and possibly contributed to the opposing theories on the origin and the nature of money (Semonova 2011: 178). In *The Politics and the Constitution of Athens*, Aristotle describes the emergence of money out of barter exchange. In *The Nicomachean Ethics*, in contrast, Aristotle emphasizes the political-legal side of money. The next section explains theories focusing on the unit of account and the state. This section summarizes the emergence of money out of barter as described by Aristotle in *The Politics*, Smith, Jevons and Menger.

In *The Politics*, Aristotle (1257a21) argues that family members first had everything in common, that is, there was no trade. In those societies without trade individuals exchanged with “one another the necessities of life and nothing more; giving and receiving wine, for example, in exchange for corn” (1257a25-27). Later scholars visualized exchange without money as C–C (commodity–commodity; see Marx 1867; Meikle 1994, 1995).

subsequently, Aristotle contends that when the family divided into parts barter gradually emerged, and thereafter money emerged “necessarily”:

When the inhabitants of one country became more dependent on those of another, and they imported what they needed, and exported what they had too much of, *money necessarily came into use*. For the various necessities of life are not easily carried about, and hence men agreed to employ in their dealing with each other something which was intrinsically useful and easily applicable to the purposes of life, for example, iron, silver, and the like. (1257a35-39, italics added)

Aristotle does not mention which men agreed to employ iron, silver, and the like. Did private individuals (economic agents) agree? Or did some representatives of sovereign legitimate power agree?

Like Aristotle, Smith (1776: 29-32) and Jevons (1875: 3-13) trace the origin of money back to barter. Smith (1776: 29) explains that when the division of labour started exchange “must frequently have been very much clogged and embarrassed in its operation” because of the absence of money. Jevons (1875: 3-4) defines a double coincidence of wants problem.¹⁹ A double coincidence of wants refers to a situation where two economic agents want to have each other’s goods at the same moment and are willing to exchange, that is, a situation where wants perfectly match. For example, economic agent A wants bread in exchange for a bottle of milk and economic agent

19 “There may be many people wanting, and many possessing those things wanted; but to allow of an act of barter, there must be a double coincidence, which will rarely happen” (Jevons 1875: 3-4).

B wants at the same moment a bottle of milk in exchange for bread. In economic practice, this perfect matching rarely happens. According to scholars in this group, the ‘double coincidence of wants’ was solved ‘naturally’ by money. Money emerged in the economy when an individual in exchange of a commodity (good or product) returned money instead for a commodity; that is, something inserted itself into the exchange and started to mediate the exchange (commodity–money–commodity; C–M–C). This mediator (medium of exchange) solved the ‘double coincidence of wants’ problem and functioned as a mediator. According to these scholars, anything that serves as a mediator in the process of exchange can be called money. Smith (1776: 30) mentions cattle, salt, shells, tobacco, sugar, hides, dressed leather, nails and metals. All are forms of inherent money with intrinsic value in the terminology of the taxonomy developed in chapter 2. According to scholars in this group, in all countries “men seem at last to have been determined by irresistible reasons to give the preference, for this employment, to metals above every other commodity” (*Ibid.*). Smith (1776: 31) notices that the use of rude metals “without any stamp or coinage” as a medium of exchange has two inconveniences: the trouble of weighing and the trouble of assaying. To solve these inconveniences, coinage, called “the institution of coined money” by Smith (*Ibid.*), was established. Smith (*Ibid.* 32) explains that a stamp “by those public offices called mints” guaranteed the quantity (weight) and quality (fineness) of particular metals. Aristotle (1257a39-41) similarly argues that a stamp standardized metals.²⁰ A stamp made from specific commodities inherent money. These scholars argue thus that money first emerged ‘necessarily’, ‘spontaneously’ or ‘naturally’ out of barter and thereafter a stamp standardized metals. Menger advocates this ‘natural emergence out of exchange’ position most clearly:

Money has not been generated by law. In its origin, it is a social, and not a state-institution. Sanction by the authority of the state is a notion alien to it. On the other hand, however, by state recognition and state regulation, this social institution of money has been perfected and adjusted to the manifold and varying needs of an evolving commerce, just as customary rights have been perfected and adjusted by statute law. (Menger 1892: 255)

In the terms of the taxonomy of chapter 2, the theories focussing on the market and the function as a medium of exchange argue that universally accessible material inherent money inserted itself into the exchange and started to mediate the exchange (C-M-C). Money is thus above all a medium of exchange. According to these theories, money was in the beginning not issued, it emerged ‘naturally’ out of barter. The characteristic

²⁰ “Of this [iron, silver, and the like] the value was at first measured simply by size and weight, but in process of time they put a stamp upon it, to save the trouble of weighing and to mark the value” (Aristotle 1257a39-41).

‘issuer’ is therefore not applicable. In a second phase, the sovereign legitimate or public legitimate power played a role by establishing standards. The legitimate was in this phase thus still not an issuer but more ‘a standardizer’.

Scholars in this group generally focus on the decentral market exchange and smoothing transactions with a mediator, that is, reducing transaction costs. This focus fits well with neoclassical economic theory (e.g., Williamson 1979, 1981). In this theory, individuals play a central role, and less attention is paid to power, groups, and coordination. Scholars emphasizing the state and the function as unit of account argue, in contrast, generally that (precursors of) states introduced money to organize society. This explanation fits better to non-neoclassical economic and non-economic theories in which power, groups and coordination play more central roles – for example, post-Keynesian economic theory.

3.3 Theories focussing on the state and the function as unit of account

The second group focuses on the state and the function as unit of account. To this group belong claim theorists, Chartallists, credit theorists, state theorists, and most other non-economic theories on the origin of money – see Dodd (2014) for an extensive overview. This group of theories underlies post-Keynesian scholars (including Modern Money Theorists, Monetary Circuit Theorists and in the description of the current system also New Currency Theorists) and includes scholars who lived in the 19th and 20th century as Alfred Innes, Georg Friedrich Knapp, Marcel Mauss, John Maynard Keynes, and Hyman Minsky. Also, several contemporary scholars and economic practitioners adhere and presume this theory; e.g., post-Keynesian economist Semenova (2011) and legal scholar Desan (2014).²¹

This group emerged at the beginning of the 20th century because of new (empirical) historical evidence. Mesopotamian clay tablets were deciphered and interpreted as monetary accounting systems. For this reason, these scholars trace the origin of money not back to the first coins (inherent money) but to the Babylonian and Sumerian civilizations and their institutions around 3,200 BC. According to these theories, “money lies behind coinage” (Grierson 1977: 12), that is, in the taxonomy developed in chapter 2 ‘money lies behind monetary systems based on inherent money.’

Arguably the most fundamental critique of the scholars in this second group is that barter exchange has never existed on a large scale in economic practice – as scholars in the first group assume. Especially anthropologists make this argument, for example,

21 For example, Semenova (2011: 4) states: “Money was introduced by a central public authority as a unit of account in which taxes to the state were denoted and had to be paid.”

Dalton (1982), Humphrey (1985) and Graeber (2011)²² (see also Desan 2013; Aglietta 2018; WRR 2019).

Innes (1913, 1914) is an example of the changing understanding of the history of money in the beginning of the 20th century and the discovery of monetary accounting systems. Innes (1913) states that historical evidence proves that “commerce from the most primitive times was carried on by means of credit [contractual money in the terms of the taxonomy developed in chapter 2], and not with any ‘medium of exchange’ [inherent money].” Therefore, Innes concludes: “there is no question but that credit [contractual money] is far older than cash [inherent money]” (*Ibid.*). Innes argues that theories emphasizing the function as a medium of exchange have no ground and emphasizes that “the belief in these theories among economists” is so “universal”

that they have grown to be considered almost as axioms which hardly require proof, and nothing is more noticeable in economic works than the scant historical evidence on which they rest, and the absence of critical examination of their worth. Broadly speaking these doctrines may be said to rest on the word of Adam Smith, backed up by a few passages from Homer and Aristotle and the writings of travellers in primitive lands. But modern research in the domain of commercial history and numismatics, and especially recent discoveries in Babylonia, have brought to light a mass of evidence which was not available to the earlier economists, and in the light of which it may be positively stated that none of these theories rest on a solid basis of historical proof—that in fact they are false. (Innes 1913: 400)

Instead, Innes (1913, 1914) argues that credit is the origin and the nature of money; that is, money is credit.²³ In this view, money is always based on credit-debt relationships. Not only credit theorists like Innes but also state theorists belong to this second group. State theorists emphasize the role of the state in the monetary system and focus on the relation between the state, money, and taxes. Scholars as Wolcott (1876) and Knapp

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22 They respectively state: “Barter, in the strict sense of moneyless exchange, has never been a quantitatively important or dominant model or transaction in any past or present economic system about which we have hard information” (Dalton 1982: 185). “No example of a barter economy, pure and simple, has ever been described, let alone the emergence from it of money; all available ethnography suggests that there has never been such a thing” (Humphrey 1985: 48). “In fact, our standard account of monetary history is precisely backwards. We did not begin with barter, discover money, and then eventually develop credit systems. It happened precisely the other way around. What we now call virtual money came first. Coins came much later, and their use spread only unevenly, never completely replacing credit systems. Barter, in turn, appears to be largely a kind of accidental by product of the use of coinage or paper money: historically, it has mainly been what people who are used to cash transactions do when for one reason or another they have no access to currency” (Graeber 2011: 40).

23 Innes (1913: 402) states, for example: “Money, then, is credit and nothing but credit. A’s money is B’s debt to him, and when B pays his debt, A’s money disappears. This is the whole theory of money.”

(1924) consider money a creature of the law.²⁴ This line of thinking can also be traced back to Aristotle because, in contrast to his view in *Politics*, Aristotle emphasizes in *Nicomachean Ethics* that money is the result of an agreement:

. . . money has become by convention a sort of representative need; and this is why it has the name ‘money’ (*nomisma*) – because it exists not by nature but by law (*nomos*) and it is in our power to change it and make it useless. (1133a28-31, italics original)

There must, then, be a unit, and that is fixed by agreement (for which reason it is called money); for it is this that makes all things commensurate, since all things are measured by money. (1133b 21-23)

In the view of state theorists, the relationship with the fiscal system is pivotal. Knapp (1924: vii) emphasizes that “the money of a State is not what is of compulsory general acceptance, but what is accepted at the public pay office.” According to state theorists, states, or something alike – for example, the state-religious institutions in Mesopotamia – have been essential for the emergence of money.²⁵

During the last decades, Modern Monetary Theorists (MMT’ers, also called neochartalists) such as Mosler, Wray, Tcherneva and Kelton have attempted to reconcile Innes’ credit theory of money and Knapp’s state theory (Dodd 2014: 106). Therefore, these scholars can be considered state-credit theorists. MMT connects the credit theory of banking with the view that “taxes drive money” (Mitchell, Wray, and Watts 2016: 111; see also Wray 1998: 36). The credit theory of banking considers commercial banks as creators of private contractual money. Chapter 5 will explain this theory in detail. Moreover, MMT’ers state that government spending also leads to money creation (explained in section 5.3.17). They emphasize consistently that the origin of money lies “in credit and debt relations, with the unit of account emphasized as the numéraire in which credits and debts are measured” (Tymoigne and Wray 2005: 2-3).

.....
24 For example, Knapp (1924: 1) argues that “money is a creature of the law” and Wolcott (1876) states:

“Money is a creature of law, it is created and upheld by law. . . . We, the people make the government. We give the government the power to make, provide and issue money under proper rules and regulations” (Wolcott 1876: 6, 21 in Carruthers and Babb 1996: 1572)

25 The equalization of the state with agreements is a possible cause of the false dichotomy between the state and the market. In practice, private agents as well as the state and private agents can agree with each other to use a specific monetary (accounting) system. This nuance is essential to understand different monetary system designs. Desan (2016: 29) argues that “groups acting through stakeholders have probably invented money, again and again, in societies as different as Mesopotamia and early England.” Desan (2016: 22) uses the term stakeholder to capture the variety of groups and resources they organized “while avoiding the implication that every collective activity is undertaken by a ‘state’.” The stakeholder may be a leader, king, warlord, counsel, or governing body. Essential is that the stakeholder has a central position in a group.

Scholars in this group trace the origin of money thus back to the monetary accounting systems in the Mesopotamian Valley around 3,200 B.C. In Babylonia and Sumer as well as in the pre-Greek civilizations of Egypt and Mycenae the rulers used central monetary accounting systems to organize society. In those societies, inherent money and contractual money did not exist, but credit money did exist. The exact development of these monetary accounting practices is largely unknown²⁶, likely because “money predates writing” (Tymoigne and Wray 2005: 1; see also Ezzamel and Hoskin 2002: 333-335; Mattessich 1994; Schmandt-Besserat 1992, 2012). However, it is well understood that the ‘invention’ of record-keeping has been essential. Without valuation based on a standard unit of account and central registration and record keeping, the development of more complex societies, specialization and exchange would have been impossible. In Mesopotamia, society was led from above. The ruling theocratic priest-class organized politics and the administration as well as the economy and religious life (Davies 2002: 50). To organize society, they used a fixed barley-silver standard to calculate silver equivalences of commodities, costs of services, debts, quotas, and penalties (Van de Mierop 2014: 21; Hudson 2000; Semenova 2011), that is, the priests used an ‘abstract’ unit of account to value the different contributions to society and to (re)distribute resources. Some scholars even argue that it seems “probable that this equivalence was based on the redistributed ration necessary to sustain a labourer and his family” (Ingham 2004: 94-5, see also Hudson 2000: 4). Without a material medium of exchange (inherent money), Mesopotamians were thus able to distribute resources and to settle transactions. In a similar way, central banks settle transactions today centrally in their bookkeeping. Exchange in the period 4,500-1,200 B.C. in Mesopotamia was thus often not conducted by payments “on the spot” (with inherent money) but “by running up debt balances” (with contractual money) (Hudson 2004: 102). Ingham (2009: 5) states that “debts were settled by netting or a final means of payment with commodities that had fixed – that is, standardized – exchange ratios, as in any system of measurement. Extensive credit-debit relations could be settled with either barley or silver because of their authoritatively established relationship.” In other words, in Mesopotamia monetary systems based on credit money dominated and commodities functioned as inherent money. However, these commodities were not coins (Schaps 2004). The key difference between credit money in Mesopotamia and today’s forms of credit money (as bank deposits, called contractual money in this thesis) is that the first was not exchangeable on demand in another form of money – inherent money did not yet exist. The key similarity is that credit money systems are, at least to some extent, centrally governed. In systems based on credit money, economic agents use a liability of a (central) trusted third party to settle transactions.

26 Or in the words of Keynes (1930: 13), “its origins are lost in the mists when the ice was melting.”

The central issuer does not only provide money but is via its monetary accounting system often involved in other parts of the economy and society. For example, in Mesopotamia, the priest class calculated the prices of commodities, costs of services, debts, quotas and penalties centrally. Today, central banks are involved in the financial system via risk management, quantitative easing, and the base interest rate.

The question of whether money existed in Mesopotamia depends on the definition or the underlying idea of money. If money is defined as coins (inherent money) and this definition is projected on Mesopotamia, then Mesopotamia was non-monetized. If the monetary accounting systems are defined as (credit) money, then Mesopotamia was monetized. Meier (2017: 20-21) suggests to view money as “the accounting process itself, a process which enabled in those days values to be exchanged, rents to be collected and products to be redistributed.” Although this is a relevant insight, it is also important to differentiate between different kinds of monetary (accounting) systems with different characteristics.

The theories focussing on the state and the function as unit of account emphasize that before the introduction of money as a medium of exchange, a unit of account and central monetary accounting systems were already used. The design of the Mesopotamian accounting systems was based on a ‘sovereign legitimate’ unit of account and central ledgers. In these ledgers, the priests-class settled balances. A unit of account enabled the priest class to determine the relative value of goods, to measure and quantify different economic contributions, to settle debts and likely even to determine standard rations. In the development of these systems neither overcoming Jevons’ (1875) double coincidence of wants problem between two individuals nor lowering transaction costs played a significant role. Society was centrally organized, and the monetary accounting systems were pivotal instruments of power. The same could be said of the balance sheets of central banks today.

3.4 Reflection

This section reflects on some pivotal aspects of the theories focusing on the market and the function as a medium of exchange and theories focussing on the government and the function as unit of account.

3.4.1 Money as the outcome of a market process

Scholars emphasizing the market and the function as a medium of exchange often use words as ‘necessarily’, ‘spontaneously’ or ‘naturally’. These scholars suggest that the history of money satisfies the requirements of ‘the invisible hand’, that is, the invention of money is the result of uncoordinated market processes. Neither coordination between (public and/or private) agents nor power struggles played a significant role. Several scholars analyse why this view has become dominant and relate it to the dominance of neoclassical economics in economic science (Goodhart 1998; Graeber 2011; Semenova 2011). For example, Goodhart (1998: 425) argues that the reason for the dominance of theories emphasizing the medium of exchange and the market is likely technical and ideological.²⁷ Similarly, Graeber (2011: 57) suggests that the myth of barter is so persistent “because it is central to the entire discourse of economics”; that is, it fits well to neoclassical economics. An insight offered by these scholars is that a central authority can provide a mediator of exchange to facilitate decentral market exchange.

3.4.2 The definition of money as debt (or credit)

Scholars emphasizing the state and the function as unit of account generally define the nature of money as debt or as credit.²⁸ Often these scholars reject the money is neutral assumption underlying neoclassical economics (discussed in chapter 1) because “all money is constituted by credit-debt relations” (Ingham 2004: 72) and argue that these relations are per definition social relations. Credit theorists such as Innes (1913, 1914) and Ingham (2004) argue that all money is credit, but not all credit is money. For example, Ingham (2004: 72) states that (1) “the holder of money is owed goods; money is a claim on the social product”; and (2) “money is a credit for the user because it is a debt (liability) for the issuer”; in other words, “money cannot be created without the simultaneous creation of debt”.

The definitions ‘money is debt’ and ‘money is credit’ are ambiguous because money is not just debt and/or credit but also the opposite of debt and/or credit. Money has multiple relations to (different forms of) debt and credit. Money is dependent on debt and money can be used to pay a debt. As a general means of final payment, money settles credit agreements (deferred payments, promises to pay) and debts (loans).

27 “The main advantages of the M-form theory [Metallism; that is theories emphasizing the medium of exchange and the market] appear to be technical, in that it lends itself better to mathematical formalisation, and ideological, in that it is based on a process of private sector cost minimisation, rather than a messier political economy process. It is, however, a pity to suspect that monetary economics may be driven more by technical and ideological purity than by empirical and predictive capacity” (Goodhart 1998: 425).

28 Another difficulty is the inconsistent use of the terms debt and credit. Dodd (2014: 94) notices that European scholars “tend to view all money as a token of debt (derived from one’s debt to society)” and Anglo-American scholars tend to view “all money as a form of credit, i.e., an obligation from society to the individual.”

Other scholars argue, for this reason, that money is not credit but the opposite of credit. For example, Kim states (see also Issing 1999: 23):

Nonetheless, because of its association with finality, the concept of money is the opposite of the concept of credit, which is associated with debt. The transfer of a credit instrument creates a creditor-debtor relation. By contrast, money is anything that is generally acceptable in the final settlement of creditor-debtor relations. This *finality* is closely associated with the “thingness” of money. (Kim 2014: 1009, italics original)

As explained in chapter 2, inherent money is – in legal terms – an object of ownership that can be used to settle peer-to-peer transactions. Its key characteristic is that it offers inherent liquidity.

In history, various forms of inherent money with (some) intrinsic value existed. For example, salt in China and cowry shells in many places in Asia and Africa functioned for long periods as money (Quiggin 1949; Morgan 1965), but this historical evidence does not mean that assets are *the* nature of money or per definition *the* origin of money. Although Innes (1913) argues that ‘money is credit,’ he also admits that tobacco and other commodities have been used as means of payment in exceptional circumstances. In other words, it seems that Innes confesses that credit is not *the* nature of money, but that credit (credit money) can be (and last centuries generally has been) positioned as means of payment.

Moreover, scholars in the second group of theories generally consider money a balance sheet item. They define an asset-liability nature of money and do not distinguish between credit money and contractual money (e.g., Bell 2001; Ingham 2004; Bezemer 2014). Monetary systems based on inherent money and without contractual money are however also possible. Chapter 2 explained that there are two different legal-economic bases for monetary systems: inherent money and credit money and that contractual money is a specific form of credit money. Moreover, access to an issuer of money can be consciously limited or not (section 2.7.4). The introduction of CBDC will give all economic agents access to the top of the hierarchy and this will change the (shape of the) hierarchy.

3.4.3 A single nature

Interestingly scholars in both groups claim that *the* origin and *the* nature of money exist. Theories describing *the* origin and/ or *the* nature are intellectually challenging – for example, Menger (1871, 1892), Innes (1913, 1914) and Ingham (2004) –, but

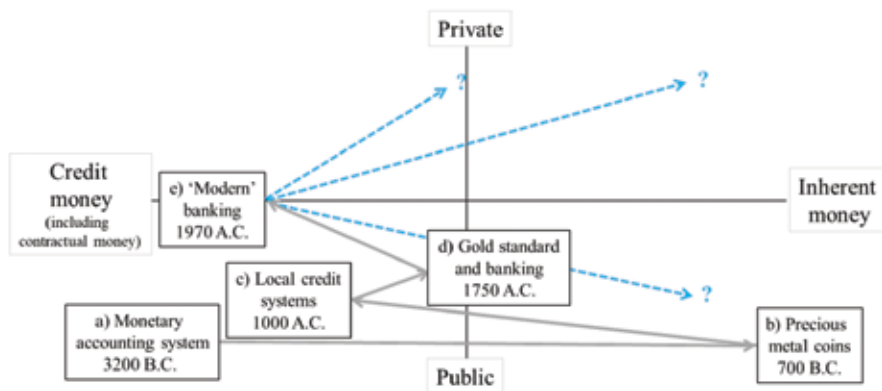
chapter 2 explained that different monetary systems with different characteristics exist. The characteristic *legal-economic basis* of the taxonomy developed in chapter 2 can be used to understand the differences and added values of the two theories. Theories focussing on the market and the function as a medium of exchange predominantly aim to explain the emergence and functioning of monetary systems based on inherent money. Theories focussing on the government and the function as unit of account predominantly aim to explain the emergence and functioning of monetary systems based on contractual money. The two theories will likely continue to disagree on the emergence of inherent money because of a lack of empirical evidence. There is, however, consensus that several central issuers brought inherent money successfully into circulation in the past (discussed in more detail in chapter 4). Economic agents could use this inherent money on a decentral level to settle (peer-to-peer) transactions. A key feature of systems based on inherent money is that the central issuer is not directly involved in the financial system and (financial) risk management. For example, the issuer cannot use its balance sheet to purchase financial assets and as a consequence does not have to assess financial risks. It supplies inherent money (money at the top of the hierarchy) to support the economy and to fulfil monetary functions for economic agents. In the case of a public issuer, taxes could be levied in this form of money.

In credit money systems, economic agents use a liability of a (central) trusted third party to settle transactions. These monetary accounting systems are centrally governed, and the central issuer is also involved in non-monetary activities. For example, in Mesopotamia, the priest class calculated the prices of commodities, costs of services, debts, quotas and penalties centrally. Today, in a similar way, central banks are involved in the financial system via risk management, quantitative easing and setting the base interest rate. An example is the expanding balance sheets of central banks. For example, the assets on the balance sheet of the ECB had a value of €8.2 trillion in August 2021, almost 70 percent of the GDP of the Eurozone. The Bank of England had assets of nearly £1 trillion in August 2021, almost 50 percent of the GDP of the UK. This ratio was 10 times higher than in 2006, and more than double the historical peak (Hauser 2021). The central authority is today thus significantly and directly involved in the financial system. Money is in credit money systems backed up by the public authority and depends on their assessment and management of (financial) risks. In the current system, there is a risk that legislators increasingly rely on the monetary authority, in the words of Tucker:

Elected politicians should not be able, in effect, to delegate fiscal policy to the central bank simply because they cannot agree or act themselves. Absent that stricture, we would all too likely find ourselves in an equilibrium where elected representatives leave the heavy lifting to the central bank. Arguably that has happened on both sides of the Atlantic. . . . The more central banks can do, the less the elected fiscal authority will be incentivized to do, creating a tension with our deepest political values (Tucker 2019b: 436, see also Menand 2022: 138)

Figure 3-1 summarizes the main steps in the historical development of money. This summary is based on Ingham (2004), Graeber (2011), Meier (2017), and especially Kumhof (Bank of England 2015) and the taxonomy developed in chapter 2. Based on this taxonomy, Kumhof’s ‘credit-based money’ and ‘token-based money’ on the horizontal axis are replaced by ‘credit money (including contractual money)’ and ‘inherent money’; and ‘sovereign power’ and ‘private arrangements’ on the vertical axis were replaced by ‘private’ and ‘public’. The history of money starts in the left-bottom corner of Figure 3-1 with the central monetary accounting systems (credit money systems) in the pre-Greek civilizations and ends with the ‘modern’ bank-based monetary and financial system (a contractual money system). The dotted lines visualize some possible future scenarios.

Figure 3-1: A brief history of money (Bank of England 2015 elaborated).



This chapter discussed the first central monetary accounting systems (a) and the first coins of precious metals (b). The development of banking (d and e) is the topic of chapter 4. The future is the topic of part II.

3.5 Conclusion

Theories focussing on the market and the function as a medium of exchange predominantly aim to explain and understand the emergence and functioning of monetary systems based on inherent money. Theories focussing on the state and the function as unit of account aim to explain and understand the emergence and functioning of monetary systems based on contractual money. A key design feature of systems based on inherent money is that the central issuer is not involved in the financial system and the wider economy. It supplies inherent money to support the economy. In credit and contractual money systems, in contrast, economic agents use a liability of a (central) trusted third party to settle transactions. These monetary accounting systems are centrally governed, and the central issuer is also involved in non-monetary activities. Money is in those systems backed up by the public authority and depends on their assessment and management of (financial) risks.



4

Design features of fractional
reserve banking, full reserve
banking and free banking

4. Design features of fractional reserve banking, full reserve banking and free banking

4.1 Introduction

In this chapter, research question c) *What are the main design features of the current monetary and financial system (fractional reserve banking) and two proposed alternative systems (full reserve banking and free banking)?* is examined. Understanding how the current design of the monetary and financial system developed over time and why the main alternative designs were proposed is required for the development of requirements and guidelines in part II of this thesis.

This chapter begins with examining the developments of coinage and some pre-developments of banking in section 4.2. Section 4.3 examines the development of fractional reserve banking and the implementation of two public protection mechanisms – central bank as lender of last resort and deposit insurance schemes – that significantly altered the relationship between banks on the one hand, and governments and society on the other hand, and contributed to strengthening the current path. Section 4.4 explains two proposals to change path – full reserve banking and free banking and derives design lessons from these proposals. Finally, section 4.5 draws some conclusions.

4.2 Pre-banking developments

Scholars agree that coins matured in the city-states of Greece and that two links have been important for the rapid growth of coins: a) the link between the state and the market, and; b) the link between the monetary and fiscal system (Graeber 2011; Dodd 2014). The formalization of coins enabled holders of sovereign power as (secular) kings and emperors to create money and to spend this money in circulation. A king, for example, paid soldiers with newly issued coins (inherent money). The soldiers subsequently bought goods and services. Thereafter, a king taxed merchants and other citizens and recirculated the collected coins. This monetary-military-fiscal construction contributed to the emergence of city-states and later to large scale empires as the Roman empire (Graeber 2011).

Contrary to Mesopotamia's theocracies, in Ancient Greece and Rome the amount of material silver and gold became important because these precious metals were the raw material for coinage. The amount of money became thus dependent on the supply of precious metals. New ore discoveries and mining were required to increase the amount of inherent money. In addition, pillage and debasement could be used to increase the quantity of money (Smith 1776: 34).

Sovereign rulers used the technology of coining to gain power. By impressing their face or another symbol and a value expressed in a unit of account on coins, the nominal value of the coins became higher than the precious metal's intrinsic value. These coins had thus a fiduciary character. Precious metal coins are inherent money with an intrinsic value and a nominal value (based on *nomos*). The intrinsic value is the value of the precious metals on the market. The nominal value is the value stamped on a coin.

The exact reason for the choice of precious metals is unknown. Likely reasons are the relative scarcity of these metals (not too little, not too much), the difficulty to counterfeit and intrinsic value (Desan 2016: 26; Zarlenga 2002). Intrinsic value, although likely limited from the beginning (in contrast to what among others Menger and Smith assume, see chapter 3), was important especially in circumstances of political instability as in war times and in the case of a weak connection between sovereign rulers and economic agents as in international trade. In these circumstances, intrinsic value contributed to the generation of trust. When a sovereign issuer of coins ceased to exist for whatever reason, the material of the inherent money still had some value. Aristotle might have meant that the nominal value of coins was valid in the region where the sovereign ruled. In this sense, money exists by law (*nomos*). In international transactions, the intrinsic value of coins, in contrast, played a (more) significant role.

In contrast to the central monetary accounting systems in Mesopotamia, monetary systems based on coinage had thus transferable inherent money – more accurately, universally accessible sovereign legitimate material inherent money. This enabled decentralized payments and decentralized market exchanges. Coins were widely used to settle transactions, that is, coins entered the process of exchange. The issuer spent the coins into circulation and was not liable afterwards. There was no promise to redeem. The holder of a coin possessed an asset of which the nominal value and intrinsic value were generally not the same. The nominal value offered inherent settlement power. In case of a crisis, the material could be sold on the market. Economic agents could use inherent money to settle transactions peer-to-peer and to settle private debts and tax obligations. Because of the material form, payer and payee had to be in the same place. The sovereign legitimate issuer controlled the amount of money but was dependent on the amount of precious metals available. A disadvantage of this system was that the amount of money was limited and therefore could not easily support economic development. New precious metals were needed to create new money for new investments in capital goods.

After the collapse of the Roman Empire, the use of coinage broke down in most places in Europe (Desan 2014, 2016). In the centuries thereafter “groups acting through stakeholders” – and thus not per definition states – invented money again in many places (Desan 2016: 29). In the Middle Ages in Europe, (local) credit systems (credit money) in the form of tally sticks, trade credit and consumption sticks dominated (Desan 2014, 2016; Graeber 2011). Coins (inherent money) were thus rarely used for a long period. Only at the end of the Middle Ages, silver and gold coins were gradually reintroduced in several places in Europe. These coins and forms of credit money formed the basis for (the invention of) fractional reserve banking in the meaning of ‘the creation of contractual money (credit money offering contractual liquidity) out of loans’. Two general purpose technologies were introduced that would significantly influence the development of the design of the monetary system. Johannes Gutenberg invented the printing press and Luca Pacioli formalized double entry bookkeeping. In the next centuries, paper banknotes (material private contractual money) and bank deposits in the bookkeeping of banks (non-material private contractual money) would gradually substitute coins made of precious metals (material inherent money) and local credit systems (credit money that does not offer contractual liquidity). In this process, monetary power would gradually shift from sovereign legitimate rulers to commercial and central bankers.

Two other developments prepared fractional reserve banking. First, money changers started to take deposits of various currencies and allowed account holders to settle transactions using bank deposits. Economic agents deposited coins for security reasons. These local payment banks enabled payment without the transfer and (risky) transport of coins (De Roover 1974: 213; Kashyap *et al.* 2002: 37-8; Meier 2017: 40). Later these payments banks would start to offer overdraft facilities. The Bank of Amsterdam (*Amsterdamsche Wisselbank* in Dutch) established in 1609 is an example of a public variant of a payments bank that contributed to security and standardization of payments. A second relevant development was that European merchant bankers established networks to facilitate international (long-distance) trade and payment. They introduced different forms of credit as mercantile bills, bills of exchange (originally called letter obligatory, Kohn 1999) and bills obligatory (or bills of debt, Stolte 2017). Also, these forms of credit improved security.²⁹ In these trade networks,

29 Schjacht (1967: 34) explains why those instruments were needed: “In the Middle Ages the transport of effective moneys was extremely difficult, not only for technical reasons, but also on grounds of security. For this reason a system of surety by letter of credit came into being. A banker in one town gave a client who needed money in another town a letter to a banker in that town who, when the letter was presented, gave the client the required money and charged it to the letter-writer's account. ... Such a money and credit arrangement was possible only if the two bankers could trust each other. Thus from the very beginning of the modern banking system a close network of relationships and friendships between many private firms was essential” (Schjacht 1967: 34).

risks were managed by private merchant bankers and coins (inherent money) were only periodically used to settle imbalances. Meier (2017: 46, italics original) considers this monetary accounting system as a “*form of decentralised, supranational double-entry book-keeping, managed primarily by merchants on the basis of confidence and trust.*” However, final settlement took place in sovereign legitimate material inherent money. The mechanisms in these merchant networks used for coordination and the generation of confidence and trust are very similar to the mechanisms that would later be developed and used in interbank banking. A difference is that merchant networks were private, and today’s central banks are generally public institutions.

4.3 Fractional reserve banking

This section first describes the ‘invention’ and historical development of fractional reserve banking (section 4.3.1). The two sections thereafter examine the introduction of the two public protection mechanisms in the current fractional reserve system that significantly changed the relationship between banks on the one hand, and the government and society on the other hand: the establishment of the lender-of-last-resort function (section 4.3.2) and the implementation of deposit insurance schemes (section 4.3.3). Both protection mechanisms play a determining role in the analysis of the cause and the social consequences of systemic financial crises (chapter 6). Section 4.3.4 reflects on these developments.

4.3.1 Historical development

Several scholars argue that banknotes (paper money, cash) have their origin in the receipts for deposited gold (and silver) (coins) in the seventeenth century in London (King 2016: 69; Turner 2012b; Ryan-Collins *et al.* 2011) but Kindleberger (1984: 35) argues that “banking developed much earlier and was connected especially with foreign trade”. Kindleberger traces the roots of banking back to Italy in the late fourteenth century and shows that before receipts various forms of credit money were created by merchants, notaries, industrialists and tax farmers. There is thus not one path but “many paths to banking” (*Ibid.*). This research emphasizes that the key shift is from credit money to contractual money, that is, to credit money offering unconditional contractual liquidity. This specific form of money brought new opportunities but also caused systemic financial crises and the need for public safety nets. Also, according to Kindleberger (1984: 283), “it is virtually impossible . . . to compare financial crises before and after about 1700.” Before 1700, “apart from bills of exchange [credit money], money was metallic [inherent money] and hence inelastic, with no bank notes [no contractual money] or any bank lending” (*Ibid.*). The evolution of money moved, in the words of Kindleberger (1984: 73), “from coins alone to coins and bank

notes, to coins, bank notes and bank deposits, and the evolution of banks from deposit banks that merely validate receipts of coin in a one-for-one basis to lending banks which actually create deposits or money.”

This explanation focusses on the path of receipts for deposited gold because in this path the role of contractual liquidity is most pivotal. When gold was deposited at a goldsmith to store it safely, the goldsmith issued a deposit receipt (also referred to as promissory note; contractual money in the terms of the taxonomy developed in chapter 2) with the promise to return the gold on demand to the depositor. The depositor wanted security and paid the goldsmith a fee for safekeeping. A difference between bills of exchange and bills obligatory on the one hand, and deposit receipts issued by goldsmiths on the other hand, is that the latter had no specific date of maturity. Bank deposits still have this feature. Practical experience taught goldsmiths that a part of the deposited coins could be used to make loans. In practice, it rarely happened that all depositors (creditors) came at the same moment to withdraw their deposits (to request their coins). By lending coins these goldsmith safe keepers gradually turned into goldsmith bankers. Goldsmith bankers earned interest on loans, and this enabled them to pay interest on deposits which made depositing more attractive.

In the mid-seventeenth century, the goldsmith bankers started to issue deposit receipts to bearer instead of in the name of the depositor – meaning that the goldsmith promised to pay back the deposited amount to the person who handed the receipt back in (Byttemier 2015: 4; Norman *et al.* 2011: 3). According to Norman *et al.* (2011: 2), “in the early stages of the development of banking, there were strong pressures on banks to accept claims on each other.” On the one hand, account holders asked banks to reduce transaction costs further. Deposits to bearer could significantly reduce transaction costs because fewer coins had to be transported. On the other hand, individual banks could gain more power and/ or make more profit when they started to collaborate with other banks because of network effects. The larger the network of banks, the higher the value for account holders. Banks belonging to the dominant network, had a larger chance to survive and make profits.

The introduction of deposit receipts to bearer changed the monetary system. These privately issued receipts (contractual money) started to function as money within the merchant community in London³⁰ because the receipts were a more convenient,

30 The relatively small, enclosed and highly interconnected community of the City of London goldsmith-bankers appears to have played a key role in the successful development of banknotes and bank deposits as money equivalents (Stolte 2017: 97). Banknotes circulated within the merchant community and the members knew the credibility of the small number of goldsmiths; 32 in 1670, 44 in 1677 and 42 in 1700 (Quinn 1997: 411); a small number compared to the

safe, and efficient way to pay and to transport. Economic agents accepted the receipts because they expected others to accept the receipts as well and because they offered contractual liquidity. Receipts could be exchanged on demand into golden coins (inherent money) that were in the vaults of the goldsmith bankers. The construct of contractual liquidity generated trust and turned credit money into contractual money.

Later goldsmith bankers started to provide loans by issuing new promissory notes (contractual money). Instead of using deposited coins, they gave new notes to borrowers.³¹ From the beginning, this form of money creation grew rapidly because “issuing banknotes [contractual money] was a lucrative business, as the banks were issuing non-interest bearing liabilities [contractual money], which were used to fund interest-earning assets [loans]” (Norman *et al.* 2011: 3). Moreover, money changers and payments banks started to allow depositors to overdraw their accounts (Kashyap *et al.* 2002: 38). Also, in this case, immaterial private contractual money (credit money offering contractual liquidity) is created.

The creation of liquidity out of illiquid loans transformed the goldsmith bankers, money changers and payments banks into commercial bankers. King (2016) calls this money creation process “financial alchemy” and McMillan (2014: 35) argues that “by transforming credit into money, bankers appear to have found the philosopher’s stone.” King (2016: 8) defines alchemy as “the belief that all paper money [contractual money] can be turned into an intrinsically valuable commodity, such as gold, on demand and that money [inherent money] kept in banks can be taken out whenever depositors ask for it.” The construct that banks started to offer relevant for this research is *unconditional contractual liquidity*.

The invention or business innovation of the creation of contractual money (credit money offering contractual liquidity) out of loans is a significant moment because it decoupled the quantity of money to a larger extent from the amount of precious metals. An advantage of this decoupling is that it facilitated (capitalist) economic development and the industrial revolution. In contrast to past kings and rulers, the first bankers were like today’s commercial bankers in business to make profits. To provide profitable loans and overdrafts, they had to assess the creditworthiness of (potential) borrowers (and their business plans) and depositors. This placed time,

foreign exchange market of for instance Amsterdam in that period. According to Quinn, “Through mutual acceptance, bilateral clearing, and apprenticeship the goldsmith-bankers of London created a system of banking . . . within which England’s great advances in state finance could flourish” (1997: 427).

31 Per Withers (1914: 24): “Some ingenious goldsmith conceived the epoch-making notion of giving notes, not only to those who had deposited metal, but to those who came to borrow it, and so founded modern banking.”

risk, and uncertainty at the core of economic practice (long) before these topics were discussed in economic theory. By creating contractual money, banks amplified the quantity of money and created systemic risk.

Thereafter, the goldsmith bankers established an interbank settlement system – a system quite similar to the interbank settlement system used for bills of exchange. This improved their ability to accept each other's notes. The processes of interbank 'clearing' (calculation of amounts and monitoring if funds are available) and 'settlement' (transferring assets/ funds to extinguish obligations) were costly. Many small innovations increased the efficiency of clearing and settlement gradually. Examples are more advanced systems for settling obligations and more convenient assets to settle residual claims (Norman *et al.* 2011: 5). Centralization was the direction of these innovations and finally, these processes became institutionalized in central banks. Today, in all monetary systems across the world, "interbank settlement ultimately occurs in state-backed central bank money" (*Ibid.*); that is, public contractual money in the terminology of chapter 2. Central banks gradually became public institutions and as a consequence risk management became increasingly also a public task.

4.3.2 The central bank as lender-of-last-resort

This section explains the introduction of a first public protection mechanism – the central bank of lender of last resort (LOLR) – that significantly altered the relationship between banks on the one hand, and the government and society on the other hand. The explanation focuses on the Bank of England because the Bank of England is generally considered to be the first 'real' central bank and functioned in the 18th and 19th century as an example for many other central banks (Bordo and Siklos 2017). The history of the Bank of England starts in 1694 when the Bank was founded as a private bank to provide a loan of £1.2 million at 8 per cent interest to the government for the war of a king. It was agreed that the Bank of England would become the sole bank for the government and was allowed to bring banknotes worth £1.2 million into circulation. These banknotes became semi-public money because the government promised to accept them for tax payments. In the literature, several scholars emphasize the importance of this institutional arrangement and relate it to power (Kindleberger 1984: 53; Davies 2002: 255-263; Ingham 2004: 128; Desan 2014: 14; Mellor 2016: 199; Di Muzzio and Robbins 2017). For example, Di Muzzio and Robbins (2017: iix, 1) state that "the monetary system we use emerged from the needs of a 17th-century English king" and was "devised by elites in England to finance William III of England's war with France." The Bank of England was during the first 150 years after its foundation a

large bank and the only joint-stock bank allowed. It kept this position until the second quarter of the 19th century (Capie 2002: 3). In the beginning, the Bank of England (and many other central banks) was thus a quasi-commercial institution that grew out of the market and got note issuing rights of governments to finance its wars (Hauser 2021).

In the 18th and 19th century systemic financial crises were recurrent events (Kindleberger 1984; Capie 2002; Kindleberger and Aliber 2005; Bordo and Siklos 2017). Banks attempted to increase their profits by issuing more deposits and/ or banknotes (contractual money, non-interest bearing liabilities) to fund loans (interest-earning assets). Sometimes bank runs occurred. Diamond and Dybvig (1983: 401) define a bank run as the moment when “depositors rush to withdraw their deposits because they expect the bank to fail.” In other words, they rush to exchange contractual money into inherent money. To prevent systemic financial crises, the Bank Charter Act – sometimes also referred to as the Peel Act – was enacted in 1844. The Bank of England was split into an issuing department and a banking department. This act made the Bank of England the sole issuer of new banknotes but did not ban the creation of contractual money. Commercial banks were still allowed to create bank deposits (non-material contractual money) out of bank loans and bank runs were thus still possible.³²

In the decades after the establishment of the monopoly on the issuance of banknotes, the Bank of England and later also other central banks developed their function of LOLR in a process of trial and error. Capie (2002: 22) describes “the evolution of the Bank of England as a lender of last resort” as “a long slow learning process.” Merhling (2012b: 13) notes that central banking, historically, “can be said to have begun with the narrow objective of stemming crises, and so with an emphasis on lender of last resort intervention.” From the beginning, conflicts of interest were a key problem of the Bank of England (Norman 2011: 24). On the one hand, the Bank of England got the tasks to be and gradually became the bank of commercial banks. On the other hand, the Bank of England had to protect the stability of the monetary and financial system in the general interest. In the case of problems at an individual bank, the question from the beginning has been if the central bank gives liquidity support to protect the whole system or to rescue an individual bank.

The ideas of Thornton (1802) and Bagehot (1873) are generally considered important in defining the function of LOLR (Goodhart 1999; Capie 2002; King 2016: 188-9). Bagehot (1873: 196-7) suggested that the function of LOLR means that in the case of

32 In the U.S, the National Currency Act of 1863 and the National Banking Act of 1864 nationalized the issuing of banknotes (Lainà 2015: 3).

a crisis a central bank should: a) lend cash freely; b) against a high interest rate, and; c) in exchange for ‘good’ securities. Assessing ‘good’ collateral is risk management that is thus an essential part of the function of LOLR. When confronted with a crisis, the central bank as LOLR should, according to Thornton (1802) and Bagehot (1873), thus provide immediately sufficient liquidity to maintain trust in the monetary and financial system. The function of LOLR is thus in theory not bailing out individual banks but providing central bank reserves that can be used for interbank payments and for purchasing cash (inherent money) to stabilize the system.

The trial-and-error process of the Bank of England ended in the 1870s when the Bank officially started to fulfil the LOLR function as formulated by Thornton and Bagehot. In the following decades, almost all countries established central banks that took the role of LOLR. This fundamentally changed the design of the monetary and financial system. Banks became the creators of the quantity of money, inherent money was no longer actively managed, and the level playing field for financial intermediation – including maturity transformation, that is, the funding of long-term loans (as mortgages) with short-term debt (contractual money) – became unequal because access to LOLR became consciously limited. Banks had access and other financial intermediaries not. Moreover, the more public central banks became, the more risk management was made public. The effects of LOLR are mixed. On the one hand, it could be argued that the function of LOLR creates stability. On the other hand, it could be argued that LOLR entangles public and private affairs and creates moral hazards. In the words of Kindleberger:

Existence of a lender of last resort creates much the same sort of moral hazard that exists in insurance: if the insured knows he is going to be made whole after a loss due to fire or an accident, he is likely to be less careful and thereby increase the chances of fire or accident. Moral hazard is not so strong in banking, for the lender of last resort has no contract to bail out bad banking. Over time, however, experience builds expectations which have nearly the force of contract. (Kindleberger 1984: 280)

As a consequence of backstopping crises with the LOLR-function, central banks became logically also interested in warding off crises before they came, that is, not only managing “the hierarchy of money and credit” (explained in section 2.6) “but also the broader underlying economy” (Mehrling 2012: 13). A (fundamental) question is why the monetary authority should be involved in financial risk management. For example, in case of a panic, central banks must distinguish between illiquidity and insolvency. When a bank with a problem asks for liquidity support, the central bank

must assess if illiquidity or insolvency is the cause. In theory, this is relatively easy, in practice it is difficult because insolvency is a probability rather than a fact (Goodhart 1999). In addition, there is no objective standard of what ‘good’ or ‘eligible’ collateral is (van ‘t Klooster 2021, Kindleberger 1984: 280). Last decade the requirements for ‘eligible’ collateral have been eased several times (Boonstra 2018: 209; de Vries 2020: 374). Banks thus know that it is very likely they get support in case of problems and that standards are eased in times of crisis – that is, rules are time-inconsistent. A consequence is that banks will likely behave less prudently and, for example, extend maturity transformation to make more profit. Regulators understand this and aim to minimize moral hazards via regulations. The problem is that each new regulation causes new moral hazards and thus indirectly the need for more regulation. These dynamics will be examined in detail in chapter 6.

During the last decades, the function of LOLR developed further on the same path. During the financial crisis of 2007-9, the function of LOLR was extended to shadow banks – central banks became market makers of last resort (MMLR) (Buiter 2018) – and the Federal Reserve System (Fed) developed into a global LOLR or global MMLR. As “the reigning center” in the beginning of the 21st century, the Fed had the “responsibility to act as lender of resort to other countries in financial crisis when trouble threatens to spill over national boundaries” (Kindleberger 1984: 281). In the past, other reigning centres as the Netherlands and UK did the same. The institutional arrangements ‘forced’ the Fed to provide liquidity to American commercial banks as well as to non-American commercial banks and shadow banks. Moreover, the Fed implemented liquidity swap lines to some other large central banks, dollars were swept against euro’s (Tooze 2018: 212-3). This enabled other major central banks to provide access to short-term dollar funding to large commercial banks in their home country. For example, the ECB could inject trillions of dollars into the European banking system. Criticisms are that the Fed and not democratically elected parliaments decided which countries/ governments received support (De Vries 2020: 390) and, more generally, that the Fed mainly considers domestic factors in its policy decisions (Prasad 2021: 278, 291). Without any parliamentary decision, the function of LOLR developed thus further (see also Menand 2022).

In short, the function of LOLR is a public protection mechanism for privately created contractual money and maturity transformation. On the one hand, LOLR contributes to stability. On the other hand, LOLR entangles public and private affairs and responsibilities, creates moral hazards, and introduces the need for regulation. From a systemic perspective, LOLR substitutes market discipline and risk management by private economic agents by regulatory supervision and risk management by public authorities. Ultimately, they decide what ‘good’ collateral is.

4.3.3 Deposit insurance schemes

This section examines the introduction of the second public protection mechanism that significantly altered the relationship between banks on the one hand, and the government and society on the other hand: the implementation of deposit insurance schemes (DIS). The continuous expansion of DIS is another example of path dependency and shows that once a public protection mechanism is implemented, “there is no easy way back” (Boot 2021: 315).

In the 20th century, the Federal Reserve System took over the role as the leading central bank in the world from the Bank of England and became the example of other central banks (Bordo and Siklos 2017). The Federal Reserve Act was signed in 1913. After the Wall Street stock market crash on October 29, 1929, and a systemic financial crisis in the autumn of 1930, the Great Depression began in the U.S. Two of the main problems of the monetary and financial system in the 1930s were a failing payment and unwillingness of commercial banks to extend credit (Phillips 1995: 43). On a large scale, economic agents exchanged bank deposits (contractual money) into gold (inherent money). A bank run that almost caused the collapse of the American monetary and financial system. Because of the severity of the crisis, the design of the system and its regulation was discussed extensively in the 1930s. Several new forms of regulations and reforms were proposed to restore trust in the banking system. Finally, three acts, the Banking Act of 1933, the Securities Act of 1933 and the Gold Reserve Act of 1934, were implemented.

The Securities Act of 1933 aimed to realize transparency in financial statements and to prevent fraud and misrepresentations. The act obligated financial disclosure – its underlying aim is used and updated to the digital age in chapter 8 and 10. The Gold Reserve Act formalized executive order 6102 signed by Roosevelt on April 5, 1933. Executive order 6102 and the Gold Reserve Act prohibited the most private ownership of and trading in gold, changed the nominal value of gold and stated that the government could pay its debts with dollars instead of gold. The underlying idea was that the hoarding of gold worsened the Great Depression and should thus be forbidden. The consequence of executive order 6102 is that the U.S. internally largely left the gold standard in 1933.³³ The Banking Act of 1933 established the Federal Deposit Insurance Corporation (FDIC), reformed the governance of the Federal Reserve System, and separated retail and investment banking (known as the

³³ Internationally, Nixon ended the convertibility of the dollar into gold in 1971. After World War II, under the Bretton Woods agreements, countries had fixed their exchange rate to the dollar. Central banks of other countries could exchange dollars for gold at \$35 per ounce. The stepwise abolishment of the gold standard made the quantity of money at the end completely independent of the amount of precious metals.

Glass-Steagall Act). Retail banks were no longer allowed to be involved in securities transactions and only retail banks kept access to LOLR. The FDIC, a new government institution, initially offered deposit insurance limited to \$2,500 per account holder.

Deposit insurance schemes aim to make bank deposits safe by breaking the ‘sequential service’ by insuring all deposits to a certain amount. Deposit insurance schemes do thus not increase safety by restricting or influencing bank assets “but rather by the promise that the government would guarantee a percentage of the deposits in *all* banks, both good and bad” (Phillips 1995: 57). After its implementation, the insured amount has been increased several times. In 1935, a new Banking Act was enacted that organized deposit insurance up to \$5,000 per account holder. Since 2011, FDIC insures deposits up to \$250,000 per account holder in the U.S. In the decades after 1933, many other countries implemented deposit insurance schemes. In 2013, 112 of 189 countries (59%) had explicit deposit insurances (Demirgüç-Kunt *et al.* 2014: 11). In most of these countries, governments also increased stepwise the amount of insured deposits. For example, in Belgium from €20,000 to €100,000 and in the Netherlands from €40,000 to €100,000 in 2009.

The consequences of the implementation of deposit insurance schemes and the continuously increasing amount of insured deposits are diverse. Diamond and Dybvig (1983) emphasize the positive consequence of preventing bank runs, but do not discuss the negative consequences – they also do not discuss the negative consequences of the LOLR function. Other scholars have a more nuanced view, for example, King (2016: 62) and Ricks (2016: 162). On the one hand, DIS reduces the risk of a bank run, but, on the other hand, it turns private banks into established and protected money creators and turns private contractual money into *public* contractual money. Deposit insurance schemes are mandatory privately organized but publicly backed-up insurances of privately created contractual money. Like LOLR, DIS entangles public and private affairs and responsibilities, and creates moral hazards. The advantage that account holders no longer must take their money out before other account holders has the disadvantage that account holders (investors) no longer have the incentive to monitor their investment, that is, private risk management is no longer necessary. Contractual money is insured. Consequently, banks are inclined to take more risks; that is, to behave less prudently. Moreover, risk-taking banks prefer currency areas with higher DIS. Several scholars connect limited liability to LOLR and DIS and argue that the combination results in “a massive implicit subsidy to risk-taking banks” (King 2016: 255; see also Landau and Genais 2019: 18). To limit subsidized risk-taking regulations are implemented. Kareken and Wallace (1977: 4) explain that deposit insurance schemes make regulation

of banks necessary; that is, “regulation is not an alternative to deposit insurance, but rather a complement.” As said, a problem is that each public protection mechanism and regulation generally causes new moral hazards and thus indirectly the need for more regulation. These dynamics are analysed in detail in chapter 6.

In short, DIS aims to protect fragile contractual money. On the one hand, DIS functions well because it reduces the number and the likelihood of systemic financial crises. On the other hand, DIS causes moral hazards – unwanted subsidies and poor incentives – and introduces the need for regulation to limit those moral hazards. Also, in the case of DIS, from a systemic perspective market discipline and private risk management are substituted by a public protection mechanism.

4.3.4 Reflection

This section explained that the creation of contractual money (credit money offering contractual liquidity) out of bank loans started as a private business and gradually changed the monetary system into a monetary-financial system. As Figure 3-1 shows, credit money systems had existed on a large scale in the past. The key difference with the current bank-based system is the promise of unconditional contractual liquidity. This did not exist in Mesopotamia and in the local credit systems in the Middle Ages in Europe.

This section also explained that governments established the function of lender-of-last-resort and deposit insurance schemes to avoid systemic financial crises. These public protection mechanisms made the monetary and financial system more stable by insuring contractual money and eliminating traditional bank runs (see also Menand 2022: 101) but also caused moral hazards. Both public protections gradually extended in scope last century. The function of LOLR was extended to shadow banks, the Fed became global LOLR and the requirements for ‘good’ collateral were eased several times. Moreover, the amount of deposits insurance under DIS increased significantly in most countries last century.

Looking back, path dependency played an important role in the development of the current monetary and financial system. Path dependency means that institutions and actors are limited in their current choices by previous events and previous institutional design choices (David 1985; North 1990, 1991; Wallis 2015). When institutions and the rules they determine are established at a certain moment, they likely endure overtime. History shows that decision makers generally prefer to maintain and slightly adapt the current system (e.g., increasing DIS) because the benefits of implementing an alternative system (changing path) are uncertain. Overtime, systems increasingly

get locked in because of the institutionalization of design choices. Different factors influence path dependency: the inherent relationship between institutions and belief systems, network effects of early standards and initial setup costs, economies of scale, technical interrelatedness, learning effects and adaptive expectations (David 1985: 334; North 1991: 108; North 1990: 112).

There are at least four reasons why contractual money (credit money offering contractual liquidity) became the dominant form of money. First, the invention of contractual money made the quantity of money flexible and standardized credit money. Without the need for more precious metals, the quantity of money could be amplified. By creating contractual money out of bank loans and offering contractual liquidity, commercial banks contributed to the funding of capital goods (an advantage), but also introduced systemic risk leading to recurrent systemic financial crises (a disadvantage). Those crises will be discussed in detail in chapter 6 and 10. Second, contractual money made payments over distance easier and in this sense contractual money is superior to material cash. Third, the amount of private contractual money grew rapidly because banks are profit-oriented businesses. They have an incentive to create as much as possible contractual money as long as there are creditworthy ('profitable') borrowers. Fourth, as explained, private contractual money became dominant because banks got access to two public protection mechanisms – central banks as LOLR (central bank loans) and deposit insurance schemes – that are unavailable to issuers of other forms of (credit) money. Privately issued contractual money received public insurances and this strengthened the existing path. As a result: 1) banks gradually became the creators of the quantity of money; 2) banks gradually became responsible for the payment system; 3) inherent money gradually became an extension of contractual money and was no longer actively managed; 4) the monetary and financial system gradually became inherently entangled and became, in fact, a monetary-financial system, and; 5) market discipline and risk management by private economic agents were gradually substituted by public protection mechanisms, regulatory supervision and risk management by public authorities.

A pivotal but difficult to answer question is whether banks are the result of a historical accident or whether they are an efficient solution to a problem (Adrian and Mancini-Griffoli 2019a: 11). Ricardo observed, according to Phillips (1995: 5), that “banks serve two primary purposes: provide a means of payment (money) and provide for the capital development of the economy (credit).” In Ricardo’s view, “the uniting of these functions in banks is largely a historical accident” (*Ibid.*). Several others observed during the last years that two tasks – running the payments system and organizing

a balanced growth of money creation in a growing economy – have gradually been taken over by private banks in the last centuries (e.g., WRR 2019; de Vries 2020). This happened in their view gradually and to a large extent without any conscious decision-making, that is, without conscious design choices. Moreover, gradually risk management was moved from private economic agents to public authorities.

There are, however, also scholars with another view. For example, Kashyap *et al.* (2002: 65) suggest that banks “may be attributable to real considerations of economic efficiency, rather than simply to historical accident or the distortions inherent in policies such as deposit insurance.” In this view, it is efficient if one institution takes deposits and offers to lend on a commitment basis, and therefore banks should be considered “a special type of financial institution” (*Ibid.* 67). The examination in this section suggests that LOLR and DIS have significantly contributed to the dominant role of banks and contractual money, and that risk management has gradually been moved to public authorities. This undermines private responsibilities and allows the socialization of losses. An open question to be explored is if private economic agents can develop with the help of digital technologies and platforms alternative forms of credit money to create and allocate liquidity on demand that are more stable, better align risk and reward, and require fewer public protection mechanisms.

4.4 Proposals to change path

This section examines the two main (theoretical) alternatives for fractional reserve banking. Section 4.4.1 explains and draws design lessons from full reserve banking and section 4.4.2 explains and draws design lessons from free banking. Section 4.4.3 reflects on the opportunities digital technologies offer for full reserve banking and free banking.

4.4.1 Full reserve banking

In 1933, the year that the first Banking Act was enacted, another reform memorandum titled *The Chicago Plan for Banking Reform* was submitted to congress (Knight *et al.* 1933 in Phillips 1995: 191-9). The memorandum was written by eight Chicago-based economists; among them Frank Knight and Henry Simons. This banking reform proposal became later known as full reserve banking and 100% money as Irving Fisher, later a leading advocate called it. *The Chicago Plan* is relevant for this research into the design of the monetary and financial system because it is the alternative design that received the most attention last century.³⁴

³⁴ The roots of full reserve banking (inspired) proposals can be traced back to Ricardo (1823), von Mises (1912) and Soddy (1926) and thus to The Chicago Plan of leading U.S. economists in the 1930s (Knight *et al.* 1933; Simons *et*

The memorandum on banking reform submitted in 1933 consisted of 12 proposals focussing on “emergency relief” as well as “permanent banking reform”, that is, changing path (Knight *et al.* 1933 in Phillips 1995: 191). Fisher (1935, 1936) claimed three benefits of full reserve banking: 1) better control of business cycles; 2) a complete elimination of bank runs; 3) a significant reduction of public and private debt (see also Benes and Kumhof 2012). The first memorandum argued that stability could be reached via “a complete separation, between different classes of corporations, of the Deposit and Lending functions of existing commercial banks” (*Ibid.*: 195); that is, in other words, a separation of the monetary system and the financial system. In such a system, public authorities are only responsible for the monetary system and are no longer involved in risk management (in the financial system).

In November 1933 a second memorandum on long-term monetary reform was published (Simons *et al.* 1933). Simons *et al.* (1933: 2) proposed the “outright abolition of deposit banking on the fractional-reserve principle.” In *The Chicago Plan*, commercial banks would be separated into deposit banks and investment banks. Deposit banks would offer fully covered deposit accounts and investment funds would have to issue securities and deposits with limited (conditional) contractual liquidity (credit money) to attract funds. In 1934 a bill was introduced to congress to realise an adequate and stable monetary system. Six reforms were suggested:

- (1) segregate demand from saving deposits [unconditional from conditional contractual liquidity];
- (2) require the banks to keep 100 per cent reserves against their demand deposits;
- (3) require them to keep 5 per cent reserves against their saving deposits;
- (4) set up a Federal Monetary Authority with full control over the supply of currency, the buying and selling of government securities, and the gold price of the dollar;
- (5) have the FMA take over enough of the bonds of the banks to provide 100 per cent reserve against their demand

al. 1933; Fisher 1935; Fisher *et al.* 1939). Other advocates were Friedman (1960), Tobin (1987), Merton and Bodie (1993), Minsky (in Phillips 1995), Miller (1995), and in the 2000s before the financial crisis Huber and Robertson (2000) and Zarlenga (2002) – see Lainà (2015) for an extensive overview. In the aftermath of the financial crises of 2007-9 many full reserve banking-inspired proposals have been published. Example are ‘full reserve banking’ (Benes and Kumhof 2012; Askari and Krichene 2016; Prescott and Wessel 2016), ‘narrow banking’ (DeGrauwe 2008; Kay 2009; Flaschel *et al.* 2010; Cochrane 2014), ‘sovereign money’ (Yamaguchi 2010, 2011, 2014; Yamaguchi and Yamaguchi 2016a, 2016b, 2017; Jackson and Dyson 2012; Daly 2013; Joób 2014; Bjerg 2014; Wolf 2014; Sigurjonsson 2015; Huber 2013a, 2017; Wortmann 2016, 2017), and ‘limited purpose banking’ (Kotlikoff 2010; Chamley *et al.* 2012a, 2012b; McMillan 2014). Several scholars summarized and analysed these modern as well as historical monetary reform proposals. For example, van Dixhoorn (2013), Dittmer (2015), Lainà (2015) and KPMG (2016) provided overviews of contemporary and historical proposals. Other scholars (e.g., Kregel 2012; Dow *et al.* 2015; Goodhart and Jensen 2015; Fontana and Sawyer 2016; Bundesbank 2017; Bacchetta 2017; and Jordan 2018) provided (fundamental) critiques. Often mentioned critiques are the re-emergence of money substitutes (or shadow bank contractual money), the impact on investments and transition risks. Dyson *et al.* (2016) and Gomez (2017) debunked some critiques.

deposits; and (6) have the FMA raise the price level to its 1926 position and keep it there by buying and selling government bonds. (Phillips 1995: 81-2)

According to Phillips (1995: 134, see also Phillips 1992; Kumhof and Jakab 2016), there were five reasons why *The Chicago Plan* was finally not implemented: political blunders of the administration, an ill-informed public, the demise of a supportive senator (senator Cuning), the widespread belief that the Banking Act of 1933 and 1935 were just steps towards more fundamental reform, and intensive lobbying from commercial bankers because they feared profit losses. Finally, because of the start of World War II, the attention shifted away from the design of the monetary and financial system. Phillips (1995: 117) concludes that *The Chicago Plan* was influential, but not considered “politically possible” in the 1930s. Most academics were “sympathetic to the plan—there were some concerns about transition, but the goals were deemed desirable”, and there was “a lot of public interest and support for the 100 per cent reserve plan” (Phillips 1995: 151-2). Although *The Chicago Plan* was not implemented, it did, according to Phillips (1992: 41), “not lose because the principles of the plan were rejected.”

The two main design features of full reserve banking are: 1) separate contractual money and the financial system, and; 2) no public protection mechanism(s) for private financial institutions. In a full reserve banking system, demand deposits will be covered for 100 per cent with cash and central bank reserves and thus be separated completely from the financial system. In addition, public protections would to a large extent no longer exist. As a consequence, risk management would be privatized, and risk and reward would be aligned. The (theoretical) results would be a stable monetary system and alignment of risk and reward in the financial system. Private economic agents are responsible for risk management and cannot socialize losses.

4.4.2 Free banking

A second proposed alternative to the current fractional reserve banking system is free banking – also referred to as currency competition. This proposal was developed by Friedrich Hayek. Hayek’s *Denationalization of Money* was first published in 1976, revised and enlarged in 1978, and republished with a new introduction in 1990 – this description uses the latter version.

Hayek (1960) defines competition as a ‘discovery process’. Several scholars note that before 1976, Hayek never applied this discovery process to the monetary system (e.g., Issing 1999; Görmez and Budd 2004: 76). In his earlier works, Hayek had emphasized in several places that the government must play a role in the monetary system. For example, Hayek (1960: 327) argues that “an effective monetary policy

can be conducted only in coordination with the financial policy of the government”. During his lifetime Hayek became disappointed with the developments of monetary institutions (the current path) and therefore, he changed his view significantly (see Issing 1999: 33-34 and Hayek 1990: 111). In his youth, Hayek experienced the Weimar hyperinflation, and in the 1970s, he was confronted with persistent inflation and high unemployment – the combination is generally referred to as stagflation. Against this background, Hayek developed his proposal to denationalize money. Hayek’s problem analysis is straight-forward. According to Hayek (1990: 23), “the source and root of all monetary evil” is “the government monopoly on the issue and control of money.” To prevent inflation and deflation that plagued the world since the 1930s and to end recurrent crisis and depressions, Hayek (1990: 130-1) proposed to abolish the government monopoly of money. In his view, economic agents only had access to “bad” money because private enterprises were not allowed to develop better currencies.³⁵

In Hayek’s proposal, central banks are abolished, and governments are no longer involved in the issuance of money and risk management. Instead, private banks issue private currencies. In line with Hayek (1990), White (1995) defines free banking as “a monetary system without a central bank, under which the issuing of currency and deposit money is left to legally unrestricted private banks.” Competition between private currencies will, according to advocates of free banking, result in the dominance of stable currencies and end business cycles and inflation. In the case that a private issuer issues too much of its currency, users can switch to other private currencies, and this will have a disciplining effect. In Hayek’s proposal, the focus lies on the function as store of value, that is, currencies predominantly compete as stores of value. The underlying driver of this process is private interest. According to Hayek (1990: 101), “the issuing banks, guided solely by their striving for gain, would thereby serve the public interest better than any institution has ever done or could do that supposedly aimed at it.” Görmez and Budd (2004: 76) add that in a system of currency competition “it will be the people with better ideas who determine development through their imitation of what works best, as opposed to a national currency where only those with power can shape evolution.”

In Hayek’s (1990: 59) proposal, issuing banks have two instruments to alter the volume of currency in circulation: 1) selling or buying their currency against other

35 A question is how accurate this problem analysis is because in the current system almost all money is created as contractual money by private banks (this will be explained in detail in chapter 5). Another analysis is that governments are (increasingly) unable to control money creation by private banks – this is for example the conclusion of WRR (2019).

currencies and securities; and 2) contracting or expanding short-term lending activities. Hayek (1990: 123) emphasizes that banks (non-issuing lending banks and other financial intermediaries) that use currencies of others “have to practise a kind of ‘100 per cent banking’ and keep a full reserve against all obligations payable on demand.” In a free banking system, there will be a distinction between what Hayek (1990: 123) calls in German “Depositenbanken” and “Spekulationsbanken”; that is, deposit banks and investment (or lending) banks – this is similar to full reserve banking. Hayek’s (1990: 123-4) expectation is that “it will soon be discovered that the business of creating money does not go along well with the control of large investment portfolios or even control of large part of industry.” Issuers should make “it clear in advance that they would not be prepared to provide notes needed to redeem parasitic issues against ‘hard cash’, i.e., by sale against some other reliable currency” (Hayek 1990: 65). This forces secondary issuers “to practise something very close to ‘100 per cent banking’” (*Ibid.*). In other words, privately issued contractual money offering unconditional contractual liquidity is not publicly insured and will as a consequence likely not maintain on a large scale in the financial system. In a free banking system, the market (investors) will force financial institutions to behave prudently and to fund themselves with securities offering market liquidity and credit money that does not offer unconditional liquidity. In 2020 money market instruments and in 2022 stablecoins collapsed because they promised unconditional contractual liquidity. The main difference between those two crises is that in the first case, central banks stepped in as LOLR and in the latter case not.

Supporters of free banking often mention Scotland from 1716 to 1844 and Canada before 1934 as examples (Ricks 2016: 95). Although these systems were relatively stable, it is questionable if they are good examples of free banking. Ricks (*Ibid.*) shows that the Scottish example is “ambiguous”, and the Canadian example is “dubious” because in both systems a certain level of government support existed. Rolnick and Weber (1985) show that problems with free banking in the U.S. between 1837 and 1863 were not the result of inherent instability. In this era, there were certain restrictions for free banks. For example, they had to deposit state bonds with the state banking authority, to pay gold or silver for notes on demand, and shareholders were liable for losses (Rolnick and Weber 1985: 4). Although free banking gained some support during the last decades, it was never supported as widely as full reserve banking. A reason might be that central stakeholders often played a pivotal role in the establishment of money and, in the last centuries, this role was played by states.

In short, in a free banking system, private issuers of currencies compete and a central bank, LOLR and DIS do not exist. Private issuers are responsible for organizing stable money and risk management. Economic agents use the currency they prefer and invest in financial institutions that predominantly fund themselves with securities offering market liquidity. The two main design features of free banking are: 1) competition between currencies to realize a disciplining effect, and; 2) no public protection mechanism(s) for private monetary and financial institutions.

4.4.3 Reflection

Proposals for full reserve banking and free banking are proposals to change path. Last century, they have not been implemented because politicians considered the benefits of alternatives too insecure and, instead, chose to adapt the current system. For this research, it is important to notice that both proposals have been developed before the digital age. Their developers did not have digital technologies available – neither conceptually nor practically. Issing (1999: 25) explicitly states that “Hayek’s analysis and comments related to a world what might be called *analogue money*” and do not relate to “the ongoing digital revolution.” Without digital technologies, the implementation of full reserve banking and free banking (changing path) would both have been rather difficult. For example, in the case of full reserve banking, processing payments centrally at deposit banks would have been time-consuming and expensive, and thus difficult to execute without digital technologies; and in the case of free banking, exchanging (switching) private currencies would have been time-consuming. Today, these difficulties can be relatively easily solved by using digital technologies. It is thus easier to change path. For example, only a mobile device and internet connection are required to transfer money and to exchange currencies and securities today. Transaction and switching costs are significantly lower. Moreover, in a digital wallet, several currencies can be stored easily.

Digital technologies and digital networks’ characteristics thus weaken obstacles for currency competition that were applicable in a purely material world. For example, today, platform-based companies or networks can relatively easily offer (free) transaction accounts and a payment system to their users. Moreover, because of lower switching costs, it has become easier to use different currencies for the different functions of money. Lower switching costs likely contribute to an unbundling of the functions of money, and especially the function as a medium of exchange and a means of payment on the one hand, and a store of value on the other hand (see also Brunnermeier *et al.* 2019: 10-11). In practice, economic agents can store value in a private currency and pay with the public currency. In addition, digital technologies

could contribute to an unbundling of the functions of banks. The opportunities for the design of the monetary and financial system offered by digital technologies and platforms will be explored further in part II.

4.5 Conclusion

This chapter examined the ‘invention’ of fractional reserve banking and the two (theoretical) alternative proposals that attempted to change path – full reserve banking and free banking. The issuance of contractual money (credit money offering contractual liquidity) out of bank loans is the main design feature of fractional reserve banking. This form of money creation made the quantity of money flexible, contractual money reduced transaction costs – especially payments over distance became more efficient – and contractual money standardized credit money. By offering contractual liquidity, banks also introduced systemic risk and excessive issuance of contractual money caused recurrent systemic crises. To minimize the risk of a crisis, two public protection mechanisms were implemented: the central banks as lender-of-last-resort and deposit insurance schemes. These public protection mechanisms strengthened the current path. On the one hand, these public protection mechanisms function well, on the other hand, they cause moral hazards and the need for regulation. It was explained that those two public protection mechanisms are essential design features of the current system and have five consequences relevant for this research: 1) banks became the creators of the quantity of money; 2) banks became responsible for the (digital) payment system; 3) credit money became standardized; 4) inherent money became an extension of contractual money and was no longer actively managed; 5) the monetary and financial system became inherently entangled – that is, the system became a monetary-financial system, and; 6) gradually market discipline and risk management by private economic agents were substituted by regulatory supervision and risk management by public authorities.

The current design of the monetary and financial system could be considered the result of path dependencies. Last century, decision makers generally chose to bailout existing issuers of contractual money (commercial banks and shadow banks), to extend existing safety nets and to implement more regulations. This path of protecting (via public protection mechanisms) and constraining (via regulations) banks by governments will be examined in more detail in chapter 6.

During the Great Depression in the 1930s, Chicago-based economists proposed changing path. *The Chicago Plan for Banking Reform* became later known as full reserve banking. The main design features of this system are separating contractual

money and the financial system and no longer publicly insuring private financial institutions. In the 1970s, Hayek proposed *The Denationalization of Money* to realize a stable monetary system. Hayek observed that competition between currencies can have a disciplining effect and contribute to stability, and proposed to stop publicly insuring private monetary and financial institutions. The design features of separating contractual money and the financial system, competition as a discipliner and no private insurances for private financial institutions are lessons that will be used in part II of this thesis. Finally, it was argued that the implementation of full reserve banking as well as free banking (changing path) is easier today due to the availability of digital technologies.



5

The functioning of the
current monetary and
financial system

5. The functioning of the current monetary and financial system

5.1 Introduction

In this chapter, research question *d) How does the current monetary and financial system function?* is examined. Research among 23,000 people in 20 countries shows that only 20 per cent of the respondents know that commercial banks create most of today's money (Motivaction International and Sustainable Finance Lab 2016). Other studies also find a widespread 'monetary illiteracy' among citizens in UK and Switzerland (Cobden 2010; Nietlisbach 2015) as well as among members of parliament (legislators) in UK (Dods 2014, 2017). Monetary illiteracy is not a new problem. Former American president Roosevelt believed, according to Phillips (1995: 4), "that the banking crisis of 1933 was in part a result of a failure of the average person to understand how our banking system works." The exact reason(s) for this widespread monetary illiteracy is (are) difficult to reveal. Within economic science, there is an ongoing debate on the cause(s). Several scholars argue that economic textbooks and central banks ambiguously deal with the question of how the current monetary and financial system functions (Werner 2012: 7; Turner 2013; Häring 2013: 2; Coe and Pettifor 2014: 2; Cliffe and Brosens 2014: 10, 2018; Wray 2015b: 6, 9; Braun 2016; Hockett and Omarova 2016; Stiglitz 2017a: 8; Di Muzio and Noble 2017: 105; Raworth 2017: 86; Focardi 2018: 17; Tucker 2019a: 7). For example, Stiglitz (2017a: 8) argues that "banks don't intermediate between 'savers' and 'investors,' as claimed in the standard textbook models"; and Focardi (2018: 126) argues that "classical textbooks on banking often give a somewhat distorted picture as they still adopt a theory of banks as intermediaries."³⁶ Several students' movements also question explanations of banking in economic textbooks (e.g., PINE Maastricht 2019; Rethinking Economics 2019).³⁷ Last years also central banks and other supervisors criticized 'conventional' explanations of money creation (McLeay *et al.* 2014a, 2014b; Jakab and Kumhof 2015, 2019; Kumhof and Jakab 2016; Bundesbank 2017).³⁸

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36 Hockett and Omarova (2016: 1144) provide an overview of treatises, textbooks, academic journals, and popular media presenting the view of banks as pure financial intermediaries.

37 In 2019, students of the University of Maastricht sent a letter to their dean and economic professors in which they presented "evidence that the textbooks currently used don't reflect the facts on how banks work" (PINE Maastricht 2019). Later that year the international students of Rethinking Economics submitted at various universities an open letter to their economics professors and teaching staff. In this letter they write:
"Economics textbooks across the world, some of them first published in the 1960s, continue to teach students a model of the monetary system in which commercial banks act as intermediaries, that only move existing money around the system, like lubricant in a machine. Many economics courses rely on the models in these textbooks, without recognising the empirical evidence that undermines them. This gives an unbalanced view of the way the monetary system functions and of the role of banks in the economy" (Rethinking Economics 2019).

38 For example, economists of the Bundesbank (2017: 7) argue that "book money is created as a result of an accounting

In the literature, three theories are often distinguished (e.g., McLeay *et al.* 2014b; Werner 2014a, 2016; Jakab and Kumhof 2015; Hockett and Omarova 2016):

1. The financial intermediation theory of banking – also referred to as “the intermediation of loanable funds (ILF) model of banking” (Jakab and Kumhof 2015) and “the Credit-Intermediation Model” (Hockett and Omarova 2016).
2. The money multiplier theory of banking – also referred to as “the deposit multiplier (DM) model of banking” (Jakab and Kumhof 2015), “the ‘money multiplier’ approach” (McLeay *et al.* 2014b: 2) and “the Credit-Multiplication Model” (Hockett and Omarova 2016).
3. The credit creation theory of banking – also referred to as “the Credit-Generation Model” (Hockett and Omarova 2016).

Moreover, shadow banking and money market instruments are generally ignored in explanations of money and banking, according to several scholars (e.g., Ricks 2016: 234; Gorton 2019: 26).

An understanding of the functioning of the current system and the three theories on banking is a precondition for the problem analysis as well as for developing requirements and guidelines (part II of this thesis). To get a proper understanding, this chapter is structured as follows. Section 5.2 explains different theories on the functioning of banks. Subsequently, section 5.3 explains with the help of balance sheets the functioning of the current monetary and financial system – including shadow banking. Section 5.4 reflects on the three banking theories. Finally, section 5.5 draws some conclusions.

5.2 Three theories of banking

The following subsections each explain one banking theory.

5.2.1 The financial intermediation theory of banking

The financial intermediation theory of banking defines banks as loanable funds institutions that transfer money from depositors to borrowers. In this view, commercial banks thus recirculate existing money. They give existing money from economic agent A to economic agent B.³⁹ According to several scholars, this theory

entry. . . this refutes a popular misconception that banks act simply as intermediaries at the time of lending – i.e., that banks can only grant credit using funds placed with them previously as deposits by other customers.” The Bank of England’s Monetary Analysis Directorate argues “money creation in practice differs from some popular misconceptions – banks do not act simply as intermediaries, lending out deposits that savers place with them, and nor do they ‘multiply up’ central bank money to create new loans and deposits” (McLeay *et al.* 2014b: 1).

39 A contemporary example of the financial intermediary theory of banking is Greenbaum *et al.* (2016) who state: “With depository financial intermediaries – the traditional banking sector – savers deposit money in banks which is then

currently dominates in economic science (Werner 2014a; Jakab and Kumhof 2015, 2019; Hockett and Omarova 2016). For example, Werner (2014a: 10) states that “it is impossible to draw up a conclusive list, since the vast majority of articles published in leading economics and finance journals in the last thirty to forty years is based on the financial intermediation theory as premise” (2014a: 10).

5.2.2 The money multiplier theory of banking

The money multiplier theory of banking argues that each commercial bank is a financial intermediary that does not and cannot create money, but collectively commercial banks end up creating money through systemic interaction. In this theory, commercial banks only multiply the money (cash) created by central banks. For example, the central bank creates cash and economic agent A receives the cash – it is generally not explained how this happens in practice. Economic agent A subsequently deposits the cash in a commercial bank. The bank adds a percentage to its reserves and lends the remaining cash to a creditworthy borrower, economic agent B. The economic agent B deposits the cash in a commercial bank, the bank adds a percentage to its reserves and lends the remaining amount to a creditworthy borrower. In theory, this process continues till all cash is added to the reserves. Contemporary examples of the money multiplier theory are Hill (2018) and Blakeley (2019). Hill (2018) writes:

An individual deposits \$1000 in a bank. . . . Assume the reserve ratio is set at 10%. Then in our example, the bank must keep \$100 in reserves on deposit at the Fed. The bank can then lend out the \$900 remaining from the original deposit, e.g., to a swimming pool maintenance company. The swimming pool company uses the funds to buy \$900 worth of chemicals and other supplies. The supply distributor takes the \$900 and deposits it in its bank account. The original depositor still has \$1000 in demand deposits and the supply distributor now has \$900, so there is \$1900 in money in the economy. Of the \$900 from the supply distributor’s deposit, the bank now has another \$810 (10% of the \$900 goes to reserves) to loan out to the next borrower. Thus, lending activity *multiplies* and the growth of the money supply continues. As the process goes on in successive rounds, the bank is able to loan out 90% of each earlier loan. The total amount that can be loaned can be shown to be $1/r$ times the original deposit, where r is the reserve ratio. In our example, the reserve ratio is 10% or 0.10. So, $1/r$ is equal to 10, and the amount of money (savings and checking account balances) created will be 10 times the original deposit or \$10,000. (Hill 139-140, italics added).

channelled to investors through bank loans” (Greenbaum *et al.* 2016: 312); “. . . people deposit money in banks, which in turn lend this money to people like you and me” (Greenbaum *et al.* 2016: 24); “Banking used to be a simple business. A bank borrowed money and loaned to others at a spread over cost” (Greenbaum *et al.* 2016: 249). Students of the University of Maastricht give several other examples: <https://pinemaastricht.wordpress.com/pine-open-letter/>

5.2.3 The credit creation theory of banking

The credit creation theory of banking assumes that each commercial bank can create money (contractual money in the taxonomy developed in chapter 2). According to this theory, each new bank loan leads to new bank deposits. This theory can be traced back to Macleod, who stated: “the business of banking is not to lend money but to create Credit; and by means of the Clearing Houses these Credits are now transferred from one bank to another, just as easily as Credit is transferred from one account to another in the same bank by means of a cheque” (Macleod 1906: 311, originally published in 1856, in Werner 2016: 356). Wicksell (1898), Schumpeter (1934), Keynes (1924), Fisher (1935), and Minsky (1992a) belong to this group. Minsky explicitly stated that “the financial instability hypothesis also draws upon the credit view of money and finance by Joseph Schumpeter” (1992a: 2). Schumpeter (1934: 74) stated that the banker “is not so much primarily a middleman in the commodity of ‘purchasing power’ as producer of this commodity.”

The credit theory of banking thus argues that banks can create new money. Macleod emphasizes that it is “a fundamental error to divide banks into ‘Banks of Deposit’ and ‘Banks of Issue.’ All banks are ‘Banks of Issue’” (MacLeod 1883: 330-331 in Ricks 2016: 75). Ricks (2016) is a contemporary example of the credit creation theory of banking. Ricks (2016: 52) stresses that banking is “not a synonym for financial intermediation” but, instead, banking is “the business of issuing large quantities of money-claims—short-term debt instruments, excluding trade credit—to fund portfolios of nonmonetary (or at least less monetary) financial assets.”

5.3 The functioning of the current monetary and financial system

The explanation of the functioning of the current monetary and financial system is based on the explanations of economists with practical banking experience (Pozsar *et al.* 2010, 2013; Sheard 2013; Cliffe and Brosens 2014, 2018; McMillan 2014; McLeay *et al.* 2014a, 2014b; Lipton 2015; King 2016; Boonstra 2018; Boonstra and van Goor 2021). To understand the functioning of the current monetary and financial system and three conflicting theories of banking, balance sheets are essential. A reason for ambiguous explanations might be that balance sheets are sometimes not used in analyses of the monetary and financial system. Non-economists but also some economic schools are not used taking a balance sheet perspective. Balance sheets are an objective way to study the current banking-based monetary and financial system and to understand the three (conflicting) theories on banking, because banking is based on balance sheets, and bankers use balance sheets themselves.

5.3.1 Balance sheets

Because the results of this thesis are also communicated to policy-oriented practitioners and the public, this section first explains the basics of balance sheets.

A standard balance sheet consists of three parts – see Figure 5-1:

- a. Assets: everything a firm owns (possessions).
- b. Liabilities: everything a firm owes (obligations).
- c. Equity: net assets belonging to the owners (value of the assets minus value of liabilities).

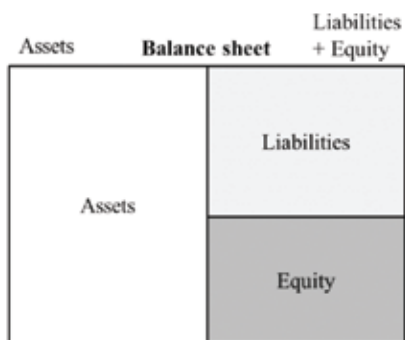


Figure 5-1: Standard balance sheet

A simplified (standard) commercial bank balance sheet consists of nine elements – see Figure 5-2:

- a. Assets
 1. Central bank reserves (public digital contractual money)
 2. Cash (banknotes, public material inherent money)
 3. Bonds (especially government bonds)
 4. Loans to other banks (interbank loans)
 5. Loans to customers (loans to the non-bank private sector, bank loans)
- b. Liabilities
 6. Bank deposits (generally referred to as customer deposits in annual reports, private digital contractual money)
 7. Loans from other banks (interbank loans)
 8. Long-term debts (bonds, time deposits, deposits offering conditional contractual liquidity)
- c. Equity
 9. Shares

Assets	Commercial bank	Liabilities + Equity
Central bank reserves		Bank deposits
Cash		
Bonds		
Loans to banks		
Loans to customers		Loans from banks
		Long-term debts
		Shares

Figure 5-2: Simplified commercial bank balance sheet

Figure 5-2 shows that commercial banks *possess* reserves – cash (inherent money) in its vaults and ATMs and central bank reserves; together referred to as liquidity reserve – and loans to customers and are *liable* for bank deposits (contractual money, credit money offering contractual liquidity). The business model of banks is largely based on the difference between the interest on loans and deposits – the interest spread. This has been the case since the beginning of fractional reserve banking (as explained in section 4.3.1).

5.3.2 Multiple-tier system

A key characteristic of the current monetary and financial system is that it is a multiple-tier system. This means that it consists of multiple tiers of monetary circuits (see Figure 5-3, a hierarchy in terms of Merhling 2012a, 2012b, see section 2.6). In a multiple-tier system, money is by design heterogeneous – that is, different forms of money denominated in the same unit of account and trading at par exist – and not all agents (commercial banks, businesses, and private persons) have access to the same tier (ledger, level). In the current system, the first tier is based on central bank reserves, the second tier on bank deposits, and the third on bank deposits and money market instruments. All are forms of contractual money. Banks in the third tier (shadow bank C in Figure 5-3) do not hold an account at the central bank and do not have access to LOLR.

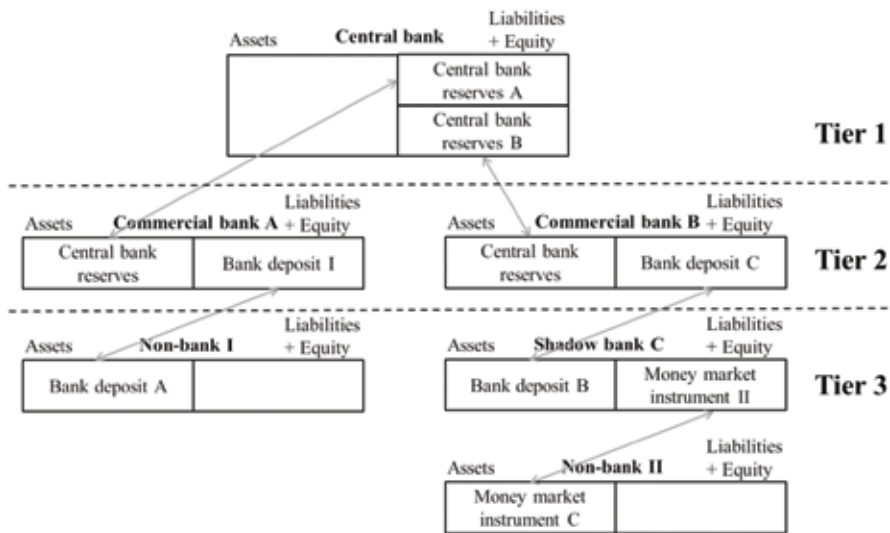


Figure 5-3: A multiple-tier monetary and financial system

The non-bank private sector does thus also not have access to the first tier, that is, access to central bank reserves is consciously limited to commercial banks. During the financial crisis of 2007-9, access to reserves was extended to shadow banks, that is, some issuers of money market instruments. This expansion continued afterwards. Banks use accounts at the central bank in tier 1 to make payments to other commercial banks and to the central bank. Moreover, the accounts give access to the function of LOLR. The non-bank private sector holds accounts at commercial banks in tier 2 and tier 3. Cash (inherent money) connects both monetary circuits as the central bank takes cash from commercial banks and exchanges central bank reserves into cash on demand at par. In this way, cash connects tier 1 and 2. Similarly, commercial banks take cash from the non-bank private sector and exchange bank deposits into cash on demand at par; in this way, cash connects tier 2 and tier 3. For stability reasons, parity (1 to 1 exchangeability) between different forms of money (contractual money in the different layers and inherent money (cash)) is essential. All forms of contractual money (credit money offering contractual liquidity) are promises to get a form of money higher in the hierarchy. Fixed convertibility on demand makes the monetary system, on the one hand, uniform and flexible (it allows replication). On the other hand, it makes the system fragile and introduces the need for public protection mechanisms – this will be discussed in detail in part II, especially in chapter 6.

5.3.3 The creation of bank deposits out of bank loans

In the current monetary and financial system, the quantity of money is largely (mainly) brought into circulation by commercial banks. Per definition, in all options the possessions (assets) as well as the obligations (liabilities) of a bank increase; that is, a balance sheet extends. This subsection explains the creation of bank deposits out of bank loans.

Figure 5-4 explains the process of providing a bank loan. Non-bank A and commercial bank A agree on a mortgage loan for the purchase of a house.⁴⁰ In the case of a mortgage, the deposit does generally not appear on the account of the borrower but on the account of a notary acting on behalf of the borrower. As a result of the loan contract, commercial bank A adds the loan to non-bank I to its balance sheets and increases the deposit account of the notary with the same amount. The notary possesses (temporarily) a bank deposit and promises to pay on behalf of non-bank I when all contractual details of the purchase of the house are fulfilled. Non-bank I possesses a promise to make a payment on his/ her behalf and has the obligation to repay the loan. The red cross visualizes the concept of mutual liability by connecting different balance sheets.⁴¹

The Bank of England's Monetary Analysis Directorate describes money creation as follows: "Whenever a bank makes a loan, it simultaneously creates a matching deposit in the borrower's bank account, thereby creating new money" (McLeay *et al.* 2014b: 1). As Figure 5-4 explains, in economic practice, the borrower does often not get the deposit on its account; instead, the account of a notary is used.

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40 If an individual or a non-bank firm applies for a loan, the commercial bank first assesses the creditworthiness of the borrower. Minsky (1986b: 256) considered "guaranteeing that some party is creditworthy" the essence of banking. Generally, a commercial bank calculates future cash flows and assesses risks by looking at the financial position of the borrower (income statement, financial statement, history of repayment, and business plan (if available)), the value of the underlying collateral (if available, often used to reduce moral hazards and credit risk) and the macroeconomic conditions (expected future interest rates on loans and bank deposits, liquidity, and credit risks). Information is thus essential. Commercial banks gather information via interviews, their own systems, and external sources. If the risk to the bank is sufficiently low (or, in other words, if the expected profitability is sufficiently high/ the net present value is positive), the bank offers a loan contract. If the borrower accepts the terms, the borrower and the bank sign a loan contract, or more accurately, both sign a mutual liability contract. The borrower promises to repay the loan (in fixed intervals with interest) and the bank promises to make a payment equal to the loan on behalf of the borrower. The loan is thus the result of a mutual decision. The borrower can purchase something, and the commercial bank obtains the legal right to a portion of the future cash flow of the borrower. Interest on loans is the calculated risk premium.

41 This construct is called 'wederzijdse schuldaanvaarding' in Dutch. Boonstra (2018: 28, 109) notices that it is also "wederzijdse bezitsvorming".

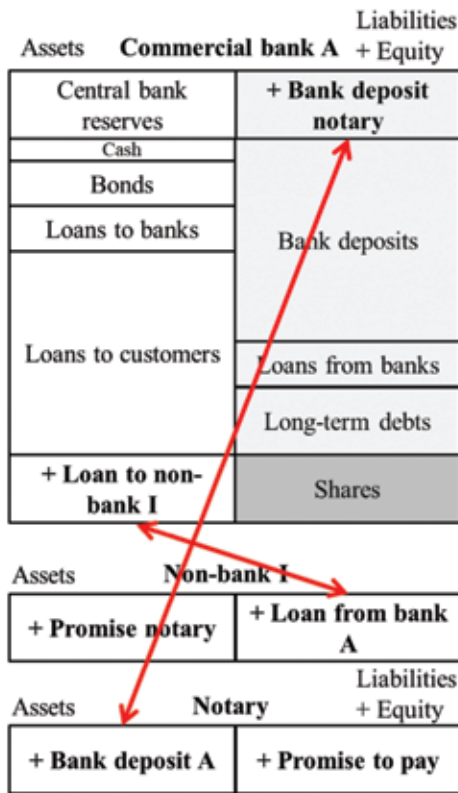


Figure 5-4: The creation of a bank deposit out of a bank loan

Figure 5-4 shows that commercial banks thus “*get indebted with their borrowers*” (Sgambati 2016: 8, italics original). The borrower (the non-bank private sector) owes money to the lender (the commercial bank) and the lender owes money to the borrower. Commercial banks thus issue a debt instrument that can be used as money because this debt instrument offers contractual liquidity. It can always be exchanged at par into cash and similar debt instruments of other banks. These debt instruments are insured until a certain amount in countries with DIS (explained in section 4.3.3) and backed up by LOLR (explained in section 4.3.2).

Commercial banks do not have the objective to create money. Their objective is to provide profitable loans to creditworthy agents. By doing so, they take the risk that the borrower defaults. Each new bank loan leads, at least temporarily, to an expansion of the quantity of contractual money.

5.3.4 A payment with a bank deposit

In the loan contract, commercial bank A and non-bank I agreed on the objective of the loan: the purchase of a house. When all contractual details are fulfilled the notary, who acts on behalf of non-bank I, instructs commercial bank A to transfer the bank deposit to the seller of the house (non-bank II). Non-bank II has an account at commercial bank B and therefore this transaction cannot be settled without the involvement of the central bank. Commercial banks settle transactions in central bank reserves. In case of a payment, central bank reserves always move in the same direction as bank deposits; in this case, from commercial bank A to commercial bank B (see Figure 5-5). Only the changing balance sheets items of the central bank, commercial bank B, the notary and non-bank I and II are shown in Figure 5.5. The central bank monetizes private short-debt instruments into contractual money by facilitating this transaction.

Commercial bank A		Central bank		Commercial bank B		Non-bank I		Non-bank II		Notary	
Assets	Liabilities + Equity	Assets	Liabilities + Equity	Assets	Liabilities + Equity	Assets	Liabilities + Equity	Assets	Liabilities + Equity	Assets	Liabilities + Equity
- Central bank reserves	- Bank deposit notary	- Central bank reserves A		+ Central bank reserves	+ Bank deposit II	- Promise notary	Loan from bank A	+ Bank deposit B		- Bank deposit A	- Promise to pay
Cash	Bank deposits	+ Central bank reserves B				+ House		- House			
Bonds											
Loans to banks											
Loans to customers	Loans from banks										
	Long-term debts										
Loan to non-bank I	Shares										

Figure 5-5: A transfer of a bank deposit

Because of this payment on behalf of non-bank I, commercial bank A has fewer liquidity reserves (only cash and no central bank reserve anymore) and is thus closer to illiquidity. The loan is still on its balance sheet, but the bank deposit of the notary and central bank reserves are transferred to commercial bank B. The balance sheet of commercial bank A shrinks, and the balance sheet of commercial bank B extends. At this moment, commercial bank A needs to attract central bank reserves for interbank

payments. There are four ways for commercial banks to increase reserves (Cliffe and Brosens 2014: 3, 2018: 3):

1. Borrow ‘excess central bank reserves’ (‘excess reserves’) from other commercial banks (an interbank loan).
2. Sell bonds.
3. Attract bank deposits or cash.
4. Borrow new central bank reserves from the central bank against the official (base) interest rate.

5.3.5 Money destruction via loan repayment

It is not certain that the provision of a loan by a commercial bank leads to a long-term expansion of the quantity of contractual money. This depends on the choice of the receiver of the new bank deposit. The receiver can store the bank deposit or use it immediately to purchase something or to redeem another loan — this occurs regularly in the case of mortgages. Redemption results in money destruction. In Figure 5-6, non-bank II pays off his loan. As a result, the balance sheet of the commercial bank B as well as the balance sheet of non-bank II shrinks.

Commercial bank B		Liabilities + Equity
Assets		
- Loan to II		- Bank deposit II

Non-bank II		Liabilities + Equity
Assets		
- Bank deposit B		- Loan from B

Figure 5-6: Money destruction via loan repayment

5.3.6 Money destruction via the issuance of shares and bonds

Also, when a bank issues shares or bonds, contractual money is destroyed (Boonstra 2018: 118). In Figure 5-7, non-bank I has an account at bank C and buys newly issued shares and bonds of commercial bank C. As a result, the composition of the balance sheets of non-bank I and commercial bank C change.

Assets	Commercial bank C	Liabilities + Equity
		- Bank deposit I
		+ Bonds
		+ Equity

Assets	Non-bank I	Liabilities + Equity
- Bank deposit C		
+ Bonds C		
+ Shares C		

Figure 5-7: Money destruction via the issuance of shares and bonds

5.3.7 The creation of bank deposits out of bank purchases

A commercial bank also creates new bank deposits when the bank purchases assets like government bonds or buildings from the non-bank private sector or the government. In this case, a commercial bank credits the account of the seller of the asset. In Figure 5-8, commercial bank B purchases government bonds from non-bank I.

Assets	Commercial bank	Liabilities + Equity
Central bank reserves		+ Bank deposit I
Cash		Bank deposits
+ Bonds		
Bonds		
Loans to banks		
Loans to customers		Loans from banks
		Long-term debts
		Shares

Assets	Non-bank I	Liabilities + Equity
+ Bank deposit		
- Bonds		

Figure 5-8: The creation of a bank deposit out of a bank purchase

5.3.8 The difference between bank lending and non-bank lending

Minsky (1986b: 256) emphasized the difference between banks and non-bank lenders by stating that “banking is not money lending; to lend, a money lender must have money”. In the case of non-bank lending, the non-bank transfers an existing bank deposit (or cash) to the borrower. In return, the non-bank lender receives a loan contract. In Figure 5-9, non-bank I lends to non-bank II. In this example, both have an account at the commercial bank C. Non-bank I transfers its bank deposit to non-bank II and adds a loan to its balance sheets. Non-bank II receives the bank deposit and accepts the obligation to repay the loan. The balance sheet of commercial bank C does not extend, only the composition changes. The bank facilitates the non-bank loan.

		Liabilities	
Assets	Commercial bank C	+ Equity	
		- Bank deposit I	
		+ Bank deposit II	

		Liabilities	
Assets	Non-bank I	+ Equity	
	- Bank deposit C		
	+ Loan to non-bank II		

		Liabilities	
Assets	Non-bank II	+ Equity	
	+ Bank deposit C	+ Loan from non-bank I	

Figure 5-9: A non-bank loan

The insight is that only the non-bank private sector agents have bank deposits on the asset side of their balance sheet and therefore only the non-bank private sector can use existing bank deposits to make loans. For commercial banks bank deposits are liabilities. The financial intermediation theory and the money multiplier theory assume that commercial banks possess the bank deposits of their clients. A bank deposit is a *liability* of a commercial bank. It is contractual money for the account holder, funding of a bank balance sheet and a claim on cash (inherent money).

5.3.9 Depositing cash

In Figure 5-10 non-bank III deposits cash into commercial bank A and receives in return a bank deposit. Commercial bank A adds the deposited cash to its assets and creates a bank deposit. Its balance sheet extends.

Assets Commercial bank A + Equity		Liabilities
+ Cash		+ Bank deposit III
Cash		Bank deposits
Bonds		
Loans to banks		
Loans to customers		Loans from banks
		Long-term debts
Loan to non-bank I		Shares

Assets	Non-bank III	Liabilities + Equity
- Cash		
+ Bank deposit A		

Figure 5-10: A cash deposit

Because of this transaction, non-bank III no longer legally owns money (as explained in chapter 2). Instead of being the owner of cash, non-bank III has a bank deposit, that is, a claim on commercial bank A. Non-bank III has become a creditor. Inherent money has been exchanged into contractual money.

5.3.10 Withdrawing cash

In Figure 5-11, non-bank III withdraws its bank deposit – the opposite transaction as shown in Figure 5-10. As a result of this transaction, the balance sheet of commercial bank A shrinks. Commercial bank A has fewer reserves.

Assets		Liabilities	
Commercial bank A		+ Equity	
- Cash		- Bank deposit III	
Cash		Bank deposits	
Bonds			
Loans to banks			
Loans to customers		Loans from banks	
		Long-term debts	
Loan to non-bank I		Shares	

Assets		Liabilities	
Non-bank III		+ Equity	
+ Cash			
- Bank deposit A			

Figure 5-11: A cash withdrawal

On demand, commercial bank A pays its debt, that is, the bank fulfils a contractual obligation when it exchanges on demand a bank deposit at par into cash. Contractual money is exchanged into inherent money. In the current design, cash can only enter the economy via the exchange of bank deposits. Inherent money has gradually become an extension of the contractual money system (explained in chapter 4). By accommodating the exchange of private liabilities (contractual money offering contractual liquidity) into public inherent money, the central bank enables monetization of these private liabilities (Hockett and Omarova 2016: 1163). Moreover, it made banks the creators of the quantity of money (explained in chapter 4).

5.3.11 Interbank lending

Interbank loans are essential for the functioning of the current monetary and financial system and for maintaining parity between different forms of money issued by different institutions. Interbank loans are a way of reallocating central bank reserves to the commercial banks that need them most (Jakab and Kumhof 2015: 10). In Figure 5-12, commercial bank A increases reserves by borrowing. Commercial bank

A approaches commercial bank B to borrow central bank reserves. Commercial bank B considers commercial bank A creditworthy and lends (some of its 'excess') central bank reserves.

Assets	Commercial bank A + Equity	Liabilities	Assets	Central bank + Equity	Liabilities
+ Central bank reserves	Bank deposits			+ Central bank reserves A	
Cash				- Central bank reserves B	
Bonds					
Loans to banks					
Loans to customers	+ Loan from bank B				
	Loans from banks				
	Long-term debts				
Loan to non-bank I	Shares				

Figure 5-12: Interbank loan

Commercial banks thus settle mutual payments in central bank reserves (public contractual money) and refinance their business by borrowing central bank reserves from each other. Interbank loans connect single commercial banks into a whole interlinked system. A faltering interbank lending market is a sign that commercial banks do not trust each other's creditworthiness, and this can lead to a systemic financial crisis.

5.3.12 The creation of central bank reserves out of loans

Instead of borrowing central bank reserves from bank B, bank A can (be ‘forced’ to) borrow central bank reserves from the central bank against the base interest rate. This is the lender-of-last-resort (LOLR) function and is about risk management. Normally the base rate is higher than the rate in the interbank lending market. A central bank only lends when a commercial bank offers eligible (‘good’) collateral. However, in practice, determining eligible collateral (assessing risks) is difficult and controversial. In a world of uncertainty, expectations can vary significantly, especially in times of a systemic financial crisis (as explained in section 4.3.2).

Figure 5-13 shows an overnight loan. This loan leads to an expansion of the balance sheet of the central bank as well as the balance sheet of the commercial bank A. The red cross connects the balance sheet in two ways and is like the creation of bank deposits out of loans by commercial banks (Figure 5-4).

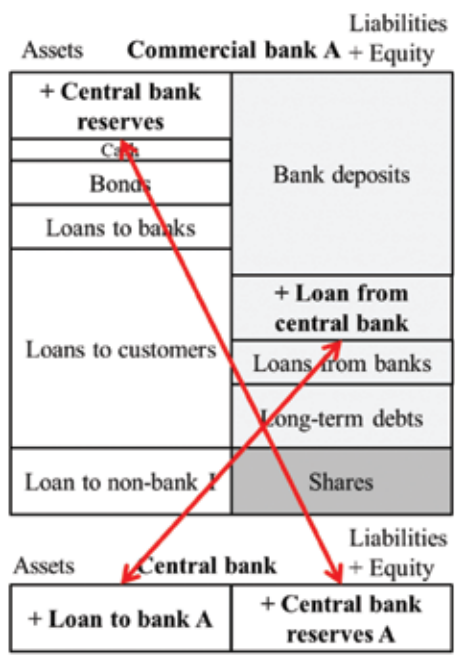


Figure 5-13: The creation of central bank reserves out of a loan

5.3.13 The creation of central bank reserves out of purchases

The central bank also creates (destroys) central bank reserves when it purchases (sells) government bonds (or other financial assets) from (to) commercial banks (open market operations) or from (to) the non-bank private sector (quantitative easing). Also, in this case, assessing risks is pivotal. In Figure 5-14, the central bank purchases government bonds from commercial bank A.

Assets		Commercial bank A + Equity		Liabilities
+ Central bank reserves				
Cash				Bank deposits
- Bonds				
Loans to banks				
Loans to customers				Loans from banks
				Long-term debts
Loan to non-bank I				Shares

Assets		Central bank		Liabilities
				+ Equity
+ Bonds		+ Central bank reserves A		

Figure 5-14: The creation of central bank reserve via a central bank purchase from a commercial bank

The central bank can also purchase government bonds from the non-bank private sector. This is often referred to as quantitative easing. In Figure 5-15, the central bank purchases bonds of non-bank I. As a result of this transaction the amount of central bank reserves as well as the amount of bank deposits increases. The balance sheet of the central bank and commercial bank A extend and the composition of the assets of the balance sheet of non-bank I changes. The commercial bank is in this case used as an ‘intermediary’ to implement monetary policy (McLeay *et al.* 2014b: 11). As a result, the amount of contractual money increases.

Assets		Liabilities	
Commercial bank A		+ Equity	
+ Central bank reserves		+ Bank deposit I	
Cash		Bank deposits	
Bonds			
Loans to banks			
Loans to customers			
		Loans from banks	
		Long-term debts	
Loan to non-bank I		Shares	

Assets		Liabilities	
Non-bank I		+ Equity	
- Bonds			
+ Bank deposit A			

Assets		Liabilities	
Central bank		+ Equity	
+ Bonds		+ Central bank reserves A	

Figure 5-15: The creation of central bank reserve via a central bank purchase from a non-bank

Open market operations (OMO) and quantitative easing are interventions of the central bank in the financial system to realize stability. Ordóñez (2018b: 5) emphasizes that “the current system is based on private banks that can only survive because they are supported by very powerful Central Banks with powers to intervene in the financial markets.” If quantitative easing, that is the purchase of government bonds by the central bank, is permanent, it is very similar to monetary financing (with public contractual money, and thus not with public inherent money). In the case of OMO and QE, central banks are involved in risk management.

5.3.14 Purchasing cash with central bank reserves

Commercial banks purchase with central bank reserves cash for their ATMs and the vaults in their offices. In Figure 5-16 commercial bank A buys cash (inherent money) from the central bank. As a result of this transaction, the composition of the asset side of the balance sheet of commercial bank A and the liability side of the balance sheets of the central bank changes.

Assets	Commercial bank A	Liabilities + Equity
	- Central bank reserves	
	+ Cash	

Assets	Central Bank	Liabilities + Equity
	- Central bank reserves	
	+ Cash	

Figure 5-16: A cash purchase with central bank reserves

The central bank registers ‘new’ cash as a liability on its balance sheet. The cash in its vaults is not registered on its balance sheets. Other economic agents register cash, in contrast, as an asset on their balance sheet. Section 2.6.1 explained why cash is today no longer a liability and why it can better be understood as inherent money in economic practice.

5.3.15 Depositing cash at the central bank

In Figure 5-17, commercial bank A deposits cash at the central bank – the opposite transaction as shown in Figure 5-16. Again, only the composition of both balance sheets changes. The central bank does not add cash to its assets. It disappears off balance.

Assets	Commercial bank A	Liabilities + Equity
	+ Central bank reserves	
	- Cash	

Assets	Central Bank	Liabilities + Equity
	+ Central bank reserves	
	- Cash	

Figure 5-17: Depositing cash at the central

5.3.16 Shadow banking

This subsection only gives a brief explanation of the basics of shadow banking and focuses on the repo channel – see McCulley (2009), McMillan (2014: 65-79), Pozsar *et al.* (2010, 2013), Ricks (2016), Hockett and Omarova (2016) and DNB (2012, in Dutch) for detailed descriptions of (the different channels of) shadow banking. Today, institutional cash managers use money market instruments mainly as a store of value.

In contrast to commercial banking, shadow banking is much harder to explain because of its complexity. In the literature different definitions of shadow banking circulate. Kane (2013: 1, italics original) defines a shadow bank as “an institution or bank-sponsored special-purpose vehicle that persuaded its customers that its liabilities can be redeemed de facto at par without delay (or can be traded as if they will be executed at par without fail at maturity) even though they are not formally protected by government guarantees.” Pozsar *et al.* (2013: 1) define shadow banking activities as “credit, maturity and liquidity transformation that take place without direct and explicit access to public sources of liquidity or credit backstops.”⁴² This thesis defines shadow banks as financial intermediaries that do not create deposits – as regulated commercial banks do – but create money market instruments that are exchangeable on demand at par into bank deposits. Shadow banks thus also have liabilities that offer contractual liquidity. These instruments are also referred to as ‘short-term debt instruments’, ‘short-term IOUs’, ‘cash equivalents’, ‘deposit substitutes’, ‘near money’ and ‘quasi money’ (Ricks 2016; Ricks *et al.* 2018). Institutional cash managers call them generally ‘cash’ and central bankers include them into ‘the broad money supply’ (M3). The exact size of shadow banking is hard to measure. The Financial Stability Board (2018) estimated the size conservatively at \$45.2 trillion in 2016. A key characteristic of the shadow banking system is that it amplifies and replicates the activities of the commercial banking system (Hockett and Omarova 2016).

A balance sheet of a shadow bank has four differences from a balance sheet of a commercial bank. First, commercial banks hold cash and central bank reserves as reserves and shadow banks hold bank deposits as reserves. Second, commercial banks have mainly bank deposits as liabilities and shadow banks have money market instruments as MMF shares and repos as liabilities. These money market instruments can

⁴² In practice, the European Banking Authority (EBA) has difficulties in defining the difference between shadow banks and commercial banks (Moe 2018: 6): “The key terms ‘deposits’, ‘other repayable funds’, ‘grant credits’, ‘from the public’) are not defined in the CRR [capital requirements regulation]. . . the results of the EBA’s first survey suggest there remains a degree of variation between the Member States as to the interpretation of the term ‘credit institution’ and therefore the entities to which the requirement to obtain a banking licence applies in the Member States” (EBA 2014: 4).

be converted into bank deposits like bank deposits are convertible into cash. Therefore, shadow banking can be conceived as a second layer of fractional reserve banking. Third, commercial banks generally have loans as assets and shadow banks securitized loans. Fourth, contractual money issued by commercial banks is covered by all bank assets and contractual money issued by shadow banks is generally covered by specific assets. Figure 5-18 visualizes a simplified (standard) balance sheet of a shadow bank.

Assets	Shadow bank	Liabilities + Equity
Bank deposits	Securitized loans	Money market instruments
		Shares

Figure 5-18: Simplified balance sheet shadow bank

The input for or the “raw material” of the shadow banking system are loans of commercial banks and other financial institutions (McMillan 2014: 65). To understand the repo channel, three elements are relevant: securitization, repurchase agreements and money market funds. The first element of the repo channel is securitization. Securitization is the process of purchasing and pooling different revenue-generating loans (for example, mortgages), slicing these loans in different parts with different credit risks and selling these parts as new securities to investors (for example, mortgage-backed securities). Securitization allows banks and other financial institutions to remove loans from their balance sheet without incurring capital regulation and amplify in this sense the creation by contractual money out of bank loans (Hockett and Omarova 2016: 1176). Securitization is often executed by special purpose vehicles (SPVs) or special investment vehicles (SIVs) or variable interest entities (VIEs). These vehicles are limited liability companies established by commercial banks and financial institutions (so called sponsors) to reduce risks and/or for other specific reasons such as increasing the capital ratio of the issuer of loans. An SPV generally pools loans on its balance sheet and issues securities with different credit risk. In Figure 5-19, SPV I issues high risk and low risk asset-backed securities (ABSs).

Assets	SPV I	Liabilities + Equity
Loans		High risk ABSs
		Low risk ABSs
		Shares

Figure 5-19: ABS SPV

Subsequently, the sponsor hires a rating agency to rate the quality of different ABSs. After the ABSs have been rated, they are sold to the non-bank private sector, commercial banks and other (bank-sponsored) SPVs. This makes shadow banking complicated. Various balance sheets are connected. In Figure 5-20, SPV II buys high risk ABSs and issues collateralized debt obligations (CDOs) with different credit risks. The sponsor of SPV II hires a rating agency to assess the CDOs.

Assets	SPV II	Liabilities + Equity
High risk ABSs		High risk CDOs
		Low risk CDOs
		Shares

Figure 5-20: CDO SPV

ABSs are thus backed by loans and CDOs by ABSs (McMillan 2014: 67). This securitization process can continue by buying, pooling and tranching CDOs into CDOs squared (CDOs²) and buying, pooling and tranching CDOs² into CDOs cubed (CDOs³) (*Ibid.*, see also DNB 2012).

The second element of the repo channel is repurchase agreements (repos). Repos are part of monetary aggregate M3 (see section 2.2). A repo is a collateralized sale of a specific asset combined with an agreement to purchase this specific asset back at a later moment. Repo transactions do not amplify commercial banking – as securitization does – but replicate banking (Hockett and Omarova 2016: 1179). Many repo contracts have a period of one night and are rolled over automatically. In repo transactions government bonds and highly rated securities as low risk ABSs and CDOs are often used as collateral. Repos are generally not used to finance real goods or means of

production but to finance the holding of financial assets (Mehrling 2010). McMillan (2014: 69) defines two functions of repos in shadow banking: 1) “repos transform credit risk” by applying a haircut to securities; and 2) “repos transform maturity” because by automatically rolling over the contract they offer “a form of contractual liquidity.” In the case of a repo, the lender withdraws its money by not rolling over the contract; this is similar to a deposit contract offering contractual liquidity.

The third element of the repo channel is money market funds (MMFs). In today’s economic practice, institutional cash managers (and wealthy individuals) store settlement power in bank deposits to a limited extent. Large amounts of uninsured bank deposits are (too) risky. Ricks (2016: 29-32) discusses money markets and draws a paradoxical conclusion: “the expectation of potential near-term transactions is one source of demand for cash equivalents, even though cash equivalents are not a medium of exchange” (*Ibid.*: 32, see also Focardi 2018: 9, 61). To store settlement power and spread risks institutional cash managers also buy shares of MMFs. Many MMF shares are considered risk-free and redeemable on demand at par; that is, “money market funds promise fixed values and first-come first-served redemption” (Cochrane 2014: 21) and some even “offer check-writing capabilities to account-holders (Hockett and Omanova 2016: 1191). MMFs are thus shadow banks offering contracts very similar to bank deposits. Therefore, central banks include MMF shares in the broad money supply (M3) (see also section 2.2). MMFs are repo lenders and monetize repo contracts. If a holder of MMF shares wants to exchange its shares into bank deposits, the MMF does not roll over some repos.

Figure 5-21 visualizes the repo channel (based on McMillan 2014: 70; Hockett and Omanova 2016). It starts with a commercial bank creating bank deposits out of loans for borrowers (1). The borrowers purchase goods of firms and pay by transferring bank deposits (2). The commercial bank transfers loans to a SPV and receives securitized loans in return (3). Institutional cash managers exchange bank deposits into MMF shares because large amounts of uninsured bank deposits are considered too risky (4). The commercial bank and the MMF execute a repurchase agreement in which securitized loans are used as collateral (5). The central bank (and indirectly the government) backs-up the system by giving commercial banks and increasingly also large shadow banks access to reserves (due to path dependencies) (6). Consequently, central banks are increasingly involved in risk management.

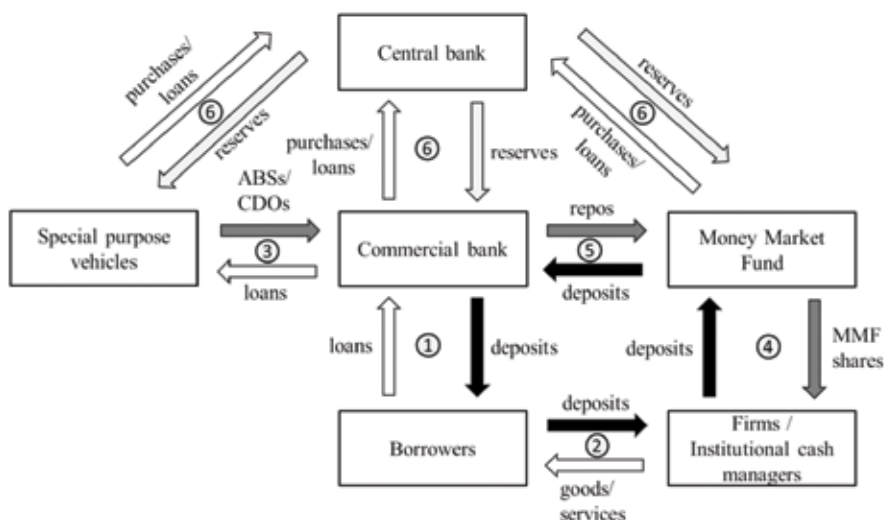


Figure 5-21: The repo channel (based on McMillan 2014: 70; Hockett and Omarova 2016)

The shadow banking system consists of many channels consisting of different institutions, securities, and forms of contractual money. For example, in practice, MMFs do not only hold repos but also asset-backed commercial paper (ABCP) and other securities on the asset side of their balance sheet.

There are six insights. First, shadow banks amplify and replicate commercial bank activities (Hockett and Omarova 2016). Second, contractual money issued by shadow banks is a close substitute of bank deposits and can at the same time be converted into bank deposits. Contractual liquidity is essential. Third, by creating money market instruments (contractual money) also shadow banks create systemic risk. Fourth, shadow banking is ultimately dependent on access to the central bank, on the public monetary authority offering public insurance to contractual liquidity. Fifth, central banks are increasingly also involved in managing financial risks in the shadow banking system. Sixth, in the digital age, banking often takes place over a chain of interlinked balance sheets (Luttrell *et al.* 2012; Pozsar *et al.* 2013; McMillan 2014; Risk 2016). Because the originator of a loan does not hold this loan on its balance sheet, measures focussing on single balance sheets – for example, capital ratios – are far less effective in the digital age than in the past; that is, digital technologies worsen the boundary problem of financial regulation (McMillan 2014).

5.3.17 Deficit spending

The focus of this research and this chapter is on the monetary and financial system, but it has to be noted that there is another channel of money creation that connects the monetary system to the fiscal system and public finance. In the current system, governments create new money in the case of deficit spending. Like shadow banking, deficit spending is much harder to visualize than commercial banking. In the case of deficit spending, the difficulty is different institutional arrangements in different countries, less attention to the top of the hierarchy in the scientific literature and no balance sheets explanations of practitioners (e.g., ministries of finance).

Wray (2012) and Tymoigne (2014) researched the actual operating processes of deficit spending in the US, Berkeley *et al.* (2022) in the UK. Key insights are that central banks are not only the bank of commercial banks but also the bank of governments and that government spending leads to new bank deposits at commercial banks and new central bank reserves at the central bank. In the words of Bell (2000: 616), “government spending from the Treasury’s account at the Fed injects reserve and creates an equivalent amount of new money.” In other words, governments spend “by crediting bank accounts” (Wray 2012: 244). Figure 5-22 visualizes deficit spending in a simplified way. In practice, the transactions are more complex and (slightly) differ per country, depending on institutional arrangements. In this example, the government purchases real estate of a non-bank. The bank deposit is transferred from the account of the government at the central bank to the account of non-bank I at commercial bank A. The real estate moves from the balance sheet of non-bank I to the balance sheet of the government. Commercial bank A adds central bank reserves and a bank deposit to its balance sheet.

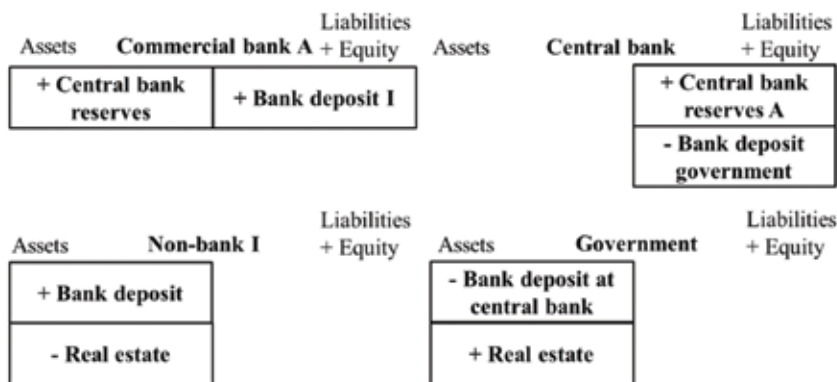


Figure 5-22: Deficit spending

Subsequently, commercial banks generally exchange central bank reserves for government bonds because banks prefer a higher interest rate. Figure 5-23 visualizes this transaction.

Assets	Commercial bank A	Liabilities + Equity	Assets	Central bank	Liabilities + Equity
	- Central bank reserves			- Bonds	- Central bank reserves A
	+ Bonds				

Figure 5-23: Exchanging central bank reserves into bonds

5.4 Reflection on three theories of banking

Section 5.3 explained the functioning of the current bank-based monetary and financial system. This section reflects on the three theories of banking: the financial intermediation theory of banking, the money multiplier theory of banking and the credit theory of banking.

The financial intermediation theory of banking assumes that banks are financial intermediaries like other non-bank financial institutions, collecting deposits that are subsequently lent out. However, loanable fund institutions offering deposits do not exist anymore in economic practice as explained in section 5.3, and especially in subsection 5.3.8. In the past, loanable fund institutions offering deposits existed. Section 4.3 explained that in the first step of the invention of fractional reserve banking economic agents deposited gold at goldsmiths and that practical experience taught goldsmiths that a part of the deposited coins could be used to make loans. It rarely happened that all depositors (creditors) came at the same moment to withdraw their deposits, that is, to request their coins. This goldsmith lending is what the financial intermediation theory of banking describes. In today’s practice, as explained in section 5.3, banks intermediate between borrowers and savers (depositors) on their balance sheets. Banks borrow from depositors (depositors are funders of banks) and lend to borrowers. Intermediation by banks takes place on their balance sheet. Bank intermediation differs fundamentally from other forms of intermediation in the economy. For example, real estate agents do not put the houses of the sellers they represent on their balance sheet and brokers only temporarily put the securities they trade on their balance sheets. Banks, in contrast, have loans and deposits often for a long period on their balance sheet. Another difference is that although many other financial intermediaries have on both sides of their balance sheets debt instruments, banks are unique because their debt instruments are (publicly insured) contractual

money. In today's practice, banks are thus not loanable funds institutions, but they are certainly financial intermediaries.

The money multiplier model theory of banking suggests that each commercial bank is a financial intermediary that does not and cannot create money, but collectively commercial banks end up creating money through systemic interaction. The money multiplier theory of banking fits a later step in the development of fractional reserve banking (as explained in section 4.3). This theory assumes that economic agents first deposit material money (inherent money, in the past golden coins, today banknotes) and that banks subsequently put a part of this money safely in their vaults and use the remaining part to provide loans. In today's practice, the bank deposits (contractual money) created by banks are still claims on banknotes (sometimes also referred to as 'the monetary base') as in the time of goldsmith banking. More lending by banks leads to more claims on the monetary base; in this sense, banks multiply the amount of money.

In today's practice, central banks (can) increase the amount of central banks reserves by purchasing financial assets as bonds from commercial banks and non-banks (as explained in section 5.3.13). These purchases result in an increase of base money in the system. When banks have more base money – more (excess) reserves, there is a possibility that they ease lending conditions. However, banks do not have to ease lending conditions. If they assess conditions as too risky, they will not increase lending and the amount of reserves is thus not multiplied. Moreover, private banks (and central banks) cannot multiply the amount of bank deposits without demand for loans of non-bank economic agents. If all non-bank economic agents are not willing to borrow, the only way to increase the amount of bank deposits is via quantitative easing (see 5.3.13). In this case, the amount of central bank reserves and the amount of bank deposits increase with the same amount. Base money is thus not multiplied. This constraint of monetary policy in the current monetary and financial system is sometimes referred to as 'pushing on a string'. The money multiplier describes in a static way the ratio between base money and broad money at this moment, and in this way, it can provide valuable information. It is however not so that an increase of base money results 'automatically' in a multiplication of broad money.

In addition, it is important to notice that cash (inherent money) is today no longer spent into circulation by the government. All cash enters society via substitution, that is, the non-bank private sector must demand cash. As explained in chapter 4, inherent money became gradually an extension of contractual money. The current

monetary and financial system is endogenous (money is created on demand) in at least four ways. First, on demand of the non-bank private sector, commercial banks can create bank deposits out of loans. Second, on demand of commercial banks, central banks can create more central bank reserves. Third, on demand, commercial banks exchange bank deposits into cash. Fourth, on demand, central banks exchange central bank reserves into cash. The money multiplier theory of banking as advocated by Hill (2018) and Blakeley (2019) thus inaccurately assumes that material inherent money is today always actively brought into circulation by central banks.

The credit creation theory of banking suggests that each commercial bank can create money. The balance sheet explanation in section 5.3. showed that a new bank loan does indeed lead to a new bank deposit (contractual money). Several bank credit theorists argue that commercial banks create money ‘out of nothing’. For example, Focardi (2018: 35, italics original) reasons: “But where does the money of the loan come from? From nowhere, because in making a loan to Z, the bank has created money *ex nihilo*.” However, this is an inaccurate description of economic practice and gives the misleading suggestion that bank deposits are fiat money – for example, Reid and Nicol (2017) and Ferguson (2019) define bank deposits inaccurately as fiat money. As explained in chapter 2, fiat money is inherent money and bank deposits are contractual money (credit money offering contractual liquidity). As explained in this chapter, the basis for bank lending in the current monetary and financial system is a mutual debt contract. The created bank liabilities can function as money because of contractual liquidity. Therefore, it is more accurate to say that commercial banks ‘create contractual money out of bank loans’ than to say that commercial banks create ‘money out of nothing’.⁴³

A consequence of the ambiguous understanding of banking relevant to this research is the scope of the debate after a systemic crisis. In the period of the Great Depression and the financial crisis of 2007-9 different banking theories dominated and this arguably contributed to different policy recommendations. In the 1930s, the credit creation theory dominated (Werner 2014, 2016b), and U.S. economists generally discussed two ‘radical’ or ‘fundamental’ banking reform proposals. Proposals that would, in the end, become the Banking Act of 1933 and 1935 (explained in section 4.3.3) and proposals for full reserve banking (*The Chicago Plan* as explained 4.4.1). At the time of the financial crisis of 2007-9, the financial intermediation theory dominated several parts

43 Moreover, some credit theorists argue that all banks are money creating institutions. For example, one of the first credit theorists, MacLeod’s (1833: 330-331 in Ricks 2016: 75), argues that all banks are banks of issue. However, this depends on the definition of banks. For example, the Bank of Amsterdam (*Amsterdamsche Wisselbank* in Dutch) was in the beginning a pure payments bank (Quinn and Roberds 2014).

of economic science. Because banks were often understood as pure intermediaries, the recommendations of economists were possibly fundamentally different. Instead of proposing fundamental reform, economists proposed microprudential regulation as higher capital ratios, conduct regulation and macro-prudential supervision.⁴⁴

Finally, it must be noticed that digital technologies have contributed to a change in banking that is ignored in most explanations of the three banking theories. The application of digital technologies in banking made it easier to create contractual liquidity out of bank loans as well as to transform bank loans into new monetary-financial instruments. Consequently, shadow banking grew rapidly. In the U.S. and the Eurozone, the size of shadow banking is today comparable to the size of ‘traditional’ commercial banking. Relevant to this research is that digital technologies make it easier to execute derivative transactions that amplify and replicate lending by commercial banks. In the digital age, banking takes place more often over a chain of interlinked balance sheets. Because the originator of a loan does not hold this loan on its balance sheet, measures focussing on single balance sheets – as for example capital ratios – are far less effective in the digital age than in the past. Consequently, the boundary problem of financial regulation worsens, and ‘traditional’ monetary policy instruments of central banks are less effective. These developments will be explored in more detail in chapter 6.

5.5 Conclusion

This chapter explained the functioning of the current monetary and financial system via balance sheets and examined three theories of banking – the financial intermediation theory, the money multiplier theory, and the credit creation theory. It was explained that the current monetary and financial system consists of three tiers (layers). The first tier is based on central bank reserves, the second tier on bank deposits and the third tier on bank deposits and money market instruments. All are forms of contractual money denominated in the same unit of account. Commercial banks in the second tier hold accounts at the central bank and banks in the third tier do not hold accounts at the central bank but hold accounts at other commercial banks. The non-bank private sector does not have access to the central bank, only to banks in the second and third

44 Aigner *et al.* (2018) suggest that the financial crisis of 2007-9 did not lead to major changes in economic science. The research analysed 440,000 articles published between 1956 and 2016 and a smaller sample of 400 top-cited papers before and after the crisis. Their results “suggest that – unlike the Great Depression of the 1930s – the current financial crisis did not lead to any major theoretical or methodological changes in contemporary economics, although the topic of financial instability received increased attention after the crisis” (*Ibid.* 1). Several other economists explicitly stated that a radical change is not needed. E.g., Bernanke (2010) argued: “Although economists have much to learn from this crisis, as I will discuss, I think that calls for a radical reworking of the field go too far.” Others proposed a ‘radical’ change. E.g., Bouchaud (2008).

tier. Contractual liquidity arranges on demand at par exchangeability between the different layers. Inherent money comes only into circulation on demand. It is an extension of the contractual money system. Subsequently, it was explained how central banks, commercial banks, and shadow banks function and that digital technologies make banking over a chain of interrelated balance sheets easier. Finally, this chapter reflected on the three banking theories and concluded that only the credit theory of money pays sufficient attention to the *monetary* functions of banks. Commercial banks are monetary-financial institutions creating contractual money out of loans. Shadow banks do not create deposits – as regulated commercial banks do – but create money market instruments that are exchangeable on demand at par into bank deposits. By explaining the different banking theories and the functioning of the current monetary and financial system, this chapter aimed to improve monetary literacy. Monetary literacy is a precondition for examining systemic financial crises and developing requirements on the monetary and financial system and guidelines for these systems in the digital age (part II).



PART II

Causes and consequences of systemic financial crises

6. Causes and consequences of systemic financial crises

6.1 Introduction

Part I reviewed reference foundations on money and banking to find clear definitions and design features of different (theoretical) monetary systems, and to improve the understanding of the functioning of the current monetary and financial system. Chapter 2 developed a taxonomy of money consisting of four characteristics to explore different monetary system designs. This taxonomy was subsequently used in chapter 3 to derive design lessons from two groups theories on the origin and nature of money – theories focussing on the function as a medium of exchange and the market versus theories focussing on the function as unit of account and the state – and in chapter 4 to find design features of the current fractional reserve banking system and two proposed alternative systems – full reserve banking and free banking. Chapter 5 explained the functioning of the current monetary and financial system and analysed three theories of banking: the financial intermediation theory, the money multiplier theory, and the credit theory.

This chapter takes the first step in design science research: explicating the problem. Design science research is a research paradigm in which researchers aim to find solutions to human problems via developing novel artifacts in novel ways (Hevner and Chatterjee (2010: 5; Hevner *et al.* 2004: 11; De Marco 2010: 157; Piirainen *et al.* 2010: 103). Design science is currently mostly applied on IT and information systems. According to several scholars, the principles underlying it apply to many other areas (Johannesson and Perjons 2014: 7; Hevner *et al.* 2004). The current monetary and financial system can be considered a complex system that has partly been purposely designed (e.g., the implementation of the function of lender-of-last-resort and deposit insurance schemes), but also emerged due to individual (business) innovations on different levels (e.g., new products and new monetary-financial institutions). The rise of cryptocurrencies and shadow banking are examples of emergent phenomena influencing the design of the monetary and financial system. The novelty of the research approach is that for the first time design science is applied on a macroeconomic topic, that is, on the monetary and financial system as a whole. This novel approach allows a new way of examining the systemic problems of the current monetary and financial system and aims to solve the identified systemic problems by developing design guidelines for the monetary and financial system as a whole. As explained in section 1.2, the outcomes of this research into a socio-technical system should not be deterministic and, therefore, this research focusses on developing guidelines that aim to give direction.

Design science is a suitable methodology for this research into the design of the monetary and financial system in the digital age for at least four reasons. First, in other fields, design science is often applied to deal with novel and complex topics. The digitalization of money is also such a novel and complex topic. There is currently a need to understand 'the design space' of the monetary and financial system of which the shapes can be demarcated by requirements and the direction can be guided by guidelines. Requirements describe how systems must function. They are statements about systems like: A particular system must have some property X (Offerman *et al.* 2010: 83). Viewing the monetary and financial system as an artifact having requirements which should not be violated provides boundaries for searching for ways to improve these systems. Guidelines do not "provide readily available solutions to design problems", but "are meant to give direction" (Bharosa and Janssen 2015: 472); they can be considered "normative, reusable and directive guidelines" (*Ibid.*). In this thesis, generic design requirements describe how the monetary and financial system must function, that is, they define the design space, whereas the generic design guidelines aim to give direction to the development of the monetary and financial system in the digital age. These guidelines can be used to evaluate and inform the development of (monetary) reform proposals, policies, and regulations, and in other research to develop other artifacts, as design principles.

A second reason to believe that design science is a suitable methodology is that the application of digital technologies in the monetary and financial system makes this system more like IT and information systems. With the help of design science, design variables allowed by digital technologies can be explored and understood. Examples of new design variables are programmable money and a maximum amount of public digital money economic agents can possess. A related added value of design science is that this methodology helps the researchers to make implicit assumptions explicit and allows the researcher to identify different streams of monetary thinking and design variables.

A third reason to believe that design science is a suitable methodology is that the starting point of design science is a problem that must be solved (Johannesson and Perjons 2014: 7). The first step in design science research is explicating the problem. This is a crucial step in the case of the monetary and financial system. The systemic problems of the current design, and especially the cause(s) of systemic financial crises, are hard to grasp with mathematical and statistical methodologies currently dominating economic science.

A fourth reason to believe that design science is a suitable methodology is that design science uses reference theories, is interdisciplinary and at the same time practice-oriented. This makes design science an attractive methodology to explore the digital future of the monetary and financial system. The development of the design guidelines relies on existing reference foundations “that are applied, tested, modified, and extended through the experience, creativity, intuition, and problem solving capabilities of the researcher” (Hevner *et al.* 2004: 2). The problem explication, the identified scenarios and the developed requirements and guidelines are practice-oriented and accessible for researchers with other (non-economic) backgrounds, policymakers, and the general public. This is important because the design of the monetary and financial system is a topic of relevance to several expert fields and of societal relevance. Design science ensures that experts with different backgrounds can understand, assess, criticize, and improve the logic. Moreover, an explicit objective of this part of this thesis is to develop knowledge by identifying the commonalities and differences between different streams of monetary thinking.

Design science research generally consists of five activities: (1) explicate the problem; (2) define requirements; (3) design and develop an artifact; (4) demonstrate the artifact, and; (5) evaluate the artifact (Johannesson and Perjons 2014: 76). Most design science research do not undertake all those activities in-depth but, instead, focus on one or two activities (*Ibid.* 2014: 79). For the monetary and financial system, designing and developing a ‘real’ (physical) artifact (3), demonstration (4) and evaluation (5) are rather difficult. The system depends on interventions of many autonomous stakeholders and historical choices. There are many variables and uncertainties and for this reason, these activities are not feasible in practice. Nevertheless, design science can be used to determine the desired direction and understand the design space. Part II of this thesis focuses, therefore, on the first three activities of design science research: 1) explicate the problem; 2) define generic design requirements, and; 3) develop generic design guidelines. Reference foundations and semi-structured interviews with experts are used in those three activities.

Figure 6.1 visualizes the structure of part II. This chapter takes the first step in design science – explicating the problem – based on the reference foundations examined in part I and additional literature. According to several scholars, the problem(s) of systemic financial crises are today not well understood (Rolnick and Weber 1985; Lo 2012; Thakor 2015; Ricks 2016: 122-142; Bernanke 2018; Gorton 2019). Subsequently, initial requirements (chapter 7) and initial guidelines (chapter 8) are drafted. Thereafter, the structure and process of the interviews to evaluate and refine

the problem analysis, the initial requirements and the initial guidelines are described (chapter 9). Chapter 10 reports the analysis of the views of the interviewed experts on the explicated systemic problems, the requirements, and guidelines. Finally, chapter 11 draws conclusions.

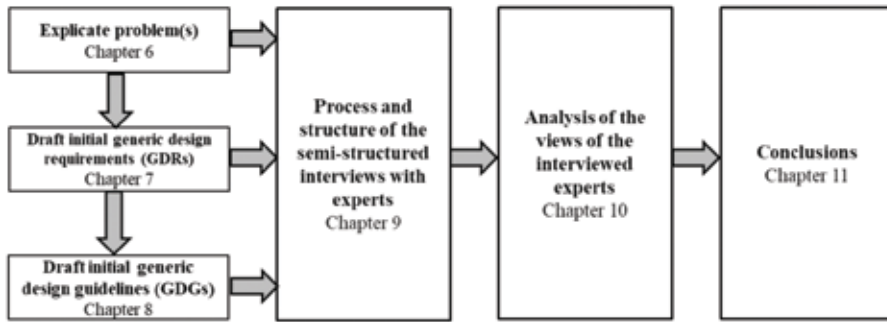


Figure 6-1: Structure of part II

The remainder of this chapter is structured as follows. Section 6.2 defines the difference between non-systemic financial crises and systemic financial crises. Section 6.3 describes two existing theories explaining systemic financial crises – the debt cycle theory and the bank run theory – and discusses an alternative theory that combines both theories – called the contractual liquidity theory in this thesis. Section 6.4 examines the systemic financial crisis of 2007-9. Section 6.5 investigates the social consequences of systemic financial crises and explains that one of the consequences has become a systemic problem in itself. Section 6.6 discusses the influences of digital technologies on the two identified systemic problems. Section 6.7 discusses other (conflicting) views. Finally, section 6.8 concludes.

6.2 Two types of financial crises

Debt cycles, booms and busts and financial crises are recurring events (Kindleberger and Aliber 2005; Reinhart and Rogoff 2009, 2013; Schularick and Taylor 2012; Valencia and Laeven 2012; Cencini and Rossi 2015). However, not all crises have resulted in large-scale and emergency government intervention(s) (Tooze 2018: 165, see also Contessi and El-Ghazaly 2011). To examine sub research question *e) What causes and what are the consequences of systemic financial crises?*, two types of crises must be distinguished: non-systemic financial crises and systemic financial crises. This distinction is similar to Schwartz's (1987: 271-2) distinction between "pseudo" and "real" financial crises.

6.2.1 Non-systemic financial crises

Non-systemic financial crises threaten and affect individual businesses, specific markets (tulips, cryptocurrencies) and in the worst-case whole sectors (as during the dot-com bubble); these crises are ‘pseudo-financial crises’ in the terminology of Schwartz (1987). The losses of these crises are covered by those who invested: risks and rewards are aligned. The collapse of individual businesses, markets and sectors does not threaten the whole current monetary and financial system and economy and can in a sense, be considered Schumpeterian (1942) creative destructions. Creative destruction is the process of substituting ‘outdated’ products, businesses and even whole markets and sectors with new products, businesses, markets, and sectors. Or in the words of Schumpeter (1934), “new combinations” (see also Croitoru 2012: 142). Creativity and creative destruction are directly linked to risk and uncertainty – fundamental aspects of market economies. The opportunity to take risk allows economic agents to invent (completely) new products, to start (completely) new businesses and to open (completely) new markets. When economic agents succeed in innovating into previously unknown areas, the allocation of investments also changes significantly.

In practice, private investors attempt to deal with (financial) risk and uncertainty in a rational way. This is a coping process (King 2016). When investors increasingly expect that a specific product (Tesla cars, Facebook) or a specific market (sustainable energy, tech) is the future, prices increase. In the case of a bust, investors (suddenly) change their expectation and reallocate their investments for whatever reason – if the reason is justified or unjustified can never be known with certainty. The possibility to change expectations and manage risks privately is thus fundamental for market economies and significant changes cause non-systemic financial crises. These crises cannot and have not to be solved. In the case of a non-systemic financial crisis, a government can decide to support specific businesses or markets.

A sovereign debt crisis (also referred to as a long-term debt crisis) differs from a crisis of individual businesses, markets, and sectors because countries cannot be subjected to creative destruction. In a sovereign debt crisis, a country is unable to fulfil its debt obligations and/ or to refinance its debts. A feature of a sovereign debt crisis is that there are many signs in advance, that is, politicians have had opportunities to decide and to act before the crisis. Although sovereign debt crises threaten individual countries (or groups of countries as in the case of the euro area), they do not lead to a collapse of the whole current monetary and financial system. Therefore, they can be considered crises

with dire outcomes that have to be solved by politicians in consultation with creditors and cannot be solved by changing the design of the monetary and financial system. In addition, history shows that the ‘right’ political institutions can solve a sovereign debt crisis (Reinhardt and Rogoff 2013).⁴⁵

6.2.2 Systemic financial crises

Systemic financial crises differ fundamentally from non-systemic financial crises. Systemic crises threaten the whole current monetary and financial system, lead to large scale and emergent government interventions and cause structural economic downturns; these crises are ‘real financial crises’ in the terminology of Schwartz (1987). Systemic financial crises are sometimes also referred to as banking crises or short-term debt crises. In the terms of the taxonomy developed in chapter 2, these crises are contractual money crises. The losses of those crises are not covered by those that invested but by all citizens. Risk and reward are not aligned. When a systemic financial crisis occurs, the threat of a collapse of the whole monetary and financial system ‘forces’ governments and central banks to intervene on a large scale and emergency level.

Because systemic crises threaten the whole monetary and financial and whole economy, they cannot be considered creative destructions. A stable monetary system is often considered a precondition for a functioning market economy (e.g., Friedman 1960: 8, this will be discussed in more detail in chapter 7). Till today, systemic financial crises have not been solved. In the words of Reinhart and Rogoff (2013: 4560, italics original), “*graduation from banking crises has proven, so far, virtually impossible*” (see also King 2010).⁴⁶ Valencia and Laeven (2012) identified 147

45 In the words of Reinhart and Rogoff (2013: 4560, italics original), “many now-advanced economies have graduated from a history of serial default on sovereign debt.”

46 King (2010: 1) states that “banking crises are endemic to the market economy that has evolved since the Industrial Revolution. The words ‘banking’ and ‘crises are natural bedfellows.” Reinhart and Rogoff (2013: 4570) summarize the fundamental difference between solved sovereign debt crises and unsolved systemic financial crisis as follows: “Countries may “graduate” from serial default on sovereign debt and recurrent episodes of very high inflation, as the cases of France, Austria, Spain and others illustrate. History tells us, however, that graduation from recurrent banking and financial crises is much more elusive.” However, there is also a relation between systemic financial crises and sovereign debt crises. According to Reinhart and Rogoff (2013: 4559), “a high incidence of global banking crises has historically been associated with a higher incidence of sovereign defaults of external debt.” The financial crisis of 2007-9, the euro crisis and especially the Greek sovereign debt crisis are an example of the relation between these crises. In the 2010s, there was in Europe an ongoing fear that a Greek sovereign debt crisis would cause sovereign debt crises in other European countries leading to another systemic financial crisis. A reason was that commercial banks possessed government bonds. Dell’Ariccia *et al.* (2018: 2) argue that “banks and sovereigns are linked by three interacting channels: banks hold large amounts of sovereign debt; banks are protected by government guarantees; and the health of banks and governments affects and is affected by economic activity.” These scholars consider “the sovereign-bank nexus” a substantial risk to financial stability (Ibid.: 37).

banking crises (contractual money crises) over the period 1970–2011 (see also WRR 2019: 122). Other research shows that the number of systemic financial crises has increased during the last decades (e.g., Reinhart and Rogoff 2009, 2013; Reid *et al.* 2017) and have become more severe (Drehman, Borio and Tsatsaronis 2012⁴⁷). After a relatively stable period, sometimes a long period as after the Second World War to the early 1970s in many countries, a new systemic financial crisis occurs again. Recurrent systemic financial crises and the ongoing risk of a systemic financial crisis show, in Minsky’s (1994c: 2) terminology, that “we still have not gotten our monetary and financial institutions ‘right’.”

6.3 Theories on systemic financial crises

In the economic literature, there is, according to several scholars, neither consensus on the cause of the systemic financial crisis of 2007-9 nor on the cause of systemic financial crises in general (see for example Lo 2012; Thakor 2015; Ricks 2016: 122-142; Bernanke 2018; Gorton 2019). Lo (2012) reviewed twenty-one books on the crisis of 2007-9 and concluded

No single narrative emerges from this broad and often contradictory collection of interpretations, but the sheer variety of conclusions is informative, and underscores the desperate need for the economics profession to establish a single set of facts from which more accurate inferences and narratives can be constructed. (Lo 2012: 151)

The first step of a proper understanding of systemic financial crises is an adequate understanding of banking. Chapter 5 explained the ‘adequate’ credit theory of banking, the ‘ambiguous’ financial intermediation theory of banking and the ‘ambiguous’ money multiplier theory. The second step of a proper understanding of systemic crises is an examination of different theories on systemic financial crises.

Lo (2012) found the following factors explaining the financial crisis of 2007-9 in the literature (see also Thakor 2015: 162-170): political factors, growth of securitization and the originate-to-distribute (OTD) model, financial innovation, U.S. monetary policy, global economic developments, misaligned incentives, success-driven skill inferences, and the diversification fallacy. Although these factors are relevant, they do not offer a theoretical explanation of *recurrent* systemic financial crises. Ricks (2016: 122) discusses six categories of theories explaining systemic financial crises of 2007-9: Austrian business cycle theorists; spending hypothesis theorists; neoclassical theorists;

⁴⁷ Drehman, Borio and Tsatsaronis (2012: 25) show that swings in the financial cycle in the U.S. became more severe.

market monetarist; debt cycle theorists, and; bank run theorists. Bernanke (2018: 3–4) categorizes explanations of systemic financial crises into ‘the “household leverage” narrative’ (similar to Ricks’ (2016) debt cycle theory) and ‘the financial fragility narrative’ (similar to Ricks’ (2016) bank run theory). This section first analyses two existing theories: the debt cycle theory (section 7.3.1) and the bank run theory (section 7.3.2). There are three reasons for the focus on these two theories. First, the debt cycle theory and the bank run theory are explicitly based on the credit theory of money (explained in chapter 5). Second, Ricks (2016: 122–129) refutes the other four theories. Third, the debt cycle theory has been the conceptual and theoretical basis for most reforms and regulations implemented during the last decades and the bank run theory presents a plausible alternative theory focussing on the design of the current monetary and financial system (Ricks 2016: 122). Thereafter, this section discusses a combination of both theories: the contractual liquidity theory of systemic financial crises.

6.3.1 The debt cycle theory

Scholars emphasizing debt cycles argue that over-indebtedness leads to busts and systemic financial crises. To this group belong among other Fisher (1933), Minsky (1982a, 1982b, 1992a, 1995b), Keen (2011, 2017), Bezemer (2012, 2014), Mian and Sufi (2014) and Mian *et al.* (2017). Those scholars generally also pay attention to bank runs (as a phase in the debt cycle) but tend to focus more on debt in their analyses. In this thesis, the distinction between the two theories is made to improve conceptual clarity. Fisher (1933) developed his debt deflation theory during the Great Depression in the 1930s. Fisher’s theoretical argument was that disequilibrium in the form of over-indebtedness exists. Over-indebtedness leads, according to Fisher (1933: 342), to liquidation “through the alarm either of debtors or creditors or both” and subsequently to a “chain of consequences in nine links” with several interrelationships.⁴⁸ Over-indebtedness is, according to Fisher, thus the cause of a systemic financial crisis.

Minsky expanded Fisher’s analysis and argued that the tendency towards instability is inherent to capitalist economies because of profit-seeking: “Profit opportunities within

48 (“(1) Debt liquidation leads to distress setting and to (2) Contraction of deposit currency, as bank loans are paid off, and to a slowing down of velocity of circulation. This contraction of deposits and of their velocity, precipitated by distress selling, causes (3) A fall in the level of prices, in other words, a swelling of the dollar. Assuming, as above stated, that this fall of prices is not interfered with by reflation or otherwise, there must be (4) A still greater fall in the net worths of business, precipitating bankruptcies and (5) A like fall in profits, which in a “capitalistic,” that is, a private-profit society, leads the concerns which are running at a loss to make (6) A reduction in output, in trade and in employment of labor. These losses, bankruptcies, and unemployment, lead to (7) Pessimism and loss of confidence, which in turn lead to (8) Hoarding and slowing down still more the velocity of circulation. The above eight changes cause (9) Complicated disturbances in the rates of interest, in particular, a fall in the nominal, or money, rates and a rise in the real, or commodity, rates of interest.” (Fisher 1933: 342).

a robust financial structure make the shift from robustness to fragility an endogenous phenomenon” (Minsky 1986a: 234). Like Fisher, Minsky focussed on debt finance and debt cycles. Minsky (1982a, 1982b, 1992a, 1995b) distinguishes three forms of finance: hedge finance, speculative finance, and Ponzi finance. In the case of hedge finance, economic agents have enough income to fulfil their contractual obligations, that is, their cash flow is positive. According to Minsky (1992a: 14), “the greater the weight of equity financing in the liability structure, the greater the likelihood that the unit is a hedge financing unit.” In the case of speculative finance, economic agents have enough cash flow income to “meet their payment commitments on ‘income account’ on their liabilities, even as they cannot repay the principal out of income cash flows” (*Ibid.*). These economic agents generally roll over their liabilities, that is, they substitute ‘old’ debt with ‘new’ debt. In the case of Ponzi finance, economic agents do not have enough cash flow from operations “to fulfil either the repayment of principal or the interest due on outstanding debts” (*Ibid.*). These agents must borrow or sell assets to pay interest (*Ibid.*).

According to Minsky’s financial instability hypothesis, economic agents gradually take more risks in stable periods and this risk-taking undermines stability in the long-term. When economic circumstances are stable, economic agents are confident in the future and are willing to take more risk. Lending by banks and non-banks financial intermediaries increases, which increases economic activity and leads to higher asset prices. Because of more activity and higher asset prices, confidence and optimism increase further. Risk calculations get less conservative because of higher share prices and capital gains. This leads to more lending and thus to higher debts. Investments increase further and shift gradually from hedge to speculation to Ponzi. According to Minsky, an endogenously generated pro-cyclical and self-reinforcing dynamics occurs that leads in the end to instability. At one moment assets become (too) overpriced and debts become too high. When some debts can no longer be served, the boom turns into a bust.

After the financial crisis of 2007-9, Minsky’s financial instability hypothesis gained popularity and today, financial instability is often considered inherent to capitalist economies (this view will be discussed further in section 6.7). Several contemporary scholars argue that the current bank-based monetary and financial system is (highly) pro-cyclical and that debt busts are the cause of financial crises (e.g., Turner 2016; van Egmond and de Vries 2016, 2018; Boonstra 2018). They generally pay less attention to how those debts are funded.

In short, debt cycle theorists argue thus that a crisis starts with weak balance sheets (e.g., Mian and Sufi 2014 focus on weak household balance sheets), lower *demand* for loans and a bust of a debt bubble. This causes a systemic financial crisis. Figure 6-2 visualizes the focus of debt cycle theorists in terms of a bank balance sheet.

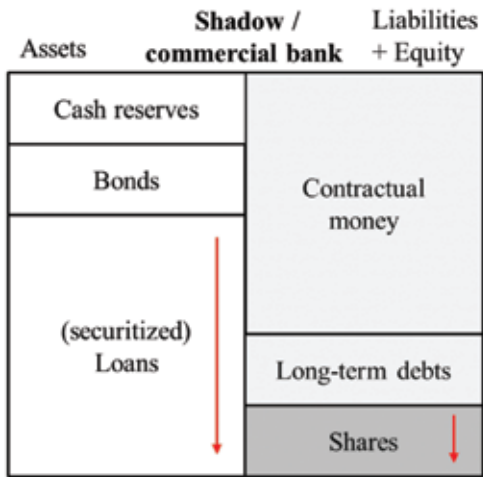


Figure 6-2: Focus of debt cycle theorists

Funding with contractual money – backed up with public protection mechanisms – gets less attention in those analyses. The problem lies predominantly in the behaviour of borrowers, investors, and bankers (the players) and the supervising authorities (the referees) – and not in the design of the monetary and financial system and design of specific monetary-financial contracts (the game).

6.3.2 The bank run theory

Scholars emphasizing bank runs argue, instead, that bank runs (and not high debt per se) are the main cause of systemic financial crises. They also mention debt cycles but tend to focus more on runs in their analyses. This view can be traced back to Bagehot (1873) and Friedman and Schwartz (1963) and the theoretical bank run models of Diamond and Dybvig (1983) and Peck and Shell (2003) and has been advocated in the aftermath of 2007-9 by among others Gorton (2012a, 2012b, 2019), McMillan (2014), Cochrane (2014), Ricks (2016), Kotlikoff (2018), Bernanke (2018) and Ricks *et al.* (2018). These scholars also use terms such as panics, self-fulfilling dynamics, coordination failures, multiple equilibria, and contagions to describe the problem of bank runs. Bernanke (2009) defines a panic as “a generalized run by providers of short-term funding to a set of financial institutions, possibly resulting in the failure of

one or more of those institutions.” Gorton (2010, 2019), Bernanke (2012) and Ricks (2016) use similar definitions. According to scholars in this group, bank runs and self-fulfilling dynamics are the key problem (e.g., Friedmann and Schwartz 1963: 441-442; Ricks 2016: 24; Kotlikoff 2018: 250). Bagehot (1873) was (one of) the first to argue that panics are the main problem. He emphasized that “the problem of managing a panic must not be thought of as mainly a ‘banking’ problem. It is primarily a mercantile one” (1873: 17).

In the case of a bank run, commercial banks must exchange bank deposits on demand at par into cash or bank deposits of another bank. Shadow banks must exchange money market instruments on demand at par into bank deposits. Non-bank agents can run a bank, but banks can also run each other. To fulfil the demand, assets must be sold immediately and/ or banks must borrow from other banks and/ or the central bank has to act as LOLR. A bank only lends to another bank if ‘eligible’ collateral is offered – an issue in case of a panic is the valuation of this collateral, that is, assessing risks (explained in section 4.3.2). Diamond and Rajan (2001: 287-8) explicitly connect fire sales to “self-fulfilling runs”. Friedman and Schwartz (1963: 308) argue that “contagion knows no geographical limits”; that is, a run on a bank in one country (or state in the U.S.) can cause a run in another country. In these uncertain circumstances, dynamics can become self-fulfilling. As a consequence, both unhealthy banks and healthy banks can become subject to a run and fail (Diamond and Dybvig 1983: 402). Because banks lose their funding (contractual money is also funding, explained in chapter 5), they dispose of existing loans and stop making new loans (Bernanke 2018: 10). The *supply* of loans decreases rapidly, and this causes real economic problems – called a ‘mercantile’ problem by Bagehot (1873).

Scholars in this group often refer to Bagehot (1873), Merton (1948) and Schelling (1980). Merton (1948) explains in an essay titled ‘The self-fulfilling prophecy’ how the expectation of a run can start a run. Similarly, Schelling (1980: 91) explains that the problem is that “everyone expects everyone else to expect everyone else to expect the result; and everyone is powerless to deny it.” A shift in expectation causes a bank run (an implosion) if enough people think it is implausible. Because of a lack of coordination, a suboptimal outcome is possible, that is, a systemic financial crisis (Ricks 2016: 70-1; Schelling 1980: 208). According to bank run theorists, a bank run is the result of a shift in expectations and thus mainly a psychological event (e.g., Diamond and Dybvig 1983; Ricks 2016).⁴⁹ Currently, this shift can lead to a collapse

⁴⁹ Ricks (2016: 70) states that “the shift from one equilibrium to the other is inherently a psychological matter”; that is, a bank run is caused by “a shift in expectations” (Diamond and Dybvig 1983: 404).

of the whole monetary and financial system. In those circumstances, governments and central banks must act immediately.

Not all scholars in this group, however, explicitly connect panics to the design of the monetary and financial system and the design of specific contracts. For example, Bagehot (1873) and Friedman and Schwartz (1963) do not in detail explore the causes of panics. In contrast, in the aftermath of 2007-9, several scholars explicitly related the design of the current monetary and financial system and design of specific contracts to panics (e.g., Cochrane 2014; Ricks 2016; Kotlikoff 2018). A bank run is possible because in the current system contractual money dominates – as the next sections will explain.

In summary, according to scholars advocating the bank run theory, bank runs cause systemic financial crises. When this happens the *supply* of bank loans decreases significantly. During a bank run, financial intermediaries lose funding, and as a result, stop making new loans. Figure 6.3 visualizes the focus of bank run theorists in terms of balance sheets.

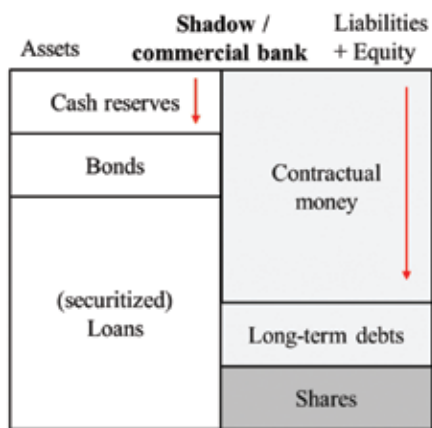


Figure 6.3: Focus of bank run theorists

Because of the devastating result of systemic financial crises caused by bank runs, these scholars conclude that panics are the biggest threat the current monetary and financial system poses to the economy (e.g., Ricks 2016: 103; Ricks *et al.* 2018: 11). According to debt-cycle theorists, a systemic financial crisis is, in contrast, caused by the bust of a debt bubble. In case of a bust, the *demand* for bank loans decreases significantly. The role of a bank run is minimal.

6.3.3 The contractual liquidity theory

Bernanke (2018: 4) and some other scholars (e.g. Minsky 1986a) notice that both theories are not (completely) mutually exclusive but complementary. The contractual liquidity theory of systemic financial crises combines the debt cycle theory and bank run theory. In the current system, commercial banks and shadow banks (including issuers of stable coins) create contractual money and cover this with risky assets ((securitized) loans) to make profits and promise contractual liquidity (explained in chapter 4 and 5). The contractual liquidity theory emphasizes that by creating contractual money out of loans (debts) and promising contractual liquidity banks produce two kinds of systemic risks: debts and promises of *unconditional* contractual liquidity.

In the aftermath of the financial crisis of 2007-9, several central bankers paid attention to the special position of bank deposits (e.g., King 2016; Shirakawa 2017; Ordóñez 2018b). They describe it as functional money and a promise to return money. This thesis defined bank deposits and money market funds as forms of contractual money based on contractual liquidity and covered with debts (see subsection 2.6.1). Contractual money based on unconditional contractual liquidity has six features⁵⁰:

- a. The issuer has the obligation to exchange on demand at par immediately, that is, the exchange rate is fixed.
- b. Infinitesimal maturity. The contract is rolled over indefinitely and automatically.
- c. Non-tradable. The contract is a relation between the account holder and the issuer.
- d. A 'sequential service constraint' (Diamond and Dybvig 1983: 408; Greenbaum *et al.* 2016: 286-7). In case of a bank run, the bank serves the first withdrawers first.
- e. A failure to fulfil withdrawals triggers bankruptcy or leads to government and/or central bank interventions to avoid self-fulfilling dynamics (a domino effect).
- f. Connected to debts.

Chapter 5 explained the difference between banks and non-banks: only the first fund their business with contractual money. Commercial banks finance themselves with bank deposits and shadow banks with money market instruments as non-floating MMFs shares and repos that are very similar to bank deposits (see section 5.3.16). The non-bank private sector funds itself with securities (bonds and/or shares). Securities trade at market value and offer market liquidity. Holders of shares and bonds have the

⁵⁰ Greenbaum *et al.* (2016: 286) define four features of deposit contracts.

possibility to sell their security on a market and are themselves responsible for risk management. The price of a security is determined on the market.

Holders of bank deposits always have the opportunity to exchange their investment at par. Tucker (2019a: 10) explicitly calls the objective of current regulation “an exchange rate of unity between public and private money-like liabilities.” The holder of a bank deposit has the right to get repayment from his/her bank. The bank has the contractual obligation to exchange a bank deposit on demand at par into cash or to transfer it at par to another account. In case of problems, the central bank acts as LOLR and risk management is thus ultimately publicly backed up.

In economic practice, contractual money fulfils several (conflicting) functions. Four of the functions of bank deposits are: 1) funding of commercial banks, that is, funding of debts; 2) means of payments of non-bank economic agents; 3) stores of value of non-bank economic agents, and 4); claims on cash of non-bank economic agents. Three of the functions of money market instruments are: 1) funding of shadow banks, that is, funding of securitized debts; 2) stores of value of (large) non-bank economic agents (as institutional cash managers), and; 3) claims on bank deposits of large non-bank economic agents (as institutional cash managers). Sometimes these functions conflict. In case of a withdrawal of a bank deposit, the legal-economic basis, and the riskiness changes for the holder of money. A risky bank deposit (contractual money) is exchanged into risk-free cash (inherent money). A risky investment in a bank can in the current system thus always be exchanged into a risk-free asset. For the bank a withdrawal of a bank deposit has significant consequences. The bank loses funding (the deposit) and reserves (cash), that is, the bank’s balance sheet shrinks. Many withdrawals endanger bank funding and the store of value function of other economic agents. In the literature, it is well-known that deposit contracts create risks because the promise to pay on demand “cannot be done in *all* states of nature” (Greenbaum *et al.* 2016: 65; Hayek 1990; King 2010; McMillan 2014; Cochrane 2014; Ricks 2016; Kotlikoff 2018).⁵¹ Funding debts with contractual money – backed up with public protection mechanisms – is, however, rarely defined explicitly as the main cause of systemic financial crises. In the literature, it is sometimes stated that this fragility is needed for liquidity and maturity transformation. This view will be discussed in section 6.7.

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51 Per King (2016: 253): “The problem is that the liquidity promised to investors or depositors can be supplied only if at each moment a small number of people wish to convert their claim on the bank into cash. Liquidity disappears if everyone wishes to convert their claim into money at the same time.”

The problem of the fragility of contractual money sometimes comes back in novel circumstances. In 2007-9, regulators had, in the words of Bernanke (2018: 1), “not adequately identified or understood the risk that a classic financial panic could arise in a historically novel institutional setting [that is, shadow banking].” Coming decade(s) e-moneys such as WeChat and Alipay and stablecoins such as Tether can cause similar problems in novel institutional settings. An open question is if public central banks will ultimately rescue those forms of money. The run on money market instruments in 2020 suggests that debt cycles are not per definition the cause of a crisis, changing sentiments or worries about assets can already cause a run on contractual liquidity.

According to the contractual money theory, the current monetary and financial system is thus (still) fragile by design because it is to a large extent based on contractual money connected to debts and new forms of contractual liquidity are continuously introduced (e.g., stable coins today). Contractual money is fragile by design because it offers unconditional contractual liquidity. Figure 6.4 visualizes the explanation of contractual liquidity theorists in balance sheet terms.

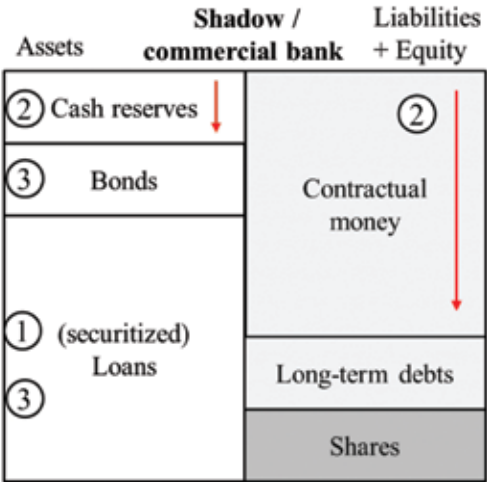


Figure 6.4: Focus of contractual liquidity theorists

In this view, a bank run is caused by justified or unjustified doubts (rumours) about assets (debts) of (shadow) banks (1). These doubts lead to a contraction of contractual money and cash reserves (2). Banks are forced to sell assets to get new cash reserves (3) or have to borrow central bank reserves from the central bank against the base interest rate (explained in 5.3.12). When they fail to get new reserves, shadow banks collapse and commercial banks must freeze access to bank deposits, that is, shut

down ATMs. When this happens, central bankers and politicians are tended or maybe better ‘forced’ to do whatever they can to rescue money, the payment system, and the monetary and financial system as a whole. To better understand the three theories on systemic financial crises, the next section revisits the main events of the financial crisis of 2007-9 and reviews comments and testimonies of bankers (using and expanding the analysis of Kotlikoff 2018) and the empirical data analyses of Ricks (2016) and Bernanke (2018) – for a full overview of the events see St. Louis Fed (2017).

6.4 The systemic financial crisis of 2007-9

The financial crisis of 2007-9 was, on the one hand, a systemic financial crisis that confirmed the validity of the words ‘this time is different’ (Reinhart and Rogoff 2009). The crisis was different because there were new markets (e.g., money markets), new techniques (e.g., securitization) and new lenders (e.g., cross-country lending). On the other hand, the problem was the same. Scholars advocating the debt cycle theory argue that it was just another debt cycle and scholars advocating the bank run theory emphasize that it was just another bank run – this time first on money market instruments and later on bank deposits. The contractual liquidity theory emphasizes the roles of funding debts with contractual money and promising unconditional contractual liquidity.

A press release of the French bank BNP Paribas on 9 August 2007 is often mentioned as the first sign of the financial crisis of 2007-9.⁵² BNP Paribas stated that it no longer allowed redemptions of three of its money market funds (contractual money funds) because the market for asset-backed securities (the assets on the balance sheet) became illiquid. In other words, BNP Paribas was no longer able to fulfil contractual liquidity. The ECB solved this problem through a conventional intervention of unconventional large scale. €94.8 million was injected into the three money market funds. In other words, the ECB ‘suddenly’ decided to insure this form of privately issued contractual money. In 2007, 43 money market funds were taken over by their sponsors, commercial banks, to get direct access to the function of LOLR, to liquidity support.

On 14 September 2007, the British bank Northern Rock got into trouble. The bank was unable to fulfil contractual liquidity and to attract new funding. Although the bank had at that moment the highest capital ratio of all banks in the UK, the Bank of England was asked for liquidity support (King 2010: 7). Two developments help to understand the problems of Northern Rock. First, the bank’s balance sheets had

⁵² “The complete evaporation of liquidity in certain market segments of the US securitisation market has made it impossible to value certain assets fairly regardless of their quality or credit rating” (BNP Paribas 2007).

multiplied five times in the decade before 2007 (Tooze 2018: 145). In this process, the composition, and the value of its assets (loans) had become much more difficult to assess for investors – including holders of contractual money (bank depositors and holders of money market instruments). Because of this lack of transparency market valuation was hindered. Second, the expansion of the balance sheet was only partially funded by bank deposits, equity, and long-term debt and mainly, for 80 per cent, by money market instruments. The commercial bank Northern Rock had thus gradually turned into a shadow bank. Its business model was based around a specific short-term funding model that suddenly became unviable (King 2010: 7). Because of a lack of trust, possibly caused by a lack of transparency, first professional cash managers and later depositors ran Northern Rock. Deposit holders realized that only 100 per cent of the first £2.000 and 90 per cent of the next £33.000 was insured. In the digital age, depositors ran Northern Rock's offices and its internet banking. As a result, the servers became overloaded. In this process, the bank was unable to fulfil contractual liquidity, and to attract new (short-term and/ or long-term) funding. The Bank of England assessed the risks as too high, and bankruptcy was the result.

On 10 March 2008, the American investment bank Bear Stearns failed. Also, this bank was no longer able to attract funding in money markets because it was unable to offer eligible collateral. In slightly different words, it had become hard (or even impossible) for others to assess the value of Bear Stearns' assets properly. Transparency about assets is essential. This insight is used to develop guidelines in chapter 8 and chapter 10. To understand what happened in the U.S., some testimonies of involved regulators and bankers are relevant. Cox, the chairman of the U.S. Securities and Exchange Commission (SEC), emphasizes in a letter to the BIS that the problem of "Bear Stearns was a lack of confidence, *not a lack of capital*" (SEC 2008, italics added). The capital ratio of Bear Stearns was "well above what is required to meet supervisory standards calculated using the Basel II standards" (SEC 2008, see also Kotlikoff 2018: 7). A high capital ratio is thus not sufficient to realize trust. The key issue was, according to Cox, that "the market rumors about Bear Stearns *liquidity problems became self-fulfilling*" (SEC 2008, italics added). Jimmy Cayne, the CEO of Bear Stearns, confirmed Cox's view in his testimony for the Financial Crisis Inquiry Commission:

Bear Stearns's collapse was not the result of any actions or decisions unique to Bear Stearns. . . . the market's loss of confidence, even though it was unjustified and irrational, became *a self-fulfilling prophecy*. (Washington Post 2010; Cayne 2010, italics added)

The letter and testimony confirm what bank run theorists suggest. Not high debts per se but ‘a self-fulfilling prophecy’ caused the systemic crises of 2007-9. This is also confirmed by the rapid fall of the share price of Bear Stearns. In the week before the bankruptcy, the share price of Bear Stearns dropped from \$70 to \$2 without ‘real’ fundamental news. The only ‘real’ news was there was a run on Bear Stearns occurring (Kotlikoff 2018).

The failure of Bear Stearns was the moment that everyone expected “everyone else to expect everyone else to expect the result” and everyone was “powerless to deny it” (Schelling 1980: 91). Professional investors and bankers suddenly realized that they did not know (exactly) the value of bank assets (securitized loans). This aggravated the self-fulfilling dynamics. Investors and institutional cash managers started to withdraw their contractual money from (shadow) banks. They asked for a form of money higher in the hierarchy (explained in section 5.3.2 and 2.6). In 2008, shadow bank money dominated in the U.S. The value of repos, eurodollars, commercial paper and money market funds was approximately \$15 trillion, the value of traditional bank deposits \$8 trillion and the value of cash and coins \$1 trillion (Menand 2022: 117).

As an investment bank, Bear Stearns did not have access to the LOLR. Because the bank was too-big-to-fail, a solution had to be invented. The largest business partner of Bear Stearns, JPMorgan Chase, received a Fed-loan of \$12.9 billion that was directly channelled to Bear Stearns with an agreement that the Fed would guarantee the risks. Financial risks were made public. If the loan would result in a loss, this would decrease the profits the Fed would pay to the government, that is, the taxpayer insured the risk (De Vries 2020: 375). This is another example of the public protecting privately issued contractual money. The lesson is that contractual money can only exist long-lasting with public protection mechanisms or should be fully covered with the highest form of money in the hierarchy.

On 15 September 2008, a larger American investment bank Lehman Brothers bankrupted. Likewise, this bank was no longer able to fulfil contractual liquidity and to attract new funding. Collateralized repo funders (contractual money funders) asked for collateral (securitized loans) and the Fed could not lend without ‘good’ collateral. In the aftermath of 2007-8, several scholars argued that the Fed’s risk assessment was at that time too pessimistic, and its reasoning was called ‘vague’ (Ball 2018; van ‘t Klooster 2021). At the end of 2007, 50 per cent of Lehman Brothers funding consisted of repos (contractual money). Other investment (or shadow) banks had a similar funding structure. Goldman Sachs, Merrill Lynch and Morgan Stanley had

40 per cent repo funding (contractual money) (Tooze 2018: 62). Also, in this case a lack of transparency, contractual liquidity, and self-fulfilling dynamics – and not high debts per se – were most significant, according to involved regulators and bankers. Richard Fuld, the CEO of Lehman Brothers, said in his testimony:

At Lehman Brothers, the crisis in confidence that permeated the markets led to an *extraordinary run on the bank* [on contractual money]. In the end, despite all our efforts, we were overwhelmed. However, *what happened to Lehman Brothers could have happened to any financial institution*, and almost did happen to others. Bear Stearns, Fannie Mae, Freddie Mac, AIG, Washington Mutual, and Merrill Lynch all were trapped in this *cycle*. Morgan Stanley and Goldman Sachs also came under attack. (Fuld 2008, italics added)

The question is if it could happen to any financial institution. It depends on how these institutions are funded. Only if financial institutions (debts) are funded with contractual money (credit money offering unconditional contractual liquidity) a run can happen. If financial institutions are funded with (long-term) securities offering market liquidity a run cannot happen. In line with Fuld, Schapiro, chairman of the SEC, stated in a testimony before the U.S. Financial Service Committee:

The immediate cause of Lehman's bankruptcy filing on September 15, 2008, stemmed from *a loss of confidence* in the firm's continued viability resulting from concerns regarding its significant holdings of illiquid assets and *questions regarding the valuation of those assets*. The loss of confidence resulted in counterparties and clearing entities demanding increasing amounts of collateral and margin, such that eventually, Lehman was unable to obtain routine financing from certain of its lenders and counterparties. (Schapiro 2010, italics added)

The fall of Lehman Brothers aggravated the self-fulfilling dynamics further. Everyone was expecting everyone to expect an implosion. It became clear that many (securitized) debts of which the value was hard to assess were funded with contractual money. On the same day, September 15, AIG, a finance and insurance company, also faced liquidity problems. To avoid a collapse, AIG received government support of \$85 billion (Thakor 2015: 161). Subsequently, on September 16, a money market fund, the Reserve Primary Fund, bankrupted. This caused a self-fulfilling run on the money market funds (contractual money funds).

To stop the self-fulfilling dynamics central banks extended first their open market operations and shadow banks merged with commercial banks to get access to the central

bank as LOLR (Gertler and Christ 2018: 14, see Bernanke 2018: 62-3 for an overview of policy responses to the panic). Therefore, central banks got more involved in risk management. In addition, in the U.S. the Treasury extended DIS to shadow banks as money market funds and the amount was increased from \$100,000 to \$250,000. An example of path dependency. The public protection mechanisms of contractual money thus extended significantly. However, “the financial crisis spread like a cancer from the shadow banking sector, which funded mainly securitized assets, to the commercial banking sector” (Gertler and Gilchrist 2018: 14). There were rumours that the situation was much more severe than expected. This further contributed to the self-fulfilling dynamics. Because of the lack of transparency, it was hard to assess if the rumours were justified or not. As earlier said, the insight that transparency is significant will be used in chapter 8 and 10 to develop generic design guidelines.

To stop the crisis, governments and central banks injected capital and purchased bad assets (especially mortgage-backed securities (MBSs)) to protect contractual money and maintain parity between different forms of money. For example, in the U.S. in October 2008 the government bought \$250 billion preferred equity in the nine largest banks under the Troubled Asset Relief Program (TARP). The Fed restored money market funding (contractual money funding) of banks via the implementation of new facilities. The Term Auction Facility (TAF) offered an alternative to asset-backed commercial paper, asset-backed securities, and collateralized debt funding. The Term Securities Lending Facility (TSLF) lent US Treasuries in exchange for MBSs. The Primary Dealer Credit Facility (PDCF) offered an alternative to repo funding. The Commercial Paper Funding Facility offered an alternative to commercial paper funding. In total, respectively \$6,18 trillion, \$2 trillion, \$8,951 trillion, and \$0,737 trillion have been lent via these facilities (Tooze 2018: 207-9, see also Ricks 2016: 99). Of the users, around 50% were non-American banks. In all those facilities, the Fed acted as counterparty and managed financial risks.

On the international scale, also fundamental changes were implemented (see also section 4.3.2). The Fed became without any public consultation global LOLR. The Fed lent to American banks as well as to non-American banks (especially European banks) on a large scale against a wide range of collateral. Also, in this case, public risk management expanded significantly. In addition, the Fed implemented currency swap lines to other major central banks. By doing this, the Fed established itself as the pivot in the global monetary and financial system. It became the global lender of last resort as well as global derivative dealer (Buiters 2018). Consequently, the Fed increasingly became involved in financial risk management.

Ricks (2016: 113-122) and Bernanke (2018) add empirical evidence to the testimonies of involved bankers and supervisors – see also various publications by Gary Gorton, e.g., Gorton (2012a, 2012b, 2019), Gorton and Metrick (2012) and Gorton *et al.* (2018). Ricks presents data to show how the bank run caused problems in the real economy in 2007-9. During the bank run, banks dumped financial assets (bonds and (securitized) loans) on the market to fulfil demand. Holders of contractual money attempted to exchange in inherent money or a form of contractual money higher in the hierarchy (see section 2.6 and 5.3.2). The fire sale led to big spikes on bond spreads and caused significantly lower asset prices. As a consequence, the costs of funding for non-bank economic agents increased significantly while the quantity of funding decreased in 2008-9 (Ricks 2016: 113-7). A run on contractual money had thus an impact on the real economy. Empirical data show that financial intermediaries that were more reliant on contractual money funding reduced lending to businesses more significantly (Ricks 2016: 118 based on Ivashina and Scharfstein 2010). Moreover, a significant failure of arbitrage in markets for credit default swaps occurred in 2008-9 that overlaps in terms of timing and accuracy of the change in US employment (Ricks 2016: 118-121; Chodorow-Reich 2014 and Bernanke 2018). Ricks (2016: 120) concludes that “the panic crunch fits the jobs disaster like a glove.” The data presented by Ricks (2016: 113-122) show that a bank run and not high debts per se led to a widespread contraction in the supply of bank loans. Bernanke (2018) confirms the analysis of Ricks (2016). Bernanke (2018) uses four sets of financial data – subprime mortgage-backed securities (ABX BBB), LIBOR-OIS, ABS spread and CDS spread – in his analysis to identify points of discontinuity in the evolution of the financial crisis of 2007-9 and to evaluate the extent to which those shifts predict changes in macroeconomic indicators. Bernanke identifies four stages:

1. the deflation of the housing bubble and increasing concerns about the mortgage market (indicated by data of ABX BBB);
2. the beginning of liquidity problems by shadow banks, the first sign of a panic, a run on contractual money (indicated by data of LIBOR-OIS);
3. a complete panic, that is a bank run on wholesale funding (contractual money) (indicated by a sharp rise of the spread of ABS credit) leading to a fire sale; and
4. capital losses of shadow banks, commercial banks, and other financial institutions (indicated by the CDS spread) leading to significantly less credit supply.

Subsequently, Bernanke (2018) analyses two sets of data categorized into ‘panic factors’ and ‘balance sheet factors’. Panic factors are short-term funding (contractual money funding) and non-mortgage credit. Balance sheet factors are housing and mortgages and bank solvency. Bernanke (2018: 48) concludes that “the predictive power of the two ‘panic factors’ greatly exceeds that of the two ‘balance sheet

factors’.” The severity of the financial crisis of 2007-9 can, also according to Bernanke, only be explained by the bank run theory, that is, “the fact that the panic preceded a broad-based downturn, and that the end of the panic preceded an improvement in macroeconomic conditions, is *prima facie* evidence that the panic had significant real effects” (Bernanke 2018: 59). The panic (and not high debts) was thus by far the best predictor of real economic changes and ending the panic (and not ending high debts) resulted in economic improvement (Bernanke 2018: 4).

The testimonies and empirical facts thus suggest that a bank run on contractual money caused the systemic financial crisis of 2007-9. Rising house prices and the bust of the debt cycle can trigger a crisis but are not always and not per definition the cause of systemic financial crises. A key question is if bubbles are funded by runnable contractual money (short-term debt) or by equity and/ or other long-term securities offering market liquidity. Research confirms that “bank-based financial structures are associated with higher systemic risk than market-based financial structures” (Bats and Houben 2020: 1, see also Bats and Houben 2017, Gambacorta *et al.* 2014). The key lesson is that banks create two types of systemic risk: debts and contractual money offering unconditional contractual liquidity. If there are justified or unjustified doubts about debts, contractual money is at risk. Moreover, a key insight is that the central banks do currently not have the instruments to manage the issuance of contractual money outside the traditional banking sector but do have the instruments to backstop contractual money and its issuers in times of crises (Menand 2022: 121).

High debts are likely increasing the chance of a bank run, especially when there is a lack of transparency about those debts. The contractual money theory thus emphasizes that the key question is how debts are funded. High debt may, however, for other reasons be undesirable; often mentioned reasons are: 1) a slower recovery after a financial crisis; 2) limiting economic growth, and; 3) more volatile expenses (IMF 2012: 96-100; IMF 2016; WRR 2019: 112). Moreover, it has to be remarked that the problem of high debts is not only a monetary and financial problem. It can be influenced via other policies as well, for example, via fiscal policy.

6.5 Problem justification

This section analyses the social consequences of systemic financial crises. The consequences often mentioned in the literature can be categorized into three groups: 1) direct fiscal costs; 2) indirect fiscal and economic costs, and; 3) loss of credibility and legitimacy. This thesis adds a fourth consequence: the emergence of a systemic dynamics of protecting and constraining banks by governments at the core of market economies.

6.5.1 Direct fiscal costs

To halt systemic financial crises, governments generally bail-out banks. In 2007-9, governments spent trillions of dollars on bailouts. The Dutch government spent, for example, €174 billion, 27.3 per cent of GDP (DNB 2011; WRR 2019: 125). The median direct fiscal costs of systemic financial crises in the first year were 6.8 per cent of GDP between 1970 and 2011 (Dell’Ariccia 2018: 29). However, direct bailout costs or direct bailout costs as a percentage of GDP are hard to calculate exactly, because the costs differ per methodology and across timeframes. Bailouts become sometimes profitable after a (long) period – for example, when shares of nationalized banks are sold to private investors. Most scholars focus on the direct bailout costs although the calculations are often “misguided and incomplete” (Reinhart and Rogoff 2013: 4565). The direct bail-out costs are relevant, but only a fraction of the indirect costs.

6.5.2 Indirect fiscal and economic costs

The indirect fiscal and economic costs of systemic financial crises are more significant (Reinhart and Rogoff 2013; Turner 2016; Ricks 2016; Bernanke 2018: 66; WRR 2019: 126). These include lost output (GDP), higher unemployment, bankruptcies and increases in public debt. The average increase of public debt after a banking crisis in developed as well as in emerging countries is 86% (Reinhart and Rogoff 2013: 4569). Wolf (2014: 325) estimates that “in the cases of the US and the UK, the fiscal costs are of roughly the same scale as a world war, while the present value of economic costs could be even greater, since economies often recover more strongly after wars than after financial crisis.” Researchers of the Dallas Fed estimated the costs conservatively at 40 to 90 per cent of one year’s output, that is, \$6 trillion to \$14 trillion, the equivalent of \$50,000 to \$120,000 for every U.S. household (Atkinson *et al.* 2013: 1). Other scholars also estimate the costs in terms of lost output. For example, Ricks (2016: 102) shows how 10 ‘panics’ in the U.S. banking system during the last two centuries caused economic disasters measured in terms of output decline. Dell’Ariccia (2018: 36) associate systemic financial crises with a cumulative output loss of 23 per cent of GDP. The indirect fiscal and economic costs are thus more significant than the direct bail-out costs.

6.5.3 Loss of credibility and legitimacy

According to several scholars, the largest costs (consequences) are not fiscal and economic, but societal and political (Wolf 2014; Goodhart 2015; Tooze 2018; Ordóñez 2018a, 2018b; Cochrane 2019; Carney 2019; OECD 2019; Tucker 2019a, 2019b; de Vries 2020; Menand 2022). These scholars emphasize the devastating loss of credibility and legitimacy of the political, administrative, and financial leaders.

The loss of credibility has, according to Tooze (2018: 22), been “flagrant” and “comprehensive”. In Tooze’s view (2018: 609), bank failures forced “scandalous government intervention to rescue private oligopolies”. Although the measures taken were relatively successfully “TARP and the bailouts became dirty words and the Fed suffered a spectacular loss of legitimacy” (*Ibid*: 610). Ordóñez (2018b: 10) argues similarly that the financial crisis of 2007-9 has “negatively affected the reputation of private banks and Central Banks and Supervisors”. Cochrane (2019) argues that “the revelation that elites didn’t know what they were doing led to today’s populism.” Also, according to Carney (2019: 9), the current monetary and financial system “is not only making it harder to achieve price and financial stability but it is also encouraging protectionist and populist policies which are exacerbating the situation.” Tucker (2019a: 24) states that “financial crises bring massive costs: economically, socially, culturally, and maybe even again (echoing Europe’s deepest 20th-century calamity) constitutionally.”

Empirical research confirms the picture of distrust and loss of credibility and legitimacy. For example, in the U.K., ten years after the fall of Lehman Brother research among 2,250 citizens shows that 66% do not think banks work in the general interest, 72% believe banks should have had more severe penalties and 63% thinks that bank can cause another financial crisis (Positive Money 2018). Research among more than 25,490 people in the Netherlands shows similar results: 62% of the respondents argue that banks did not learn anything from the crises and 81% think a state bank is required (Radar 2019; see also WRR 2019: 28-29). Other research shows a rapidly declining trust in central banks. For example, in 2014, the majority of Europeans distrusted the ECB (Roth *et al.* 2016; Gallup 2014). In short, the consequences of the loss of credibility and legitimacy are, although diverse and hard to assess exactly, significant.

6.5.4 The systemic protecting and constraining of banks by governments

The fourth consequence of systemic financial crises is rarely mentioned in the literature but is relevant because it has become a systemic problem in itself: the systemic protecting and constraining of banks by governments. Ordóñez (2018a, 2018b, 2020) and Cochrane (2014) are two of few scholars who explicitly connect the fragility of currently dominant forms of private money to public protection mechanisms and an increasing amount of regulation. Minsky (1986a: 106) also explicitly connects public protection mechanisms to moral hazards and the introduction of new forms of contractual money: “Every time the Federal Reserve protects a financial instrument, it legitimizes the use of this instrument to finance activity. This means that not only does Federal Reserve action abort an incipient crisis, but it sets the stage for a resumption in

the process of increasing indebtedness – and makes possible the introduction of new instruments.” This section explores these dynamics in more detail and is structured as follows: section 6.5.4.1 explains the systemic protecting and constraining of banks by governments and section 6.5.4.2 analyses its consequences.

6.5.4.1 Systemic dynamics

In the aftermath of a systemic financial crisis, the reaction of politicians is already more or less the same for more than a century. Existing public protection mechanisms are extended and/ or a new public protection mechanism and/or more constraints (regulations) are implemented, and public risk management is expanded. In the aftermath of 2007-9, among others access to the central bank extended to shadow banks and the amount of deposits insured increased significantly – e.g., in euro-area to €100,000 and in the U.S. \$250,000. Moreover, new regulations were implemented, for example, resolution procedures, macro-prudential supervision, stress tests and capital-to-risk-weighted-assets ratios. This is another step in the systemic protecting and constraining of banks by governments that emerged last century. On the one hand, banks receive support and are protected, on the other hand, banks are regulated and constrained.⁵³

The underlying driver is that new regulations as well as new public protection mechanisms and central bank interventions in the financial system (as QE) generally create new moral hazards and cause thus indirectly the need for more and ‘better’ regulations. Figure 6-5 visualizes the systemic protecting and constraining of banks by governments and the relationships among elements. The arrows show the relationship between elements. If an arrow points into one direction, the influence is one-directional. If an arrow points into two directions, the influence is mutual. The pluses and the minuses show if the influence is increasing (or reinforcing) the other element (a plus) or decreasing (or diminishing) the other element (a minus).

The dynamics start with the creation of contractual money out of bank loans (a). This form of money creation decoupled the monetary system from precious metals, but also caused monetary fragility by introducing two kinds of systemic risks (b) – debts and contractual money (credit money offering unconditional contractual liquidity). Sometimes a systemic financial crisis occurs (c). In the case of a systemic financial crisis, governments and central banks are ‘forced’ to support forms of contractual money and its issuers (banks) (d). They implement and/or extend public protection

⁵³ The description of this dynamic is based on presentations of and (e-mail) conversations with Miguel Ángel Fernández Ordóñez (former governor of the Bank of Spain).

share of 76% in 2016, and increase of 5% since 2006 (WRR 2019: 211) – although those statistics are hard to interpret because some activities of banks are monopoly activities (especially money creation and money registration), other activities are oligopoly activities (e.g., payment services and lending to consumers and SMEs) and other activities are non-monopoly activities (e.g., lending to corporates, advice, insurance and wealth management). One of the causes of the concentrated market structure is likely the growing amount of increasingly complex regulation. More regulation makes it more difficult to establish a bank. New entrants can, for example, not enter the market without a large compliance department.

According to several scholars, the amount as well as the complexity of regulation have become problems (King 2010; Haldane and Madouros 2012; Wolf 2014; van Egmond and de Vries 2016, 2018; Ricks 2016; Admati 2016; Kolly *et al.* 2017; Gorton 2019: 25). In the aftermath of the financial crisis of 2007-9, the Bank of International Settlement has published 2,795 pages of regulation (Kolly *et al.* 2017). Subsequently, these pages were converted into national (and European) laws and guidelines. As a result, today, the total number of regulations in several countries comprises tens of thousands of pages. For example, in the U.S., the final Dodd-Frank rule releases count over 15,000 pages in the *Federal Register* while the Federal Reserve Act of 1913 counted 24 pages (Ricks 2016: 248-250). Another example is the number of regulatory revisions. According to the Boston Consulting Group (2017: 4, 10), global commercial banks face 200 regulatory changes a day. Only in 2015, 51,600 revisions had to be implemented. A question is if and how executive board members of banks (private economic agents) can be held liable for this amount of regulations and regulatory changes.

The systemic protecting and constraining of banks by governments might also be an explanation for the slow growth of alternatives as fintech. Today, the once promised fintech revolution appears to have been stalled (Santander InnoVentures 2015; Accenture 2017). A reason might be that the quantity and complexity of current regulations hinder new entrants and help existing commercial banks to protect their position (Cochrane 2014: 4). This is confirmed by Blankfein, former CEO of Goldman Sachs (see also Birch 2020: 2014):

But in some ways, and there are some parts of our business, where it's very hard for outside entrants to come in, disrupt our business, simply because we're so regulated. You'll hear people in our industry talk about the regulation. And they talk about it, you know, with a sigh: Look at the burdens of regulation. But in some cases, *the burdensome regulation acts as a bit of a moat around our business.* (Blankfein in La Roche 2015, italics added).

Today, commercial banks are heavily regulated, but have on the other hand by design public protection mechanisms and privileges that fintech companies and other non-bank financial institutions do not have access to. In the words of Hockett and Omarova (2016: 1202), today “the public’s full faith and credit” is behind commercial banks and without the same access “alternative finance is not likely to outgrow its present fringe status.” This difference makes the level playing fields for financial intermediation and payments service providers unequal.

Not only the amount and the complexity but also the costs of regulation on the side of banks as well as on the side of regulators and supervisors have increased significantly during the last decades. The number and size of supervising institutions have grown significantly in the last decade. Also, on the side of banks costs of regulations have increased significantly. For example, 15% of the 204,000 employees of Citigroup worked in compliance, risk, or control in 2018; whereas only 4% worked in those fields in 2008 (Birch 2020: 125).

There is thus an ongoing entanglement of public and private affairs and responsibilities. This has as explained two sides. On the one hand, commercial banks receive protections and have exceptions and privileges (e.g., bailouts, special resolutions, no obligatory prospectus). On the other hand, the government is in the case of the commercial banks involved in many aspects of private businesses, including risk management (‘constraining’). Some argue that interference with the management of banks via microprudential regulations and conduct regulations conflicts with ordoliberal and neoliberal principles (de Vries 2020: 623-5). Increasingly supervisors act as a kind of “shadow management” (Kay 2009: 19). This conflicts not only with ordoliberal and neoliberal principles but also with a basic principle of market economies. In a market economy, private entrepreneurs (banks) should make their own decisions and risk assessments. For example, today, not private bankers but governments increasingly determine the balance sheets composition of banks, what an adequate amount of capital is and even “what counts as capital” and “how it is calculated” (Hoenig 2016). Risk management is thus increasingly the responsibility of public institutions instead of private economic agents.

Another example of increasingly public risk management is stress tests. Stress tests turned the Treasury and the Fed in the U.S., in the words of Tooze (2018: 298), “into credit-rating agencies in chief – the “United States of Moody’s” – official arbiters of private creditworthiness and confidence in America’s financial system.” Public supervisors execute stress tests (assess risks) to determine if commercial banks must

raise more capital. By doing so, they take over the role of private economic agents. This led to the idea, called “implicit promise” by Tooze (2018: 301), that commercial banks passing the stress test are safe. In the case of troubles, commercial banks that passed the stress test are expected to get assistance from these supervisors. Supervisors cannot allow bankruptcy because this will negatively influence their credibility. The expectation of assistance leads subsequently to lower funding costs. A related issue is that bank supervisors tend to focus on banks that have been underperforming because not doing so could force the government to bail out banks. Well-performing banks are ignored. However, as Kareken and Wallace (1977: 37) notice, the reason that a bank has been so profitable might be that “it has not been obeying regulations.” It could be argued that during the last decades supervisors and central banks have more and more become guardians of profitability of banks. They increasingly feel responsibility for the businesses they supervise. In a way, stress tests and other forms of regulation can be considered attempts of governments and supervisors to make commercial banks profitable. Profitable banks are healthy banks and healthy banks are essential to financial stability. Central ideas underlying a market economy and especially a capitalist market economy are competition, the ability to bankrupt and decentral risk management. In the current monetary and financial system, competition is by design limited because of commercial banks. Though competition endangers the profitability of these banks and can lead to bankruptcy. Central bankers and other supervisors therefore continuously monitor the profitability of commercial banks and increasingly also shadow banks. When profits decrease, the likelihood of a bankruptcy of a commercial bank increases and the risk of a systemic crisis thus also increases, especially when profits of more than one bank decrease. This is quite normal in markets with heavy competition. A bankruptcy must be avoided because this can lead to a broader run on contractual money. In such circumstances, central banks will likely use monetary policy to prevent a systemic financial crisis. By doing this, they protect existing banks (the existing path) and limit the growth of new financial intermediaries. This is, however, what their mandates demand from them. Ordóñez calls these actions diabolic:

These actions are logical because they avoid banking crises in the short term but are “diabolic”, because they prevent alternatives to current banks from arising. They have perverse effects since they increase leverage and stop innovations, which, in the long term, make the banking system more fragile and increase the risks of crisis. (Ordóñez 2018b: 10)

In addition, in the current design, the main monetary policy instruments are the base interest rate in combination with eligible collateral, open market operations

and quantitative easing. With QE the interference in financial markets became much stronger and risk management became more public. In August 2021, the total assets on the balance sheet of the ECB equalled almost 70% of the GDP of the Eurozone are, the assets on the balance sheet of the Bank of England 45% of the GDP of the UK, the Fed 37% of the GDP of the US, and the Bank of Japan 133% of the GDP of Japan (see for example, Hauser 2021). In the case of QE, central banks directly intervene via the purchase of securities like government bonds and corporate bonds. In these interventions, they must make decisions in which public interests and private interests have to be considered without having clear rules. QE influences (relative) prices of securities, redistributes wealth and raises fundamental questions. A key question is: ‘Why does the central bank purchase bond A and not bond B?’ This choice is per definition normative and can lead to fundamental criticisms that undermine the independent status of the monetary authority (van ‘t Klooster 2017; Cochrane 2019; Prasad 2021; Menand 2022). For example, central banks are accused of contributing to climate change because of the purchase of bonds of fossil fuel corporations (Corporate Observatory Europe 2016, 2017) and of contributing to rising inequality (Tooze 2018: 367) and favouritism (Prasad 2021: 331). The ECB is increasingly accused of purchasing government bonds to reach other objectives than price stability, e.g., protecting the Eurozone, replenishing government deficits and protecting weak banks (see for example, Issing, Stark and Schlesinger 2019; de Vries 2020). Also, the proportionality of quantitative easing has been questioned (e.g., van ‘t Klooster 2017). The ECB alone injected €2.5 trillion. The effect on consumer price inflation has been limited and there have been many unintended known and unknown consequences. The interventions are so large because QE – and to a lesser extent also the other instruments of the central bank – rely on indirect and hard to assess monetary transmission mechanisms. In theory, QE should lead to lower long-term interest rates and more investments, but in practice, it also (or mainly) leads to booms in financial and real estate markets (Focardi 2018). In recent years, the functioning of the conventional monetary instruments and monetary transmission mechanisms have been questioned. For example, several central bankers argued that a lower interest rate no longer appears to lead to higher inflation and higher nominal demand in the real economy (Yellen 2017; Borio *et al.* 2018).

Public protection mechanisms and public risk management lead to less market discipline as well as subsidised funding for commercial banks (Sanders 2019; Haldane 2013; Haldane and Booth 2014; Hockett and Omarova 2016: 1195; Ricks 2016: 185–190). The funding advantage of the large global banks is estimated at hundreds of billions a year (Davies and Tracy 2014). The credit rating of a bank improves when

the chance of government support in the case of instability is higher (Sanders 2019; DNB 2015). A consequence of this subsidized funding is inefficient capital allocation (Sanders 2019: 30).

In short, the consequences of the systemic protecting and constraining of banks by governments are various and interrelated. In the interviews, the consequences will be further researched.

6.6 Digital technologies

The previous sections examined recurrent systemic financial crises and identified a second systemic problem: the systemic protecting and constraining of banks by governments at the core of market economies. This section explains how digital technologies have worsened both problems. The first development is that bank deposits and money market instruments have been digitalized and cash not. During the last decades, private (shadow) banks digitalized their operations in several ways and cash (public inherent money) was not digitalized. Banks introduced, for example, internet banking which enabled the almost complete automation of deposit payments and ATMs automatized the exchange of deposits into cash and cash into deposits. The digitalization of central bank reserves made interbank clearing and settlement faster. In this process, transaction costs were reduced, and the position of banks became more dominant because of the growing dependence on contractual money issued by banks. The quantity of money and the payment system are increasingly dependent on private contractual money, and this will likely without change continue in the digital age. This has increased the need for public protections mechanisms and indirectly the need for regulations (constraints) to limit moral hazards. Moreover, it ‘forced’ central banks to get more involved in risk management.

The second development is that the application of digital technologies in the current monetary and financial system has accelerated the dynamics and worsened the boundary problem of financial regulation (see section 5.3.16). When banking processes were completely material, shadow banking was relatively difficult. It was for example very hard and costly to “slice, dice, and redistribute credit over a chain of balance sheets” (McMillan 2014: 54). In the digital age, it is much easier and cheaper to transform bank loans into new monetary-financial instruments. Today, the originator of a loan does not have to hold this loan on its balance sheets (explained in section 5.3.16). Digital technologies have contributed to the gradual substitution of the originate-and-hold model by the originate-to-distribute model. Loans are used to make new financial instruments and distributed to other financial institutions. Moreover,

it is much easier in the digital age to move loans and other financial instruments regularly from balance sheet to balance sheet. For this reason, measures focussing on single balance sheets – as capital ratios – are far less effective in the digital age than in the past. As a consequence, central banks increasingly have less control over the creation of contractual money and debt by (shadow) banks; that is, policy instruments of central banks are less effective (WRR 2019). In short, digital technologies likely worsen the two identified problems.

6.7 Other (conflicting) views

In the literature, several other views can be found on the fragility of banks and recurrent systemic financial crises. This section categorizes their views into four groups: 1) systemic financial crisis are inherent to capitalist economies; 2) fragility is needed for liquidity creation and maturity transformation; 3) bank deposits with sequential service provide incentives for investors to monitor and discipline banks, 4) money creation by banks is needed for innovation, and; 5) fractional reserve banking has on a systemic level three advantages over alternative systems - a) the quantity of money moves along with economic activity; b) new money enters where it is most needed, and; c) the system fulfils various desires of customers.

The first group of scholars considers systemic financial crises ‘inherent’ to capitalist economies (e.g., Bernanke 2018; Bernanke *et al.* 2019). In this view, the monetary and financial system of capitalist market economies is inherently unstable. Therefore, these scholars do not aim to develop alternatives for the main cause of systemic financial crises – contractual liquidity – but, instead, recommend to “increase the capacity of policymakers to respond effectively to panics” (Bernanke 2018: 5, 66-7). Bernanke *et al.* (2019) argue that there have been sufficient investments in the prevention of financial crises last decade, but consider it is problematic that the Fed and the U.S. government have today fewer instruments available to act in the case of a systemic financial crisis because of new rules limiting the power of the Fed (e.g., no more capital support) and the Dodd-Frank Act. However, it is questionable if the chance of a systemic financial crisis is indeed significantly lower. In the years before the systemic financial crisis of 2007-9, several central bank governors and economists similarly claimed that there was no risk of a systemic financial crisis anymore (Engelen 2015; Booth 2020: 18-21). Today, the quantity of money is still fragile, because it consists to a large extent of contractual money and contractual money will likely continue to dominate in the digital age. New forms are continuously introduced (as section 6.6 explained). Moreover, it could be argued that investments in preventing systemic financial crises have strengthened the protecting and constraining of banks

by governments and increased the involvement of central banks in risk management, and that, therefore, the conflict with a principle of market economies has gotten worse in the last decade. Because of their focus on stabilizing the current contractual money system, scholars in this group do generally neither consider and discuss the development and implementation of by design stable digital public money nor attempt to solve the systemic protecting and constraining of banks by governments and privatizing risk management. They stick to the current path.

The second group of scholars argues that fragility caused by contractual money is needed for liquidity creation and maturity transformation. Examples are Diamond and Rajan (2001: 289) who argue that “financial fragility allows liquidity creation”, and Drechsler *et al.* (2020: 1) who state that “a defining function of banks is maturity transformation – borrowing short-term and lending long-term. This function is important because it supplies firms with long-term credit and households with short-term, liquid deposits.” Most scholars in this group do not explain why banks and not non-bank financial intermediaries (as mutual funds) should provide loans. Kashyap *et al.* (2002: 1) are an exception. These scholars argue that the synergy between taking deposits and lending by banks is “the provision of liquidity on demand.” It is, however, unclear why non-bank financial intermediaries would be unable to offer commitments in which “a borrower has the option to take the loan down *on demand* over some specified period of time” (*Ibid.* 34-5, italics original). Liquidity on demand can be implemented in novel ways by using digital technologies and platforms. In addition, scholars in this group do generally not notice a change in bank lending (e.g., Prasad 2021: 39). Banks increasingly do not extend long-term credit to firms as they assume. Research shows that bank lending shifted from (high-productive) loans to firms towards (low-productive) real estate loans (mortgages) and loans to other financial institutions during the last decades (Keen 2011; Beck *et al.* 2012; Turner 2012a, 2012b, 2013, 2016; Jordà *et al.* 2013, 2014; Bezemer 2012, 2014; Bezemer and Zhang 2014; Bezemer and Hudson 2016; Bezemer, Grydaki and Zhang 2016; Stiglitz 2016a: 280; 2016b: 47-8; 2017a: 1). Also, in the aftermath of the financial crisis of 2007-9, this trend continued. For example, in 2017 10.4% of all bank loans were (high-productive) loans to businesses in the UK; a decrease of around 1% since 2008 (Bikas 2018). In addition, scholars in this group do not explain to what extent maturity transformation is the result of public protection mechanisms and to what extent it is the result of market processes. For example, Drechsler *et al.* (2020) show that bank assets have an average estimated duration of 4.2 years versus 0.4 years for liabilities. Equity is not taken into account. It is unclear what percentage of this mismatch of almost 4 years is the result of public protection mechanisms and what

the amount of maturity transformation would have been without public protection mechanisms, that is, in the market. Drechsler *et al.* (2020) point to the deposit franchise to explain why banks can pay deposit rates that are insensitive to market interest rates across countries. They argue that market power of banks allows them to keep interest rates on deposits low even when the market interest rate increases (see also Drechsler *et al.* 2017). Deposit franchises (banks) have, according to Drechsler *et al.* (2020: 2), high but fixed costs because of branches, salaries, and marketing. However, in the digital age physical branches are increasingly less relevant and other financial intermediaries have high salaries and can spend large amounts on marketing. This is not unique for banks. To this second group belong also scholars who argue that information insensitivity of money markets (and limited transparency) is needed to create money market liquidity (e.g., Holmstrom 2015; Tucker 2019a; Gorton 2019). For example, Gorton (2019: 27) states that “information-insensitivity means that agents find it too costly to produce private information about the backing collateral for the short-term debt [contractual money].” Scholars in this group do not discuss the creation of by design stable information insensitive public digital money and maturity transformation based on tradable securities and conditional contractual liquidity. Moreover, they do neither explore market processes for the funding of banks nor the possibility of free-floating bank liabilities in the digital age. In such a system, banks must tell investors what they are going to do with the money invested in them (as other financial intermediaries already do), the value of liabilities reflects the market value of assets, and risk management is privatized.

The third group of scholars suggest that contractual money (demand deposits) with sequential service provides incentives for investors (depositors) to monitor and to discipline banks (e.g., Calomiris and Kahn 1991). Contractual money allows depositors “to ‘vote with their feet’; withdrawal of funds is a vote of no-confidence in the activities of the banker” (*Ibid.* 1991: 497). In this view, sequential service arranges that not all depositors have to monitor the bank. According to those scholars, contractual money is, for this reason, in some cases superior to maturity-matched debt funding and equity funding. However, the question still is why public protection mechanisms are needed and if private entrepreneurs and financial institutions cannot develop better alternatives without public protections mechanisms using novel digital technologies and platforms. Selling other liabilities on a large scale can also have a disciplining effect on financial institutions. Finally, this incentive is increasingly less effective because of a significant increase of DIS in most countries during the last decades (explained section 4.3.3).

The fourth group argues that money creation by banks is needed for innovation. This view can be traced back to Schumpeter (1934) who emphasized the relationship between bank credit and entrepreneurial innovation, that is, “credit is primarily necessary to new combinations” (Schumpeter 1934: 70). According to Schumpeter, innovations are financed with new money and not by savings (existing money). The creation of credit money is, according to Schumpeter, key to the process of development and distinguishes a capitalistic economy from a pure exchange economy (Bertocco 2009: 619). Credit “is the characteristic method of the capitalist type of society – and important enough to serve as its *differentia specifica* – for forcing the economic system into new channels, for putting its means at the service of new ends” (Schumpeter 1934: 280). By issuing new money, bankers alter the distribution of ownership of means of production. This leads to short-term inflation because more demand is added. In the long term, new productivity is realized by new firms which lead to deflation (Anderson 2009: 280-281). Commercial banks and commercial bankers are, in this view, thus decisive actors for innovation. They allow and facilitate the transfer of factors of production from existing producers to new innovative entrepreneurs that will develop new products. However, today, innovative entrepreneurs are generally not funded by banks but by private investors and financial institutions as venture capitalists, that is, not by new money but with existing money (see among others Bertocco 2009: 628), and also in the past it is questionable if banks funded new combinations. For example, Kindleberger (1984: 73) remarks that, in the beginning in the UK, banks mainly financed trade.

The fifth group of scholars argues that fractional reserve banking – the creation of contractual money out of bank loans – has on a systemic level three advantages over alternative systems (e.g., Boonstra 2013, 2018; Boonstra and van Goor 2021): 1) the quantity of money moves along with economic activity; 2) new money enters where it is most needed, and; 3) the system fulfils various desires of customers. However, it could be argued that these advantages are questionable. As mentioned above, research shows that the quantity of money increasingly does not move along with economic activity. Moreover, from an economic view, it could also be argued that contractual money increasingly does not enter the economy where it is most needed (second advantage), but increasingly flows directly to the real estate and financial markets – and thus not flows to investments in new capital goods and/or “new combinations” (Schumpeter 1934). Some scholars go even further by connecting the creation of contractual money by banks to favouritism. For example, Stiglitz (2016b: 48; 2016a: 280) states that “bankers use their economic power to enrich themselves and their friends”; in other words, they lend “to those whom they “trust” and judge

creditworthy, with collateral that they value” (2017: 14) (see also Prasad 2021: 41). It is thus at least questionable that in the current system the quantity of money moves along with economic activity and that new money enters where it is most needed. Where money is most needed is, in fact, a normative discussion. The third advantage – the system fulfils various desires of customers – is also the problem of the current system. As explained in section 6.3.3, the different desires sometimes conflict in the current system causing systemic financial crises, and to prevent these functions to conflict, protection mechanisms have been implemented causing a second systemic problem: the systemic protecting and constraining of banks by governments. The proper question in the digital age is if we can use digital technologies and platforms to fulfil the various desires and significantly decrease the likelihood of a systemic financial crisis and brake or even cease the systemic protecting and constraining banks by governments. In other words, how can we make space for economic agents to develop more stable and more market-based alternatives? This will be explored in the following chapters.

6.8 Conclusion

This chapter examined the cause(s) and the consequences of systemic financial crises. It was explained that a systemic financial crisis forces governments to intervene on a large scale and emergency level and that two credible existing theories are explaining *recurrent* systemic financial crises: the debt cycle theory and bank run theory. According to debt cycle theorists, a systemic financial crisis starts with weak balance sheets, lower demand for loans and a bust of a debt bubble. According to bank run theorists, bank runs cause systemic crises. When a run happens the supply of loans decreases significantly. As a combination, the contractual liquidity theory of financial crises was discussed. This theory emphasizes that contractual money is fragile by design and that a key question (combining insights of debt cycle and bank run theorists) is how debts are funded, with unconditional contractual money – backed up with public protection mechanisms – or with securities offering market liquidity?

Subsequently, this chapter categorized the social consequences often mentioned in the literature into three groups – direct fiscal costs, indirect fiscal and economic costs, and loss of credibility and legitimacy – and a fourth consequence was identified – the systemic protecting and constraining of banks by governments. It was explained that the latter consequence has gradually become a systemic problem in itself with various (interrelated) consequences; among others, an increasing amount of increasingly complex regulation, increasing cost of regulations, a concentrated market structure with high entry barriers, increasingly less market discipline, increasingly financial risk management by central banks, and sub-optimal capital allocation.

Based on this examination, it is concluded that contractual money, that is, credit money offering unconditional contractual liquidity is a main cause of systemic financial crises as well as the systemic protecting and constraining of banks by governments. If the aim is to solve those two systemic problems, alternatives for contractual money have to be explored, developed and implemented. This problem analysis will be used to develop guidelines and will be evaluated and refined via semi-structured interviews.



Towards an initial set of generic design requirements

7. Towards an initial set of generic design requirements

7.1 Introduction

This chapter uses reference foundations to develop an initial set of generic design requirements. Because these initial requirements are innovative and preliminary, they will be evaluated and refined via semi-structured interviews (explained in chapter 9). The final set of generic design requirements will be presented in chapter 10. The requirements should demarcate the design space and provide boundaries for searching for future directions.

The remainder of this chapter is structured as follows. First, section 7.2 elaborates on two principles used in drafting the initial set of requirements. Thereafter, section 7.3 drafts six initial requirements on the monetary system, section 7.4 one initial requirement on the financial system, and section 7.5 one initial requirement on the fiscal system. Subsequently, section 7.6 discusses how the initial set of requirements relates to the problems explicated in chapter 6. Finally, section 7.7 summarizes the initial set of requirements in a table.

7.2 Two economic principles

In drafting the generic design requirements, two in economic science widely accepted principles are used as reference foundations (Schumpeter 1934, 1942; Hayek 1945; Musgrave 1957, 1959). First, the principle underlying market economies that private entrepreneurs and enterprises should take on a decentral level most decisions about the production of goods and services, pricing, and investments, because this is the most efficient way to allocate resources in many cases. Decentral decision making gives economic agents freedom and an incentive to develop (new) ideas, business plans, goods, and services (Schumpeter 1934, 1942). In the case of investing, this means, for instance, that private financiers and not central planners assess risks and decide where they invest in, and which (future) economic activities add (most) value. Decentral decision making allows economic agents to make optimal use of knowledge and information available at a decentral level (Hayek 1945).

A second principle is that the government should apply central decision making (coordination) and set central standards if positive network externalities can be realized for all economic agents (Musgrave 1957, 1959). In the case of positive network externalities, the benefit (utility) of a product or service increases when more people use it. The aim of central decisions and central standards should be facilitating efficient decentralized economic activity and allowing economic agents to develop

(new) goods, services, and businesses as easily as possible. Moreover, central decision making should prevent (the emergence of) monopolies and oligopolies. In the case of a monopoly or an oligopoly, decentral making is to a large extent substituted by central decision making. The aim of the government should thus be realizing level playing fields where no private business or limited number of private businesses has the power to control the market. There is thus a design tension between the principle of a completely decentralized market economy and the need for central decision making and coordination in some cases that must be taken into account in drafting the initial set of generic design requirements

7.3 Initial generic design requirements on the monetary system

The generic design requirements aim to describe how the monetary and financial system must function and to provide boundaries for searching for future directions. A purpose of the monetary system is facilitating decentral market exchange. By facilitating decentralized exchange, the monetary system enables specialization. One of the success factors of market economies is large scale specialization. Economic agents use the monetary system to exchange (to purchase and to sell) goods and services, to invest (to purchase and to sell securities) and to settle public tax and private debt obligations. There is thus an interdependent connection between the monetary and financial system, and between the monetary and fiscal system. Also, this connection must be taken into account in drafting initial requirements.

7.3.1 Initial generic design requirement 1

In a market economy, exchange of goods and services is more efficient when all economic agents use the same unit of account, that is, when economic agents “speak the same money language” (Issing 1999: 17, see also King 2016: 285). When all products and services are expressed in a common monetary value – that is, when all prices are set in the same unit of account –, exchange smoothens, and this facilitates specialisation. Like a language, a unit of account is more useful when more individuals use (speak) it. For the function as unit of account, positive network externalities thus exist (see examination of reference foundation functions of money in section 2.2).

Throughout history the government – or past central organizational structures, explained in chapter 3 – generally provided the monetary system in a country (or a precursor as a city-state or a kingdom) or a group of countries (as in the case of the euro) with a unit of account. The government did generally not have the power to enforce the use of the public unit of account, but it could and did encourage the use of the public unit of account in several ways (Buiter 2009). Today, governments, for

instance, stimulate the use of the public unit of account by composing all contracts and their bookkeeping in this unit of account. Moreover, governments generally accept only money expressed in the public unit of account for taxes, fees, and fines (see examination of reference foundation two groups of theories on the nature and origin of money in chapter 3).

Of all the reference foundations discussed in the previous chapters, only in a free banking system a public unit of account would not exist (see section 4.4.2). In such a system, various private currencies with their unit of account would compete. The main disadvantage of using more units of account (money languages) is that decentral exchange becomes less efficient because it is more complicated. When economic agents use various units of account (speak different money languages), time must be spent on calculating and understanding each other's prices. As a result, (decentral) exchange will be less efficient and specialization will be hindered. By establishing a public unit of account (a standard), the government can thus realize positive network externalities for all economic agents. Based on this logic, a first initial generic design requirement is formulated:

Initial generic design requirement 1: The government must ensure at least one public unit of account.

7.3.2 Initial generic design requirement 2

In the literature, several scholars emphasize the importance of the function as means of (final) payment and its relationship to free exchange (Lerner 1947: 313; Mishkin 2004: 56; Thornton 2014: 203; Wolf 2014: 120). For example, Focardi (2018: 7, *italics original*) defines money as “*a tool that allows implementing economic decisions freely and autonomously by transferring the ownership of things or granting the fruition of services.*” To function efficiently, a market economy thus needs a means of payment/ a medium of exchange that can be used in exchange on a decentral level.

Keynes (1930: 4, *italics original*) argued that “the State or Community” has claimed the right to name, describe or title money (referring to the function as unit of account) as well as “the right to determine and declare *what thing* corresponds to the name”. Only in a free banking system, a public currency would not exist (see examination of reference foundation different banking systems in chapter 4). Based on the assumption of self-interest, advocates of free banking reason that competition between private currencies will lead to stability. For example, according to Hayek (1990), economic agents will choose out of self-interest for the most stable private currency. The validity of this claim is hard to assess empirically. Currency speculation occurs and

economic agents sometimes decide to move into currencies whose value is rapidly increasing – e.g., bitcoin at the end of 2017. On the other hand, it could be argued that cryptocurrencies already have a disciplining effect on central banks. In the aftermath of 2007-9, monetary policy became unconventional and expansionary. To protect their settlement power, some economic agents switched to private cryptocurrencies last decade. This could be interpreted as a sign that they do not trust the current monetary policy and it seems reasonable to expect that if expansionary policy continues, more economic agents will switch to private cryptocurrencies. This expectation could lead to tighter monetary policy of central banks. Other scholars argue that it is unlikely that currency competition will lead to stability and notice that Hayek does not discuss the chance of the emergence of a private monopoly issuer of money (Howard 1977; Fernández-Villaverde and Sanches 2016; Ricks 2016). The most significant disadvantage of a diversity of currencies relevant for drafting requirements is that decentral exchange becomes less efficient because of higher information costs and the need for insurances for deferred payments (Cooper and John 1988; Issing 1999; Camera 2017).

Hayek (1990: 55) argues that “there is no reason why within a given community there should be only one kind of money that is generally (or at least widely) accepted.” Positive network externalities are a good reason (King 2016: 287; Issing 1999: 18, 24; Landay and Genais 2019: 58). Decentral market exchange smoothens if all economic agents use the same unit of account – speak the same money language – and use the same means of payment – use the same ‘thing’ – to settle transactions (see research into reference foundation functions of money in section 2.2.). Moreover, for efficient taxation and thus effective funding of public goods and merit goods, ‘currency consensus’ is efficient and convenient (explained in more detail in section 7.5). By establishing a public currency (a standard), the government can thus realize positive network externalities concerning (decentralized) payments (settlements) for all economic agents. Such a standard smoothens exchange and makes the functioning of a market economy more efficient. Based on this logic, a second initial generic design requirement is formulated:

Initial generic design requirement 2: The government must ensure at least one public currency.

7.3.3 Initial generic design requirement 3

In a market economy, exchange smoothens when the costs of a monetary transaction are lower, that is, when the costs of using a form of money are lower. In the terminology of transaction costs economics (TCE) (Williamson 1979; 1981), these costs refer to external transaction costs, that is, the costs of transactions between economic agents (institutions), and not to the costs of transactions within an institution that are central to TCE. The focus of TCE and this analysis is thus different. TCE argues that businesses grow (shrink) if the external transaction costs are higher (lower) than the internal transaction costs. This analysis focuses on the external transaction costs, that is, transactions with money.

In the reference foundations about the functions of money, several scholars define characteristics of a good medium of exchange and/ or means of payment and/ or a form of money (Scorer 2017; Boonstra 2018: 53; Hill 2018: 42-3). The transaction costs of a form of money can be categorized as follows:

- a. Transfer costs: the costs of transferring a form of money from economic agent A to economic agent B.
- b. Transportation costs: the costs of transporting a form of money from point A to point B.
- c. Storage costs: the costs of storing a form of money at a single point.
- d. Security costs: the costs of securing the transfer, the transportation, and the storage of a form of money.
- e. Resilience costs: the costs of being able to transfer, transport and store a form of money 24 hours 365 days a year.
- f. Accessibility costs: the costs related to giving all economic agents in a currency area access to the form of money.
- g. Information costs: the costs of assessing the value of an amount of a form of money.
- h. Denomination costs: the costs of getting the right denomination of a form of money.
- i. Depreciation costs: the costs of substituting damaged money with new money.
- j. Risk costs: the costs of insuring the (counterparty, financial/credit, and liquidity) risks involved in a transaction in a form of money (in case of settlement is not real-time).
- k. Update costs: the costs of updating a form of money to new technologies and innovations.

The lower the total costs of a transaction with a form of money, the more likely economic agents will use it as a medium of exchange and means of payment in transactions. This means that if the government ensures a public currency, it should also aim to offer a

form of money or forms of money with as low as possible total transaction costs for all economic agents to smoothen market exchange. If the transaction costs of a form of money decrease significantly compared to other forms of money, economic agents will use this form of money more often. For this reason, the government must ensure as low as possible transaction costs of (forms of money of) the public currency. Based on this logic, a third initial generic design requirement is formulated:

Initial generic design requirement 3: The government must ensure that the public currency has as low as possible transaction costs.

7.3.4 Initial generic design requirement 4

To realize network externalities over a long period, as low as possible transaction costs and stable settlement power of a currency are pivotal.⁵⁴ Stable settlement power smoothen exchange and is a precondition for stable (continuous) investments in capital, public and merit goods. If the settlement power of the public currency is volatile, economic agents will exchange the public currency into other currencies, securities and/or other (financial) assets to store value (see examination into reference foundation free banking); that is, volatility of the public currency leads to unnecessary transactions and thus to higher transaction costs. Moreover, volatility of a currency hinders investing, because it is harder to assess risks and profitability of business proposals.

King (2016: 85) notices that money in market economies is used as a means of payment and to deal with uncertainty, that is, money is a liquid reserve that gives economic agents some certainty in an uncertain world. In practice, this means that economic agents need to have access to ‘a place’ to store the settlement power of the public currency (Friedman 1969: 3; Wolf 2014: 120; Ricks 2016: 31; Tucker 2019a: 17). This allows them to transport settlement power of the public currency through time and space. In the literature, stable settlement power is often linked to the widespread use of a currency and stable economic development. For example, Camera (2017: 140) argues that “instability [of a monetary system] is a problem because it gets in the way of widespread adoption” (see also Friedman 1960: 8; Schjacht 1967: 62; Minsky 1994b: 6; Hill 2018: 43; Boonstra 2018: 53). To realize a stable settlement power, growth of production requires growth of the quantity of currency in circulation. This is, according to several scholars, the main principle of currency policy (Schjacht 1967: 117; Fisher 1922; Minsky 1994b). For widespread use of the public currency and stable economic development, stable settlement power of the public currency is thus

⁵⁴ As explained in chapter 2, settlement power is more accurate than purchasing power because money is not only used to purchase goods and services (to settle transactions) but also to settle public and private debt obligations.

pivotal. Based on this logic, a fourth initial generic design requirement is formulated:

Initial generic design requirement 4: The government must ensure that the public currency offers stable settlement power.

7.3.5 Initial generic design requirement 5

To realize stable settlement power, the institution(s) governing the public currency should not be able to benefit from this responsibility, that is, it should not be able to use monetary policy in its interest. This means that governance should neither be in the hands of or influenced by governments (day-to-day politics) nor guided by private interests. If money creation is in the hands of a government, politicians can use money creation to improve their position. For example, by handing out newly created money to all citizens before the elections. Private interests should also not solely guide the governance of money. In history, private parties regularly over-issued contractual money (claims on the public currency) to make short-term profits causing systemic financial crises (see research into reference foundations fractional reserve banking in section 4.3 and theories about systemic financial crises in chapter 6).

To reach price stability, the government should establish a public monetary authority (MA) independent of the government (politics). The objective of this MA should be realizing stable settlement power of the public currency. Empirical studies confirm that this institutional arrangement most likely leads to stable settlement power (Klomp and de Haan 2010).

Of all the reference foundations discussed in the previous chapters, only in a free banking system a public MA would not exist. Hayek (1990: 81) proposed to abolish the central bank, because in his view, “no authority can beforehand ascertain, and only the market can discover, the ‘optimal quantity of money’.” However, it is unlikely that the market can realize stable settlement power of money, because of coordination problems if all economic agents are allowed to issue the public currency. An independent public MA aiming to realize stable settlement power of the public currency is, therefore, likely beneficial for all economic agents. However, in a market economy, economic agents should have the freedom to store value according to their preferences – this will be discussed in more detail in the next section (7.3.6) and section 7.4. Based on this logic, a fifth initial generic design requirement is formulated:

Initial generic design requirement 5: The government must ensure that the monetary authority is independent of the government.

7.3.6 Initial generic design requirement 6

The first five initial requirements focussed on the public currency. This section explains the benefits of allowing private currencies. First, in line with the reasoning of Hayek (1990), currency competition may lead to stable currencies because of disciplining effects (see research into reference foundation free banking in section 4.4.2). This disciplining effect concerns the function as a store of value. In a market economy, economic agents should be free to decide on a decentral level how they store value (see explanation of reference foundation principle of market economies in section 7.2): in the public currency, in private currencies, securities or other (financial) assets? The independent public MA should have the explicit objective to realize stable settlement power of the public currency. If this is the case, private currencies have the potential to discipline the governance of the MA (Fernández-Villaverde and Sanches 2016). If the MA fails to provide a stable (and efficient) public currency, economic agents can move into private currencies to store value. At a later moment in time, when they want to settle a transaction, they exchange the private currency into the public currency again. If the public currency depreciates, economic agents receive a larger amount of the public currency at a later moment, that is, their settlement power in the public currency increases. Before the digital age, switching currencies was relatively hard and expensive. Today, digital currencies can be exchanged almost real-time and switching costs are decreasing. When economic agents move on a large scale into private currencies and securities to store value, the MA knows that economic agents distrust its governance, and a change of policy is required. An example is the move towards cryptocurrencies during the corona crisis. Central banks injected liquidity on a large scale into the monetary and financial system. As a result, the settlement power of the public currency depreciated, and some economic agents moved into cryptocurrencies to store settlement power.

A second reason to allow private currencies is that they can function as backup systems for the public currency. In case of emergency (e.g., a crash, a cyberattack or mismanagement of the public currency), economic agents can switch to private currencies – for the functions of medium of exchange and means of payment. Having a backup system is beneficial for all economic agents.

A third, more marginal (at least at this moment in time) reason to allow private currencies as complementary currencies and regional currencies is that they provide functions for certain groups of individuals, e.g., improving social cohesion and realizing a local (circular) economy (van der Linden and van Beers 2017). Private currencies give (groups of) economic agents the opportunity to organize the local

or regional economy to some extent in line with their own (local, regional) values (preferences). This freedom on a decentral level should be given in market economies. Based on this logic, a sixth initial generic design requirement is formulated:

Initial generic design requirement 6: Private currencies must be allowed as competitors, discipliners, and backup systems.

7.4 Initial generic design requirement on the financial system

Two of the purposes of the financial system are the funding of capital goods (means of production) and the organization of deferred payments (credits and debts) by connecting and intermediating between investors and businesses (Minsky 1994b; McMillan 2014; Greenbaum *et al.* 2016). To produce goods, capital goods and (skilled) labour are required. Investments in capital goods realize new business ideas and contribute to economic development. In the literature, many scholars link the financial system with resource allocation and economic development (Mehrling 1999: 141; Keen 2017: 116). Without investments in capital goods production falters. Economic agents differ on the desirability of specific investments (e.g., windmills or coal plants) and the number of investments, but they implicitly agree on the need for continuous investments in capital goods. In a market economy, it is assumed that private economic agents know (generally) better in which new business plans and capital goods to invest than central authorities (planners) know, because they have better information about local/ regional circumstances. In addition, the financial system organizes and facilitates credit and debt relationships. In a market economy, economic agents should have the freedom to decide on a decentral level who they give credit to, to whom they lend and from whom they borrow.

Time, risk, and uncertainty are pivotal for market economies and especially for the financial system. Uncertainty about the future and the ability to take risks on a decentral level allows economic agents to invent and invest in (completely) new products, to start (completely) new businesses and to open (completely) new markets – within the laws. In the financial system, economic agents should thus be free to move in unknown directions, that is, to invest into uncertain and risky business plans and be allowed to decide to whom they want to extend credit and by whom they want to borrow (in line with reference foundation principle of market economies in section 7.2). Based on this logic, a seventh initial generic design requirement is formulated:

Initial generic design requirement 7: Legal entities must be allowed to issue securities, to establish credit-debt relationships and to trade securities, credits, and debts.

7.5 Initial generic design requirements on the fiscal system

A purpose of the fiscal system is the funding of public goods and (to some extent) merit goods. Public goods are goods and services that the market under-produces or is unable to provide. Public goods differ from private goods in being non-excludable and non-rivalrous. Therefore, the government usually provides these goods and funds them via taxation. Examples are national defence and public order. Musgrave (1957, 1959) developed the concept of merit goods. Merit goods are goods and services (or ‘wants’) that are “considered so meritorious that their satisfaction is provided for through the public budget, over and above what is provided for through the market and paid for by private buyers” (Musgrave 1959: 13). Contrary to public goods, both the public and private sector can provide merit goods. Examples are education, museums, libraries, and health care. Musgrave argued that the market will underproduce, undervalue and underinvest in merit goods, because individuals focus on their costs and have imperfect information. The consumption of merit goods is often considered to deliver positive benefits for society as a whole and, therefore, it is argued that the government should spend public budget to deliver merit goods. For example, a government agrees that all individuals should receive (some form of) education regardless of the ability to pay, because in the long-term a higher educated workforce will lead to productivity gains, new business ideas and more welfare. Merit goods also differ from pure public goods because the first can be excludable and rival. The costs of public and merit goods are part of the share of government expenditures as % of GDP. In developed countries, the share of the government of total GDP is typically between 40% and 50% (Focardi 2018: 41).

Section 2.2. examined the reference foundation functions of money and explained that something can function as a means of payment and medium of exchange if (at least) two economic agents agree that something is a means of payment and/ or medium of exchange. To function as a means of tax payments, the government must accept it. Section 3.3. examined reference foundation theories on the nature and origin of money focussing on the government and the function of account and explained that state theorists consider the relationship between money and the fiscal system pivotal. For example, state theorist Knapp (1924: vii) emphasizes that “the money of a State is not what is of compulsory general acceptance, but what is accepted at the public pay office.” Similarly, Lerner (1947) wrote:

The modern state can make anything it chooses generally acceptable as money and thus establish its value quite apart from any connection, even the most formal kind, with gold or with backing of any kind. It is true that a simple declaration that such and such is money will not do, even if backed by the most convincing constitutional evidence of the state's absolute sovereignty. But if

the state is willing to accept the proposed money in payment of taxes and other obligations to itself the trick is done. (Lerner 1947: 313)

The decision and the enactment in laws to collect taxes in a specific means of payment increases the willingness of economic agents to accept this means of payment and encourages and forces citizens to value in the unit of account of this means of payment, that is, to use this money language (initial GDR 1). The research into reference foundations theories on the nature and origin of money (chapter 3) and different (theoretical) banking systems (chapter 4) showed that representatives of sovereign legitimate power (e.g., kings, city-states) and public legitimate power (modern states) often played an important role in the growth of monetary systems. The relationship between money and governments (states) – or past central organizational structures – is today for at least two reasons likely still significant. First, governments are well-positioned to establish and to maintain a unit of account for a long period. Second, governments still decide which money thing(s) is (are) accepted for payment of taxes, that is, the means of tax payments. This is pivotal because governments are today the largest counterparties in the economy – in addition, they are the legislator and have a monopoly on violence.

Only in a free banking system (see examination of this reference foundation in section 4.4.2), taxes need to be paid in private currencies. The choice of the government which private currency or private currencies it chooses for tax payments influences the acceptance of private economic agents and the relative value of private currencies. Acceptance by the government changes the status of a private currency to a (semi-) public currency. In the case of free banking, a key question is whether the government should accept all currencies or just one. Minsky (1986a) noticed that everyone can in principle ‘create’ money but that the key problem is to get it accepted. Especially acceptance by the largest counterparty in the economy, the government, is important to organize and can be considered a subsidy and a distortion of an equal level playing field for private currencies. Moreover, it is the task of the government to tax stocks and flows of money, securities, and other assets and to do this as efficiently as possible to fund public and merit goods. Accepting one currency – the public currency – significantly increases efficiency and realizes a level playing field for private currencies (forms of liquidity), in line with the reference foundation principle of market economies. Based on this logic, an eight initial generic design requirement is formulated:

Initial generic design requirement 8: The government must accept only the public currency for tax payments.

7.6 Evaluating the current monetary and financial system

Chapter 6 examined the reference foundation different theories on systemic financial crises and explicated two problems of the current design of the current monetary and financial system: 1) recurrent systemic financial crises, and; 2) the systemic protecting and constraining of banks by governments. This section discusses how the drafted initial generic design requirements relate to the two explicated problems.

The first problem, recurrent financial crises are an ongoing threat to the stable settlement power of the public currency (initial GDR 4). A systemic financial crisis in the current system endangers contractual money, that is, bank deposits and money market instruments offering unconditional contractual liquidity. Material cash is not endangered because it is inherent money. Cash has compared to other digital forms of money several disadvantages leading to high(-er) transaction costs. For example, (international) payments over distance with material cash are inefficient and impede decentral exchange. The fragility of digital contractual money (bank deposits and money market instruments) thus threatens initial GDR 4 and the high transaction costs of public material inherent money (banknotes and coins) conflicts with initial GDR 3. The next chapter reasons that public digital money can solve some of the disadvantageous characteristics of both forms of money to some extent. In other words, combining the advantageous characteristics of material cash and digital bank deposits may lead to a form of money with lower total transaction costs. This can smoothen exchange and contribute to solving the two identified systemic problems.

Chapter 4 examined the reference foundation different (theoretical) banking systems and explained that governments implemented public protection mechanisms to avoid systemic financial crises and implemented regulations (constraints) to avoid moral hazards caused by those protection mechanisms. Subsequently, chapter 6 explained that almost every new regulation leads to new moral hazards and thus indirect to the need for more regulations. As a result, the amount of regulation is increasing continuously, and public central banks are increasingly involved in risk management. Today, in several countries, the amount of financial regulation for banks comprises tens of thousands of pages and global banks must implement tens of thousands of regulatory changes a year. As a result, an increasing number of bank employees are working in compliance, risk, and control (see section 6.5.4.2). The most important consequence from a systemic perspective is that public regulators and not private economic agents on a decentral level increasingly assess risks and decide how banks are governed, how banks' balance sheets look and how banks should behave. Also, after the financial crisis of 2008-9, governments extended public protection

mechanisms and implemented thousands of pages of regulation. Moreover, central banks implemented unconventional monetary policy. With the policy of quantitative easing (QE), risk management by central banks expanded further and consequently, the independence of central banks is increasingly questioned (discussed in detail in section 6.5.4.2). Today, a key problem is thus that in the financial system, decisions are increasingly taken on a central level instead of a decentral level. Central banks increasingly assess risks and influence and determine asset prices instead of private economic agents. This conflicts with the principle of market economies that decentral decision making (including risk management) should be generally preferred above central decision making.

7.7 Conclusions

This chapter first introduced two additional reference foundations that were used in drafting the initial generic design requirements: 1) the principle of market economies to generally prefer decentral decision making above central decision making, because this is the most efficient way to allocate resources in many cases, and; 2) the principle that governments should only apply central decision making (coordination) and only set central standards if positive network externalities can be realized for all economic agents. Subsequently, this chapter explained the purposes of the monetary system, the financial and fiscal system and drafted, based on the examination of reference foundations, a set of eight initial generic design requirements – summarized in Table 7-1. These initial requirements demarcate the design space.

Table 7-1: Initial generic design requirements

<i>Initial generic design requirements</i>	
initial GDR 1	The government must ensure at least one public unit of account.
initial GDR 2	The government must ensure at least one public currency.
initial GDR 3	The government must ensure that the public currency has as low as possible transaction costs.
initial GDR 4	The government must ensure that the public currency offers stable settlement power.
initial GDR 5	The government must ensure that the monetary authority is independent of the government.
initial GDR 6	Private currencies must be allowed as competitors, discipliners, and backup systems.
initial GDR 7	Legal entities must be allowed to issue securities, to establish credit-debt relationships and to trade securities, credits, and debts.
initial GDR 8	The government must accept only the public currency for tax payments.

Finally, this chapter discussed how the drafted initial generic design requirements relate to the explicated problems. The next chapter uses reference foundations to develop a set of initial generic guidelines. These guidelines aim to give direction within the design space to solve the explicated systemic problems – to at least some extent. Also, these initial guidelines will be evaluated and refined via semi-structured interviews.



Towards an initial set of generic design guidelines

8. Towards an initial set of generic design guidelines

8.1 Introduction

This chapter uses reference foundations to develop an initial set of generic design guidelines. Like the initial requirements, the initial guidelines are innovative and preliminary. For this reason, they will also be evaluated and refined via semi-structured interviews (explained in chapter 9). The final set of generic design guidelines will be presented in chapter 10. The guidelines aim to give direction within the design space.

This chapter is structured as follows. Section 8.2, 8.3 and 8.4 draft each one initial generic design guideline. Finally, section 8.5 summarizes the initial guidelines in a table.

8.2 Initial generic design guideline 1

Chapter 6 examined two theories on systemic financial crises (a reference foundation) and explained that bank deposits and money market instruments are fragile by design because they are forms of contractual money offering contractual liquidity. If the aim is to decrease the likelihood of systemic financial crisis and to meet initial GDR 3 – the government must ensure that the public currency has as low as possible transaction costs – and initial GDR 4 – the government must ensure that the public currency offers stable settlement power – to a larger extent, then it is an option to base the monetary system in the long run to a larger extent on inherent money and to a lesser extent (or even not) on contractual money. Today, public inherent money is, however, only available in *material* form (banknotes and coins).

Chapter 2 examined different taxonomies of money (a reference foundation) and explained that the novelty of cryptocurrencies in monetary terms is that they are forms of *digital* inherent money. Before the introduction of bitcoin in 2009 only material forms of money had been inherent. All digital forms of money were forms of contractual money. Cryptocurrencies are private digital inherent money that can be used as a means of payment to settle transactions over long distances without a central agent like a (central) bank. Moreover, they can be used to store settlement power. Chapter 2, 3 and 7 explained that private currencies will likely never be used on a large scale as means of payment because economic agents must pay taxes in public currencies – forms of money denominated in the public unit of account. Also, in the digital age, the connection between the monetary and the fiscal system is still relevant. However, as a store of value they could be attractive.

Chapter 6 explained how banks digitalized their operations in several ways during the last decades. Banks introduced, for example, internet banking which enabled the almost complete automation of payments with bank deposits and ATMs automatized the exchange of deposits into cash and cash into deposits. The digitalization of central bank reserves made interbank clearing faster. Moreover, chapter 6 observed that public inherent money was not digitalized and maintained material.

Today, digital technologies offer the opportunity to implement a new form of money: public digital money (broadly discussed in the CBDC literature, a reference foundation). According to several scholars, this form of money can combine (some of) the advantages of material cash and digital bank deposits. Tobin (1987: 172, see also Tobin 1985) was one of the first to propose to “make available to the public a medium with the convenience of deposits and the safety of currency.” Lynch and Lunquist (1996) described digital money as numbers that are money and emphasized that these numbers should be storable, transferable, and unforgeable. Table 8.1 compares the relative different costs (defined in section 7.3.3) of this new form of money with public material inherent money (banknotes and coins) and private digital contractual money (bank deposits) to understand the advantages and disadvantages.

Table 8-1: Costs of different forms of money

	Public material inherent money (banknotes and coins)	Private digital contractual money (bank deposits)	Public digital money
(a) Transfer costs: the costs of transferring a form of money from economic agent A to economic agent B.	high	medium	low
(b) Transportation costs: the costs of transporting a form of money from point A to point B.	high	low	low
(c) Storage costs: the costs of storing a form of Money.	high	low	low
(d) Security costs: the costs of securing the transfer, the transportation, and the storage of a form of money.	high	medium	low
(e) Resilience costs: the costs of being able to transfer, transport and store a form of money 24 hours 365 days a year.	low	medium	high

(f) Accessibility costs: the costs related to giving all economic agents in a currency area access to a form of money.	low	high	medium
(g) Information costs: the costs of assessing the value of an amount of a form of money.	high	low	low
(h) Denomination costs: the costs of getting the right denomination of a form of money.	high	low	low
(i) Depreciation costs: the costs of substituting damaged money by new money.	high	low	low
(j) Risk costs: the costs of insuring the risks involved in a transaction in a form of money (relevant in case settlement is not real-time).	low	high	low
(k) Update costs: the costs of updating a form of money to new technologies and innovations.	high	high	low

The transfer costs (a) of public material money are high for payments over distance compared to forms of digital money. Private digital contractual money has high transfer costs for international payments and the transfer speed of those transactions is generally low. Public digital money has the potential to significantly reduce transfer costs because of economies of scale. The development of an international settlement system could, in addition, significantly reduce transfer costs of international payments. The transportation costs (b) and the storage costs (c) of public material inherent money are high, especially for large amounts, compared to digital forms of money because of its material form. Transporting and storing digital money is generally significantly cheaper. The security costs (d) of large amounts of public material money are high compared to digital forms of money. The security costs of contractual money are relatively high compared to public digital money because all commercial banks and the central bank must secure their operations. In the case of public digital money, one single system must be secured – whether or not by a distributed ledger. The resilience costs (e) of public material inherent money are low because material money cannot be hacked, and electricity and internet are not needed. The resilience costs of public digital money are possibly higher than the costs of private digital contractual money because protecting a single-point-of-failure is more difficult and thus more expensive. Possibly a distributed ledger can be used to decrease these costs. The accessibility

costs (f) of contractual money are high. Although contractual money already exists for decades, still not all economic agents have access to this form of money and for large groups of economic agents it is still too expensive to get access. The accessibility costs of public material inherent money are low. All economic agents can (start to) use this form of money, nobody must give permission or access. The accessibility costs of public digital money are likely slightly higher because a device and internet or phone connection are needed. Moreover, if access to public digital money is permissioned, accessibility costs increase, because know your customer (KYC) procedures must be followed. However, economies of scale can be realized compared to contractual money. Currently, all banks have their own KYC-procedures. The information costs (g) of public material inherent money are high. It costs time to count an amount of material cash, and the larger the amount, the more time it takes. The information costs of digital forms of money are low because the numbers are equal to the amount. The denomination costs (h) of public material inherent money are high compared to digital forms of money. Only in case of a payment with material money change is needed. The depreciation costs (i) of public material inherent money are higher compared to digital forms of money. Material money depreciates relatively fast. The risk costs (j) of contractual money are high compared to forms of inherent money because only contractual money has liquidity and counterparty risk. The update costs (k) of public digital money are potentially much lower than the update costs of material inherent money and digital contractual money because the infrastructure can be designed in this way. This may offer advantages in terms of innovation. In short, overall, it seems that public digital money could significantly reduce transaction costs and thus smoothen exchange.

However, according to several central banks, commercial banks and economists, the reasons for implementing public digital money are broader than transaction costs and payments. Since 2016, most central banks are exploring if the public money should be updated to the digital age. They refer to it as central bank digital currency. Articles and reports on CBDC are a reference foundation in this research. Central banks generally emphasize the general (or public) interest in money. For example, researchers of the Riksbank (2018: 13) state: “the alternative, that the state leaves the payment market entirely in the hands of the private sector, would be a unique and entirely new situation for a modern, developed economy.” Similarly, researchers of the Lietuvos Bank state: “Leaving changes with potential global impact fully in the hands of the private sector – whose primary goal in today’s form of capitalism is shareholders’ profit maximisation – risks structural changes that would not be in the best public interest. Therefore, the institutions whose primary goal is the good of

society cannot stay at the side-lines of this change” (Juškaitė *et al.* 2019: 5). Several commercial banks and economists also propose updating public money for various reasons (e.g., Foundry 2016; Bordo and Levin 2017; Cerqueira Gouveia *et al.* 2017; Bloomberg 2017; Berentsen and Schär 2018; Brunnermeier *et al.* 2019; Landau and Genais 2019). For example, Bordo and Levin (2017: 19-21) warn for the consequences of not introducing a CBDC and leaving the issuance of digital currency to private agents only. This can in their view cause macroeconomic instability, loss of monetary control, systems risks and severe downturns. Therefore, Bordo and Levin argue that “a passive and inertial approach to CBDC may not be the most prudent strategy” (2017: 21). Landau and Genais (2019: 71) argue that “in a highly digitalized economy, a CBDC is necessary to preserve and guarantee universal access to public money, which in turn may be essential to protect the uniformity of the currency and its role as a unit of account.” Brunnermeier *et al.* (2019: 3) conclude that “governments may need to offer CBDC in order to retain monetary independence.” Berentsen and Schär (2018: 97) argue that there is “a large unmet demand for a liquid asset that allows households and firms to save outside the private financial sector”. The financial crisis of 2007-9, the euro-crisis and increased debt-to-GDP ratios “diminished the trust in the financial system, in central banks’ ability to function as lender of last resort, and in governments’ ability to prevent another financial crisis without having to resort to drastic measures such as confiscatory taxes or forced conversions . . .” (*Ibid.*: 100). Consequently, material inherent money is today increasingly used “as an insurance against insolvency of financial institution” (*Ibid.*, see also Landau and Genais 2019: 64), that is, in the terminology of this thesis, a collapse of contractual money. In several countries, the amount of material cash is increasing while payments with material cash are stable or decreasing (Judson 2018). Other scholars argue that the lack of a digital safe asset undermines the economy and financial instability (Caballero 2010; Caballero and Farhi 2014a, 2014b). Brunnermeier *et al.* (2019) argue that platforms and data (information) increasingly have a central position in the economy in the digital age and that the rapid growth of M-Pesa in Africa and WeChat and AliPay in China suggest that we are moving in the direction of a payments and payments data centred monetary and financial system. Public digital money could play a pivotal role in this change. In short, the reasons to develop and introduce public digital money in the literature are diverse and the commonalities and differences will be examined in detail in the interviews (chapter 10).

This thesis argues based on the examination of reference foundations (i.e., theories on systemic financial crises, different banking systems and principle of market economies) that the most important reason to introduce public digital money (in combination with

the two other guidelines) is that it could help to solve the explicated systemic problems (chapter 6). Public digital money is stable by design and does – like material cash – not require any financial (microprudential) regulation and financial risk management. Moreover, public digital money can be used as a discipliner for banks – in line with the free banking theory – and is a precondition for generic design guideline 2. In the literature, several scholars argue that the introduction of public digital money (called a CBDC or ‘safe haven’) could realize more market discipline. In the sense, that in a system with this form of money market participants and not regulators will force banks to hold more capital (e.g., the Riksbank (Volkskrant 2018); Berentsen and Schär 2018; Andolfatto 2018; WRR 2019). For example, the Netherlands Scientific Council for Government Policy states that “the fact that people have a real alternative will have a disciplining effect on existing banks. It will force banks to fund themselves more responsibly, with more equity (capital) and long-term debt” (WRR 2019: 237, own translation⁵⁵). Two risks of introducing public digital money often mentioned in the literature are the increasing risk of a systemic financial crisis and a too rapid and too large disintermediation of commercial banks (e.g., Bindseil 2020). A gradual increasing limit on the amount of digital inherent money and a negative interest or tax rate above this amount can be used to deal with those risks. If the limit increases every year with a predictable amount, the implementation of digital inherent money (transition) can be governed. Also, these design variables will be explored in more detail in the interviews.

In short, public digital money is today possible due to digital technologies and its implementation can contribute to solving the problems explicated in chapter 6. Based on this logic, a first initial generic design guideline is formulated:

Initial generic design guideline 1: The public currency should be gradually updated to the digital age; that is, digital inherent liquidity, digital cash, should be gradually developed and introduced.

8.3 Initial generic design guideline 2

Several scholars notice that digital technologies not only offer the opportunity to introduce public digital money, but also to restructure the financial system and especially the liability side of banks (e.g., Chari and Phelan 2014; Cochrane 2014; McMillan 2014; Kotlikoff 2018; Wortmann 2018; Prasad 2021). One of the benefits

55 In Dutch: “Het feit dat men een daadwerkelijk alternatief heeft, zal een disciplinerend effect hebben op de bestaande banken. Het zal banken dwingen zich verantwoord te financieren, met meer eigen vermogen (kapitaal) en vreemd vermogen met een lange looptijd. De creatie van geld en schuld door commerciële banken wordt op die manier ook beter begrensd” (WRR 2019: 237).

of fractional reserve banking is that it allows banks to amplify the quantity of money. One of the disadvantages of a fractional reserve system is recurrent systemic financial crises (explained in chapter 6).

An alternative to funding based on contractual liquidity is funding based on market liquidity (see research into the reference foundation different banking systems in chapter 4). In the case of market liquidity, private economic agents are responsible for risk management. The amount of market liquidity has increased significantly during the last decades. For example, the market capitalization of global equity markets rose from \$2.5 trillion in 1980 to \$95 trillion in 2019, and the market capitalization of global cryptocurrency markets rose from 0 in 2009 to \$1.5 trillion in 2021 (World Bank 2019, Sifma 2020, Coinmarketcap 2021). Both markets are today completely digital. Global equity markets have been digitalized during the last two decades and cryptocurrency markets have been digital from the beginning. The size of global bond markets rose from \$5.4 trillion in 1980 to \$105.9 trillion in 2019 (World Bank 2019, Sifma 2020). These markets have been partly digitalized in the last decade. A difference with equity markets is that bond markets are much more diverse. In 2021, there were about 41,000 stocks and millions of bonds with different characteristics (Wigglesworth 2021). Moreover, not all bonds are tradable. However, after the financial crisis of 2007-9, government bonds and bonds of large corporations have been digitalized. Today, around 30 per cent of bonds trade digital and the expectation is that the trend of digitalizing bonds will continue (*Ibid.*; Wigglesworth and Rennison 2018)

In the digital age, market liquidity is increasingly accessible to more people and at more places. Today, only a mobile device and internet or a phone connection are needed to pay and to trade securities and currencies instantly. This may facilitate a substitution of contractual liquidity with market liquidity in the financial system and, moreover, contribute to the unbundling of the functions of money (Brunnermeier *et al.* 2019). Today, on financial markets, securities and private currencies can be always bought and sold at market prices. Due to digital technologies, it is today possible to store value in the public currencies and private currencies and assets, and to use the public currency as a means of payment.⁵⁶

⁵⁶ In the 1930s when *The Chicago Plan* was written real-time buying and selling for all economic agents was not possible; and scholars living before the digital age as, for example, Diamond and Dybvig (1983) and Diamond (1984) were not able to take into account digital technologies and the increased liquidity of assets and liabilities due to these technologies.

A financial system based on securities offering market liquidity offers three significant advantages (see research into the reference foundation different banking systems in chapter 4 and theories on systemic financial crises in chapter 6). First, in a financial system based on securities the risk of a systemic financial crisis is lower. Research confirms that market-based financial systems have lower systemic risks and are more resilient than bank-based financial systems (Bats and Houben 2017, 2020). The reason is that bank-based financial systems are to a large extent based on contractual liquidity and market-based financial systems on market liquidity. The essential difference of market-based financial systems is that the owner of a security sells to another economic agent instead of demanding the issuer to redeem a claim. The advantage is that investors do not have claims on the issuer “which could send it into bankruptcy” (Cochrane 2014: 17) but instead have tradable securities that can float freely. The value of the securities depends on (expected) future cash flows and not on the contractual promise of the issuer.

A second advantage is that when all financial intermediaries are to a significantly larger extent (or completely) funded with tradable securities, public protection mechanisms are to a large extent no longer needed and the focus of financial regulation can change – the next section will explain this shift in more detail. In a market economy, private investors (and not regulators) should have the responsibility to take (on a decentral level) most decisions about investments and how these investments are funded (based on reference foundation principle of market economies, see section 7.2). Last century, regulators are increasingly determining the composition of the liability side of banks, thus how banks are funded. In a market-based financial system, the involvement of regulators (on behalf of the government) is lower, because economic agents must take/ are ‘forced’ to take responsibility. In such a system, economic agents who invest understand that they take risks, and that the government (taxpayers) cannot protect and do not insure this risk-taking. Consequently, the independence of the monetary authority (GDR 7) could improve.

A third advantage is that a financial system based on securities offering market liquidity realizes a level playing field for financial intermediation and, therefore, improves capital allocation. The research into theories of systemic financial crises (reference foundation, see especially section 6.5.4) explained that if the aim is optimal capital allocation that there should be no difference in funding opportunities of different financial intermediaries. If all financial intermediaries are, in the long run, to a larger extent or even completely funded by securities based on market liquidity (and possibly uninsured *conditional* contractual liquidity), this is realized. Security funded

financial intermediation will lead to a change in maturity transformation. Maturity transformation will be based on tradable securities and market liquidity instead of maturity transformation being based on contractual money, contractual liquidity, public protection mechanisms and regulations. The amount (or length) of maturity transformation will likely change because economic agents must decide on a decentral level what level of maturity mismatch they prefer and consider acceptable – without public protection mechanisms. Less maturity transformation could improve financial stability (e.g., Fiedler *et al.* 2018). Based on these three advantages, a second initial generic design guideline is formulated:

Initial generic design guideline 2: In the digital age, the financial system should be more (or even fully) based on market liquidity and less (or even not) on contractual liquidity

8.4 Initial generic design guideline 3

Chapter 6 described the emergence of the systemic protecting (via public protection mechanisms) and constraining (via regulations) of banks by governments and discussed interrelated consequences of this dynamics as an increasing amount of increasingly complex regulation, increasing cost of regulations, a concentrated market structure with high entry barriers, increasingly less market discipline, more public risk management and sub-optimal capital allocation. Last century, governments implemented an immense amount of regulation for banks. However, several scholars argue that as simple as possible regulation is the essence of a good design (Kay 2009; Ricks 2016). Especially, in the case of microprudential and conduct regulations, public regulators and not private economic agents determine what is needed at private institutions. This conflicts with the principle of market economies (reference foundation discussed in section 7.2).

In the monetary system, systemic risk diminishes when it is to a larger extent based on inherent money. In the financial system, systemic risk diminishes when it is to a larger extent based on securities offering market liquidity. For a market-based financial system, especially transparent information about the riskiness of assets of financial intermediaries is essential – see reference foundations different banking systems (chapter 4) and systemic financial crises (chapter 6), see also Rolnick and Weber 1985⁵⁷). This allows decentral market price formation and decentral valuation

57 Rolnick and Weber (1985: 17) researched free banking era in the U.S. between 1837 and 1863 and concluded that transparent information about assets is essential: “Contrasting the experience of the Free Banking Era with that of the National Banking System and the Great Depression makes it clear that regulations which do not provide information to holders of bank demand liabilities will not prevent bank runs and panics. ... regulations which seem to provide

and improves the alignment of risk and reward. Chapter 4 explained that the Securities Act of 1933 in the U.S. aimed to realize transparency in financial statements and to prevent fraud and misrepresentations. Its underlying aim should be updated to the digital age. A higher level of transparency about the riskiness of assets of financial intermediaries, that is, fewer information asymmetries about assets, does improve the functioning of the financial system, and may also contribute to the realisation of non-financial values. Economic agents can have access to more information. In a market-based financial system, all financial institutions must tell investors what they are going to they with the money invested in them (as non-bank financial institutions already do) and the value of liabilities reflects the market value of assets.

In addition, today digital technologies offer several new possibilities to provide transparent information, for example via “full and real-time disclosure” (Kotlikoff 2018). This would enable the regulators and investors “to see the state of the ledger at all times” (Birch 2020: 161). Digital technologies allow not only instant and full disclosure of financial data but also of non-financial data which could improve the functioning of markets and give economic agents on a decentral level responsibility for the development of the economy. Based on this logic, a third initial generic design guideline was formulated:

Initial generic design guideline 3: In the digital age, financial regulation should (gradually) focus on instant and full disclosure of financial and non-financial data

8.5 Conclusion

This chapter developed an initial set of guidelines for the monetary and financial system in the digital age. The aim of these guidelines is not to give definite answers but to give direction within the design space to the development of the monetary and financial system in the digital age and to contribute to solving the two systemic problems identified in chapter 6 – recurrent systemic financial crises and the dynamics of protecting and constraining banks by governments. Table 8-1 summarizes the initial generic design guidelines.

.....
information, but really don't, could be the cause of bank panics rather than the solution”.

Table 8-2: Initial generic design guidelines

<i>Initial generic design guidelines</i>	
initial GDG 1	The public currency should be gradually updated to the digital age; that is, digital inherent liquidity, digital cash, should be gradually developed and introduced.
initial GDG 2	In the digital age, the financial system should be more (or even fully) based on market liquidity and less (or even not) on contractual liquidity.
initial GDG 3	In the digital age, financial regulation should (gradually) focus on instant and full disclosure of financial and non-financial data.

These initial guidelines are innovative and preliminary and will therefore be evaluated and refined via semi-structured interviews. The next chapter explains how the interviews were set up to evaluate and refine the problem analysis, initial requirements, and initial guidelines, and to identify the commonalities and differences between the views of the interviewees.



Semi-structured interview research method

9. Semi-structured interview research method

9.1 Introduction

Because the initial generic design requirements and guidelines are innovative and preliminary, they are evaluated and refined via semi-structured interviews. This chapter is structured as follows. Section 9.2 explains what semi-structured interviews are, whereas section 9.3 describes how the interview protocols were developed. Subsequently, section 9.4 explains the expert selection criteria, and section 9.5 the invitation process. Section 9.6 summarizes the characteristics of the interviewees. Finally, section 9.7 explains how the interviews (the qualitative data) were analysed and reported in chapter 10.

9.2 Semi-structured interviews

In a semi-structured interview, the interviewer asks a limited number of predetermined questions while other questions are not planned in advance. It combines features of structured interviews (all questions are planned in advance) and unstructured interviews (no questions are planned in advance). In this thesis, semi-structured interviews were chosen to evaluate and refine the problem analysis, initial requirements, and initial guidelines, and to identify the commonalities and differences between the views of the interviewees. Evaluation via semi-structured interviews is often used in design science “when evaluating highly innovative and still immature artifacts” (Johannesson and Perjons 2014: 138). Generic design requirements and generic design guidelines for the design of the monetary and financial system in the digital age are – as explained in chapter 1 – innovative as well as preliminary. The aim of the interviews was evaluating and validating as well as refining and identifying alternative (conflicting) views.

Semi-structured interviews allow interviewees to contribute to knowledge development, that is, on the one hand, refining the analysis, requirements, and guidelines, and, on the other hand, questioning the analyses, requirements, and guidelines by giving alternative (conflicting) views. Moreover, semi-structured interviews allow going into detail and discussing what interviewees consider most important.

The main disadvantage of semi-structured interviews is that there is a risk of biases because of the preferences of the researcher who provides the arguments (Johannesson and Perjons 2014: 142). To minimize the risk of biases, experts working in different fields and preferring different banking theories have been invited for the interviews (explained in section 9.4). By interviewing experts with different specialisms and arguing in favour of different banking theories, the consensus, and key dissensions

among them can be identified. In addition, the objective of part II of this thesis is developing requirements and guidelines as well as developing knowledge about these topics, that is, improving our understanding of the options for the design of the monetary and financial system in the digital age.

During the semi-structured interviews, an interview protocol was used to enable replication and comparison of the results. When interviewees had a different view compared to the analysis presented in chapter 6, 7 and 8 and/ or argued that a topic is highly relevant for the digital future of the monetary and financial system, the interview deviated from the protocol. This allowed the identification of differences. For example, if an interviewee did not consider systemic financial crises a systemic problem, the researcher asked questions to understand this conflicting view. In the interviews, the researcher attempted to ask all questions – the sequence depended on the course of the interview. In a couple of interviews, there was a lack of time because the interviewees steered the conversation with their answers several times towards the topic, they found most relevant. It was decided to have two rounds of interviews. In the first round, the interviews were about the problem analysis, the requirements, and the guidelines (21 interviewees). In the second round, the interviews focussed on the guidelines (8 interviewees). The guidelines are the main artifact of this thesis and were therefore discussed in both rounds.

9.3 Interview protocol

An interview protocol contains a list of questions and fulfils three functions: a) standardization of the context of the questions; b) conducting systematic and comprehensive interviews, and; c) making the interview an inquiry-based conversation (Castillo-Montoya 2016; Nugroho 2018: 26). Castillo-Montoya (2016) developed an interview protocol refinement (IPR) framework consisting of four phases: 1) ensuring interview questions align with research questions; 2) constructing an inquiry-based conversation; 3) receiving feedback on the interview protocol, and; 4) piloting the interview protocol. Table 9-1 presents the purposes of the four phases. The next subsections discuss these phases.

Table 9-1: Interview Protocol Refinement (IPR) Method (Castillo-Montoya 2016: 828)

Phase	Purpose of Phase
1) Ensuring interview questions align with research questions.	To create an interview protocol matrix to map the interview questions against the research questions.
2) Constructing an inquiry-based conversation	To construct an interview protocol that balances inquiry with the conversation.
3) Receiving feedback on the interview protocol.	To obtain feedback on the interview protocol (possible activities include close reading and think-aloud activities).
4) Piloting the interview protocol.	To pilot the interview protocol with small sample.

9.3.1 Phase 1: Ensuring interview questions align with the research questions

Table 9-2 aligns the interview questions with the research questions e), f) and g). These questions were used in the first round of interviews.

Table 9-2: Aligning interview questions with research questions for the protocol of the interviews in round 1.

Research questions	Interview question
<i>Research question e): What causes and what are the consequences of systemic financial crises?</i>	<i>What is your view on the problem of fragility?</i> • Question derived from the analysis presented in chapter 6. • Answers used to evaluate and refine the problem analysis and to identify other (conflicting) views.
	<i>What is your view on the rising number of increasingly complex regulations?</i> • Question derived from the analysis presented in chapter 6. • Answers used to evaluate and refine the problem analysis and to identify other (conflicting) views.
	<i>What is your view on the influence of the application of digital technologies in banking and finance on monetary fragility and regulation?</i> • Question derived from the analysis presented in chapter 6. • Answers used to evaluate and refine the problem analysis and to identify other (conflicting) views.

<i>Research question e): What causes and what are the consequences of systemic financial crises?</i>	<i>What is your view on contractual liquidity? Do you agree it is the fundamental cause of systemic financial crises?</i> • Question derived from the analysis presented in chapter 6. • Answers used to evaluate and refine the problem analysis and to identify other (conflicting) views.
	<i>Do you think that systemic financial crises are still possible when contractual liquidity is substituted in the long run? Why or why not?</i> • Question derived from the analysis presented in chapter 6. • Answers used to evaluate and refine the problem analysis and to identify other (conflicting) views.
<i>Research question f): What are the (minimal) generic design requirements on the monetary and financial system?</i>	<i>What is your view on the requirements?</i> • Question derived from initial GDRs drafted in chapter 7. • Answers used to refine the GDRs and to identify the agreements and dissensions between interviewees.
<i>Research question g): What are the (minimal) generic design guidelines for the monetary and the financial system in the digital age?</i>	<i>What is your opinion about the development and gradual introduction of digital inherent liquidity?</i> • Question derived from initial GDG 1 drafted in chapter 8. • Answers used to refine the GDGs and to identify design variables and open questions.
	<i>What is your view on the gradual substitution of contractual liquidity by inherent liquidity and market liquidity in the digital age?</i> • Question derived from initial GDG 2 drafted in chapter 8. • Answers used to refine the GDGs and to identify design variables and open questions.
	<i>What should be the focus of financial regulation in the digital age?</i> • Question derived from initial GDG 3 drafted in chapter 8. • Answers used to refine the guidelines and to identify design variables and open questions.

<i>Research question g): What are the (minimal) generic design guidelines for the monetary and the financial system in the digital age?</i>	<i>What is your vision of competition between public and private currencies? What are the advantages and disadvantages?</i> • Question derived from chapter 4, 7 and 8. • Answers used to identify design variables and open questions.
	<i>What is your view on the relevance of maturity transformation in the digital age?</i> • Question derived from the analysis of chapter 6. • Answers used to identify design variables and open questions.
	<i>Do you think it is possible to completely separate public and private affairs and responsibilities in the digital age? Why or why not? What is necessary?</i> • Question derived from chapter 4, 6, 7 and 8. • Answers used to identify design variables and open questions.
	<i>What technological opportunities do digital cash, digital private currencies and digital (tokenized) securities offer in the long-term? What opportunities and risks do you see?</i> • Open question to identify design variables and open questions.
	<i>Which practical step or steps do you think should be taken first?</i> • Open question to identify design variables, open questions, and recommendations.

The interviews in the second round focused on the generic design guidelines (the main artifact of this thesis). After the first round, the initial guidelines were updated and sent with an accompanying explanation (Appendix III) to the interviewees to have a more focussed interview/ conversation about the guidelines in the second round. Table 9-3 aligns the interview questions for the second round with the research question g).

Table 9-3: Aligning interview questions with research questions for the protocol of the interviews in round 2.

Research questions	Interview question
<i>Research question g): What are the (minimal) generic design guidelines for the monetary and the financial system in the digital age</i>	<i>What is your view on generic design guideline 1?</i> • Question derived from chapter 8 and results of interviews in the first round. • Answers used to refine the guidelines and to identify design variables and open questions.
	<i>What is your view on generic design guideline 2?</i> • Question derived from chapter 8 and results of interviews in the first round. • Answers used to refine the guidelines and to identify design variables and open questions.
	<i>What is your view on generic design guideline 3?</i> • Question derived from chapter 8 and results of interviews in the first round. • Answers used to refine the guidelines and to identify design variables and open questions.
	<i>What is your vision of competition between public and private currencies?</i> • Question derived from chapter 4, 7 and 8. • Answers used to identify design variables and open questions.
	<i>What is your view on the likelihood of systemic financial crises in a system of public and private currency competition?</i> • Question derived from chapter 6 and 8. • Answers used to evaluate guidelines.
	<i>What is your view on three (new) risks mentioned by interviewed experts in the first round? And do you see other risks?</i> • Question derived from the first round of interviews in which interviewees mentioned three new risks: 1) a private currency or security becoming very large; 2) technological problems (bugs, hacking) of the public digital currency, and; 3) mismanagement of the public digital currency. • Answers used to refine risks and to identify other risks.

	<i>What is your view on a complete separation of public and private responsibilities?</i> • Question derived from chapter 4, 6, 7 and 8. • Answers used to identify design variables and open questions.
	<i>What is your view on the four conditions mentioned to realize a complete separation in the first round of interviews? And do you see other conditions?</i> • Question derived from the first round of interviews in which the interviewees mentioned four conditions: 1) sufficient reserves of digital inherent liquidity; 2) supervision focussing on transparency; 3) time-consistent rules, and; 4) additional rules • Answers used to refine conditions and to identify other conditions.

9.3.2 Phase 2: Constructing an inquiry-based conversation

In the second phase, an inquiry-based conversation through an interview protocol was developed using the four points of Castillo-Montoya (2016: 813); that is, 1) the question in the protocol should differ from the research questions (see Table 6-2); 2) the interview protocol should follow “social rules of ordinary conversation” (*Ibid.*); 3) the interview should consist of a variety of questions, and; 4) the protocol should have “likely follow-up and prompt questions” (*Ibid.*). Several scholars define four types of questions to connect the conversational and inquiry goals of the interviews: 1) introductory questions; 2) transition questions; 3) key questions, and; 4) closing questions (Castillo-Montoya 2016; Rubin and Rubin 2012). Transition questions connect the introductory questions with the questions related to the research questions. These questions are in the case of semi-structured interviews with experts not needed. The invited experts know in advance where the interviews are about, are likely interested in and willing to give their view on the topic of this research and are free to steer the interview with their answers towards topics they find most relevant.

9.3.3 Phase 3: Receiving feedback on interview protocols

A colleague researcher with interviewing experience and knowledge about monetary economics was asked to evaluate the introduction document and the interview protocol structure for the first round of interviews. Both documents were improved after having received the comments. Appendix 1 presents the evaluated aspects (structure, writing and length) – based on Castillo-Montoya (2016: 825) and Nugroho (2018: 31-

32) – and the generally positive comments of the researcher. In the second round of interviews, feedback on the protocol was not considered to add value because of the experience gained in the first round of interviews.

9.3.4 Phase 4: Piloting the interview protocol

Two interviewees were selected for pilot interviews in the Netherlands for the first round of interviews. After the pilot interviews, the interview protocol was evaluated with the interviewees and some minor adaptations were made. Table 9-4 presents the final interview protocol for the first round. Appendix II presents the protocol translated into the Dutch language that was used for the interviews in the Netherlands.

Table 9-4: Interview protocol first round

Introduction

Thank you for accepting the invitation. The purpose of this interview is evaluating some of the outcomes of my PhD thesis. In my research, I apply design science to investigate the design of the monetary and financial system in the digital age. I am researching how digital technologies such as the Internet and distributed ledger technology can be used to overcome the main shortcomings of the current monetary and financial system and to develop new forms of money. My research and this interview are about the long-term. It is a novel topic with a novel methodology, at least in economic science.

Introductory question

I would like to record our conversation. The records will not be published. This conversation is thus anonymous. After the interview, I will transcript the record within a week. You receive the transcription with the question to validate within two weeks. The validated transcript will subsequently be used for qualitative data analysis.

Are you ok with recording this conversation today?

Yes / No

If yes: Thank you. Please let me know if at any point you want me to turn off the recorder.

If no: Thank you for letting me know. I will only take notes of our conversation.

Before we begin the interview, do you have any questions?

Key questions

Then we start with the questionnaire. The first question is:

IQ1) Are you familiar with the banking theories fractional reserve banking, full reserve banking and free banking? If yes, do you have a preference? And why?

The following questions concern the problems of the current design of the monetary and financial system. In my research, I define two problems. The first problem is the by design fragility of the monetary system. The current system is fragile because fragile forms of money, namely bank deposits and money market instruments, dominate.

IQ2) What is your view on the problem of fragility

Subsequently, I describe the emergence of a cycle of ever more and more complex regulations. Fragile forms of money can only exist with safety nets. The two best known are the central bank as a lender-of-last resort and deposit guarantee schemes. On the one hand, these safety nets work well. On the other hand, they cause moral hazards. To limit these moral hazards regulation is required. The problem, however, is that almost every new rule causes new moral hazards and thus indirectly the need for more regulation.

IQ3) What is your view on the increasing amount of increasingly complex regulations? Is it a problem? If yes, what are the consequences?

In my research, I explain that digital technologies have worsened both problems. In recent decades we have become increasingly dependent on fragile forms of money. Bank deposits and money market instruments have been digitalized and stable cash has not. As a result, more and more regulations are needed. In addition, the application of digital technologies in banking and finance has worsened the boundary problem of financial regulation. Digital technologies have increased the mobility of money and loans. This makes regulation more difficult.

IQ4) What is your view on the influence of the application of digital technologies in banking and finance on monetary fragility and regulation?

In my thesis, I distinguish between three types of liquidity: market liquidity, inherent liquidity, and contractual liquidity. Market liquidity is based on supply and demand. Inherent liquidity is the liquidity offered by cash and is based on an agreement. Contractual liquidity is defined as the obligation of the issuer of bank deposits and some money market instruments to exchange on demand at par one form of money into another form of money. In other words, the exchange rate is fixed; there is no market price formation. Based on empirical data and an analysis of testimonies of bankers and regulators after the financial crisis of 2007-9, I conclude that contractual liquidity is the root cause of systemic financial crises and the cycle of ever more and increasingly complex regulations?

IQ5) How do you see this? Do you agree with this?

Based on an extensive literature review I elicit requirements for the monetary and financial system. This is not easy because of the existence of different theories in economic science. For example, the theories of fractional reserve banking, free banking, and full reserve banking sometimes conflict. Now I would like to briefly hear your view on each of the following eight requirements.

Read each requirement and ask:

IQ 6) Do you agree?

<i>Initial generic design requirements</i>
The government must ensure at least one public unit of account.
The government must ensure at least one public currency.
The government must ensure that the public currency has as low as possible transaction costs.
Private currencies must be allowed as competitors, discipliners, and backup systems.
The government must accept at least/ only the public currency for tax payments.
The government must ensure that the public currency offers stable settlement power.
The government must ensure that the monetary authority is independent of the government.
Legal entities must be allowed to issue securities, to establish credit-debt relationships and to trade securities, credits, and debts.

In my thesis, I also formulate design guidelines. These guidelines should give direction to the design of the monetary and financial system in the digital age. The first guideline is: the public currency should be gradually updated to the digital age; that is, digital inherent liquidity, digital cash, should be gradually developed and introduced.

IQ 7) What is your opinion about the development and gradual introduction of digital inherent liquidity (CBDC, digital cash)?

Digital technologies not only enable a new form of money, digital inherent liquidity (CBDC, digital cash) but have also significantly increased market liquidity during the last decades. Today, only a mobile device and the internet are needed to trade securities and currencies. This development is the basis for another guideline: in the digital age, the financial system should be more (or even fully) based on market liquidity and less (or even not) on contractual liquidity. The reason is that the more the financial system is based on market liquidity, the more stable it is, the better the risk and rewards are aligned, and the fewer safety nets, regulations and government interventions are needed. One possibility is thus to gradually substitute contractual liquidity with inherent liquidity and market liquidity in the digital age.

IQ 8) Do you think this is indeed possible in the long-term? Why or why not?

The result would be a monetary system in which public and private currencies compete and a liberalized system of financial intermediation. In a sense, this design can be considered as a combination of proposals of full reserve banking and free banking, updated to the digital age.

IQ 9) What is your vision on competition between public and private currencies? What are the advantage and disadvantages?

It is regularly stated that maturity transformation is the essence of banking. However, due to increased market liquidity, that is tradability of assets and liabilities, maturity transformation seems to be increasingly less relevant in the digital age. After all, financial intermediaries can always finance tradable loans, securitized or not, with always tradable securities, whether or not tokenized.

IQ 10) What is your view on the relevance of maturity transformation in the digital age?

Added after 3rd interview: What is the role of state support in maturity transformation?

A still unanswered question is whether it is possible to completely separate public and private affairs and responsibilities in the monetary and financial system in the digital age. The economist of The Chicago Plan suggested such a separation in the 1930s. For example, it is regularly argued that in the case of a crisis, governments will rescue failing financial institutions because voters ask them to do so.

IQ 11) Do you think it is possible to completely separate public and private affairs and responsibilities in the digital age? Why or why not? What is necessary?

Digital technologies offer many new opportunities. For example, programmable money. Smart contracts make for instance real-time taxation possible.

IQ 12) What technological opportunities do digital cash, digital private currencies and digital (tokenized) securities offer in the long-term? What opportunities and risks do you see?

In the current system, financial regulation focuses on micro- and macroprudential supervision. The question is whether this is the most useful supervision in a new system. In addition, digital technologies offer new opportunities.

IQ 13) What should be the focus of financial regulation in the digital age?

If not mentioned, ask: What do you think about full and real-time disclosure of financial and non-financial data? Should every financial intermediary be obligated to publish a prospectus?

Contractual liquidity is thus the root cause of monetary fragility and systemic financial crises.

IQ 14) Does this also mean that in the long run when contractual liquidity has been substituted systemic financial crises can no longer occur? Why or why not?

The requirements and design guidelines are quite abstract and a problem with all proposals for a more fundamental change of the monetary and financial system is the practical implementation.

IQ 15) Which practical step or steps do you think should be taken first?

Closing questions

Thank you. We have discussed quite some topics.

IQ 16) Have we missed something relevant? Do you have a final remark?

Closing

Thank you for your time. It was valuable. You will receive the transcript of the interview within a week for validation.

Because of the limited time of the interviewees, the length and the abstractness (difficulty) of question 6 (about the generic design requirements) and the similarity of the answers to this question of interviewed experts preferring the same banking theory (fractional reserve banking, full reserve banking and free banking), it was decided after the seventh interview to ask this question only directly in interviews where interviewees preferred a new banking theory (e.g., free banking) or advocated a different scenario. After the third interview, one sub-question was added to question 10 (about maturity transformation) to have a more focussed and meaningful conversation about this topic. These changes make comparability of the interviews more difficult but contribute to the objectives of the interviews: evaluating and refining the problem analysis, requirements, and guidelines, and identifying commonalities and differences. The second round of interviews focused as said on the main artifact, the generic design guidelines. Table 9-5 presents the final interview protocol for the second round. Appendix II presents the in Dutch translated protocol.

Table 9-5: Interview protocol second round

Introduction

Thank you for accepting the invitation. The purpose of this interview is evaluating and refining the generic design guidelines elicited in this PhD research. *My research and this interview are about the long-term.*

The topic of this research, the design of the monetary and financial system in the digital age, as well as the methodology, design science, are (relatively) novel, at least in economic science. Because of the novelty and the immaturity of the outcomes of this thesis, evaluation takes place via two rounds of interviews and informed argument. In the first round, 21 experts were interviewed. In this second round, 7 experts will be interviewed. The elicitation of generic

design guidelines is often used to contribute to solutions to complex problems. The guidelines are meant to give direction and do thus not provide readily available solutions to problems and should also not be considered a blueprint.

Introductory question

Have you read the document I sent you?

If no: Explain and discuss the document in about 15 minutes.

If yes: Do you have any questions about this document?

Key is that all interviewees have more or less the same level of knowledge when the interview starts. The focus of the interview is the generic design guidelines.

I would like to record our conversation. The records will not be published. This conversation is thus anonymous. After the interview, I will transcript the record within a week. You receive the transcription with the question to validate within two weeks. The validated transcript will subsequently be used for qualitative data analysis.

Are you ok with recording this conversation?

Yes / No

If yes: Thank you. Please let me know if at any point you want me to turn off the recorder.

If no: Thank you for letting me know. I will only take notes of our conversation.

Before we begin the interview, do you have any questions?

Key questions

Then we start with the questionnaire. The first generic design guideline is: The public currency should be gradually updated to the digital age; that is, digital inherent liquidity should be gradually developed and introduced.

IQ1) What is your view on this guideline?

The second generic design guideline is: In the digital age the financial system should be more (or even completely) based on market liquidity and less (or even not) based on contractual liquidity; the more the system is based on market liquidity, the more stable the system is, the better risk and rewards are aligned, and the less safety-nets, regulations and government interventions are required.

IQ2) What is your view on this guideline?

The third generic design guideline is: In the digital age financial regulation should be (much) more about improving transparency and protecting consumers and investors and (far) less about micro-prudential requirements.

IQ3) What is your view on this guideline?

In the long-term, the (theoretical) result of the generic design guidelines would be a monetary system in which public and private currencies compete and a liberalized system of financial intermediation. In a way, this design can be considered a combination of the proposals of full reserve banking and free banking updated to the digital age.

IQ 4) What is your vision of competition between public and private currencies?

IQ 5) What is your view on the likelihood of systemic financial crises in such a system?

The experts in the first round of interviews mentioned three new risks. The first risk is that one private currency or security becomes very large. The second risk is technological problems (bugs, hacking) of the public digital currency. The third risk is the mismanagement of the public digital currency.

IQ 6) What is your view on these risks? And do you see other risks?

An open question is if it is possible to entirely separate public (monetary) and private (finance) in the digital age. In the first round of interviews experts mentioned four conditions to realise a complete separation:

1. The availability of sufficient reserves of (run-proof) digital inherent liquidity in society and a safe digital (and physical) payments system (in line with generic design guideline 1).
2. Supervision focussing on transparency (of risks) and protecting consumers and investors (in line with generic design guideline 3).
3. The implementation of stable time consistent rules. An option is a law prohibiting governments and central banks from bailing out financial intermediaries.
4. The implementation of additional rules to accomplish a complete separation.

IQ 7) What is your view on a complete separation and these conditions? And do you see other conditions?

Closing questions

Thank you.

IQ 8) Have we missed something relevant? Do you have a final remark?

Closing

Thank you for your time. It was valuable. You will receive the transcript of the interview within a week for validation

9.4 Expert selection criteria

Experts can be defined as persons who possess an “institutionalized authority to construct reality” (Hitzler *et al.* 1994). A characteristic of expert knowledge is the chance of becoming “hegemonial in a certain organizational and functional context within a field of practice” (Bogner and Menz 2002b in Meuser and Nagel 2009: 19). Expert knowledge can structure the condition of actions of others in a relevant way (*Ibid.*). For this research, experts on the digital future of money, banking and finance were relevant. Their ideas might shape the structure (design) of future economic activity.

The design of the monetary and financial system in the digital age is a multi-disciplinary topic, but most experts have knowledge in a specific field. Economists have knowledge about the economy, IT-specialists about technologies, legal scholars about laws, etc. Because of its multi-disciplinary character of the topic interviewees were selected based on five criteria:

1. At least one publication, interview, presentation or talk about the digitalization of money and/ or the monetary and financial system.
2. At least five years of study and/ or working experience in a relevant field: central banking and supervision – commercial banking and finance – fintech start-ups – digital technologies – economic science – research NGOs in banking and finance. This distinction is relevant because experts from different fields have different knowledge, experiences, and interests. For example, central bankers explicitly have the task to manage the stability of the current monetary and financial system while some fintech start-ups explicitly state that they aim to disrupt the current system and some research NGOs generally explicitly aim at reforming the system.
3. Availability to participate in a direct (i.e., face-to-face) interview in the Netherlands, Sweden, Switzerland, or UK. In these countries, research and political-societal debate about the design of the monetary and financial system became advanced last decade. The Sveriges Riksbank and the Bank of England published several papers on CBDC (e.g., Sveriges Riksbank 2017, 2018; Barrdear & Kumhof 2016; Meaning *et al.* 2018; Kumhof & Noone 2018). In the Netherlands and Switzerland, the citizens’ initiatives (*Ons Geld*⁵⁸ and *Vollgeld*⁵⁹) stimulated research (e.g., WRR 2019; Berentsen & Schär 2018) and political-societal debate.

58 I co-initiated this initiative: <http://www.burgerinitiatiefongeld.nu/>

59 <https://vollgeld-initiative.com/>

4. Different ages: representation of experts born before 1980 and born in 1980 or later. This criterion is relevant because people born after 1980 are generally raised with computers and digital technologies. They are sometimes called “digital natives” (Prensky 2001). Moreover, their ideas will likely dominate in the digital age in the long run.
5. Different preferred banking theories represented: representation of experts preferring fractional reserve banking, full reserve banking and free banking. This criterion is relevant because advocates of different banking theories emphasize different aspects and prefer different designs.

To include as much as possible different views, at least one expert of each group was interviewed. It was relatively hard to find experts preferring free banking who also met the other criteria, and it was before the interviews sometimes not known which banking system invited experts preferred (in the long run).

9.5 Invitation process

In the first round, a list of experts fulfilling and distributed over the five criteria was made. Thirty-two experts fulfilling the criteria were found. These experts were invited by email for semi-structured interviews of 60 minutes to evaluate the problem analysis and the initial sets of requirements and guidelines. They were told that if they would give permission, the interviews would be recorded and transcribed and that the transcriptions would be anonymized and used only for the qualitative data analysis of this thesis. Twenty-six experts replied and six experts did not reply. Of the twenty-six who replied, two answered that they were too busy, and six that they were unable to participate in a face-to-face interview at the moment the researcher planned to be in Sweden, UK, Switzerland, and the Netherlands. The experts unable to participate were asked to recommend a colleague or someone else in their country with an interest in and knowledge of the design of the monetary and financial system in the digital age. Subsequently, the researcher checked if these recommended experts fulfilled the formulated criteria. Three experts were found via experts unable to participate. In total, twenty-one experts were interviewed in the first round. When the experts accepted the invitations, the exact date, time, and place of the face-to-face interviews were planned.

In the second round, a list of ten experts working in the Netherlands was made. These experts were invited by email for semi-structured interviews of 60 minutes to evaluate and refine the initial generic design guidelines elicited in this research. They were told that if they would participate, they would receive a document with a summary of the thesis and the initial generic design guidelines to read in advance (appendix III). They were also told that if they would give permission, the interviews would be recorded and transcribed and that the transcriptions would be anonymized and used only for the

qualitative data analysis of this thesis. Seven experts replied and three experts did not reply. One expert asked if one of his colleagues could join the interview. In total, eight experts were interviewed. When the experts accepted the invitations, the exact date, time, and place of the face-to-face interviews were planned, and the document was sent.

A drawback of the invitation process is that experts who accepted the invitation are possibly more positive towards the topic than experts ignoring the invitation. Former CEO's and governors of central banks accepted the invitation while present CEO's and governors of central banks did not reply or answered to be too busy. This drawback was confirmed by the remarks of two interviewed experts after the interview. A former CEO of a large European bank and a former governor of a European central bank told after the interview that they only became interested in a more systemic change of the monetary and financial system after quitting banking. When they worked in banking, their interest in and knowledge about the topic of this research was limited. Moreover, it should be observed that central bankers only wanted to participate when the interviews were off-the-record. Other limitations of the semi-structured interviews (including the invitation process) will be discussed in the final chapter (section 11.3).

9.6 Characteristics of interviewees

The twenty-one interviewed experts in the first round are (in random order): a director of a fintech start-up who has been chairman of a supervisory board of a European central bank, a legal scholar at a research NGOs in banking and finance, a director at a research NGOs in banking and finance, an econometrist at a research NGOs in banking and finance with a specialization in circular economy, a former governor of a European central bank, a senior economist at a European central bank, a senior research advisor at a European central bank, a financial data technologist who is a board member of a research NGOs in banking and finance, a head of a data analytics and reporting department at a European commercial bank who publishes books on money, a fintech and central banking specialist at a publisher, a head of a research team at a European central bank, a former CEO of a European commercial bank who is also an economist, a researcher at a research NGOs in banking and finance, a professor of economics, a professor of sustainable finance, a head of a distributed ledger department at a consultancy firm who is also an entrepreneur, a director of a fintech company, a professor in economics who is also advisor at a European commercial bank, a lecturer in fintech who has been a CEO and board member of several financial institutions, a research associate in fintech, and a dean of a faculty of business and economics who is also research fellow at an American central bank.

The eight interviewed experts in the second round are (in random order): a senior manager at a European non-bank financial firm who is also chairman of a fintech start-up, an associate professor of economics and sustainability who is also a member of a research NGOs in banking and finance, two directors at a European central bank, one manager at a European central bank, a senior economist at a European commercial bank specialized in digital technologies, a senior regulator at a European Financial Service Authority who is writing a PhD, and a director of a research NGOs in banking and finance.

Table 9-6, 9-7 and 9-8 summarize the characteristics of the interviewees. The first question in the interviews in the first round was about the preferred banking theory and during the interview, the preferred future of the monetary and financial system was discussed in detail. In the second round, this question was not asked because the interviewees received a document in advance, and this would likely have influenced their answer. Table 9-6 categorizes the interviewees in the first round into four groups: fractional reserve banking (nine interviewees), full reserve banking (eight interviewees), free banking (two interviewees) and no preference (two interviewees).

Table 9-6: Age and preferred banking theory of interviewed experts in the first round

Age	
Born before 1980	12
Born in 1980 or later	9

Preferred banking theory/system	
Fractional reserve banking	9
Full reserve banking variant	8
Free banking	2
No preference	2

Table 9-7: Age of interviewed experts in the second round

Age	
Born before 1980	6
Born in 1980 or later	2

Table 9-8: Working field of interviewed experts

	<i>Central banking and supervision</i>	<i>Commercial banking and finance</i>	<i>Fintech start-ups</i>	<i>Digital technolo- gies</i>	<i>Economic Science</i>	<i>Research NGOs in banking and finance</i>
E1						X
E2					X	X
E3	X					
E4		X				X
E5	X		X			
E6						X
E7						X
E8	X				X	
E9	X				X	
E10	X		X			
E11	X			X		
E12		X			X	
E13					X	
E14					X	
E15			X	X		
E16			X	X		
E17		X			X	
E18		X	X			
E19			X	X		
E20	X				X	
E21		X		X	X	
E22					X	X
E23						X
E24		X	X	X		
E25	X					
E26		X		X		
E27	X				X	
E28	X					
E29	X			X		
	11	7	7	8	11	7

Although sometimes only a limited number of interviewees (one, two or three) expressed a certain view (e.g., free banking or monetary financing of private spending), the interviewees represent a large variety of views on the topic(s) of this research. The selected interviewees are likely representative for the various streams of monetary

thinking. Research among 23,000 people in 20 shows that 13% prefers fractional reserve banking, 59% full reserve banking and 28% has no clear view on who should create the quantity of money (Motivation International and Sustainable Finance Lab 2016). These statistics suggest fractional reserve banking was over-presented in this small sample.

9.7 Data analysis

The data of the interviews have been investigated in seven steps. First, the recorded interviews – except the first test interview – were transcribed with the automatic speech recognition tool AmberScript.⁶⁰ Second, the transcripts were manually refined and synchronized with the recordings using AmberScript. Third, the transcripts were sent to the interviewees who were asked to verify the transcripts within two weeks. To limit the time spent on verification by the interviewees, unclear parts and sentences that would possibly be used as quotes were highlighted in yellow in the transcripts. The interviewees were asked to verify at least those parts and sentences. All interviewees verified the interviews. Fourth, the answers and arguments were coded. Four basic categories were distinguished:

- Basic answers to questions. For example, in the case of the question about contractual liquidity as the main cause of systemic financial crises: agree, disagree or an unclear answer.
- Arguments refining and strengthening the problem analysis, the requirements, or the guidelines. For example, a quote of a practitioner about the complexity of regulation.
- Arguments representing a different (conflicting) view. For example, a remark that there is no systemic problem or a remark that financial exclusion is a systemic problem.
- Statements representing a new view or idea. For example, a remark that digital technologies enable a new monetary instrument as monetary financing of government spending or a proposal on how public and private responsibilities can be separated.

Fifth, the coded answers and arguments were counted and grouped. Sixth, views and arguments expressed by only one expert were excluded. Seventh, quotes typically for a certain expert view were selected and if needed edited and translated from Dutch into English. Finally, counted and grouped answers and arguments were analysed and chapter 10 was written.

⁶⁰ <https://www.amberscript.com/>



10

Analysis of the views of the
interviewed experts

10. Analysis of the views of the interviewed experts

10.1 Introduction

This chapter reports the analysis of the interviewees' views on the systemic problems of the current monetary and financial system, the requirements, and the guidelines. In this way, this chapter contributes to taking the three steps of design science: 1) explicate the systemic problem(s); 2) define requirements, and; 3) develop generic design guidelines.

This chapter is structured as follows: section 10.2 examines the views of the interviewees on the systemic problems of the current monetary and financial system. Section 10.3 explains the scenarios that were identified during the analysis of the interviews and are useful to better understand the guidelines. Section 10.4 reports the interviewees' views on the requirements and refines them. Section 10.5 reports their views on the guidelines and refines them and summarizes the different arguments interviewees used to advocate a guideline and the design variables mentioned. Finally, section 10.6 draws conclusions.

10.2 Views on systemic problems

Chapter 6 examined recurrent systemic financial crisis and identified the systemic protecting and constraining of banks by governments as a second systemic problem. To contribute to solving those problems, an initial set of three guidelines was developed. The interviews in the first round focussed on those problems and guidelines. Most interviewees considered those two problems as being systemic but had different views on the cause of systemic financial crises and mentioned other systemic problems. This section analyses the different views. Section 10.2.1 analyses the views of the interviewees on the two problems identified in chapter 6. Section 10.2.2 categorizes the other systemic problems mentioned by the interviewees. Section 10.2.3 summarizes the different problem analyses.

10.2.1 View on problems identified in chapter 6

Most interviewees argued that the systemic financial crises are 'systemic'. Seventeen interviewees in the first round (82% of the total) argued that the systemic financial crises cannot be solved within the current design. There was thus a broad consensus that recurrent systemic financial crises are a relevant problem that needs to be addressed. Four interviewees (18% of the total) argued that these crises can be solved within the current design. This view will be discussed in more detail in section 10.2.2

Interviewees mentioned the negative consequences of the systemic protecting and constraining of banks by governments. Interviewees were asked about their view on the growing amount of increasingly complex regulation and its consequences. Eighteen interviewees in the first round of interviews (86% of the total) argued that the current amount and complexity of regulation are causing problems. Three interviewees in the first round of interviews (14%) did not consider the current amount of regulation in their country (context) a problem.

Three of the interviewees argued that the current amount of regulation is a problem worked in practice (commercial banking & finance and fintech) and explained in detail how financial institutions currently have large risk & compliance departments to deal with all regulations and policy documents, how difficult it is to comply and how complexity is increasing continuously. Four consequences of the growing amount of complex regulation were mentioned by three or more interviewees arguing that the current amount of regulation is a problem: 1) increasing regulatory costs; 2) protections for large banks cause high entry barriers; 3) lack of incentive for fintechs to compete with banks, and; 4) hindering market discipline and private risk management. Eight interviewees (38% of the total) mentioned increasing costs of complying with all the regulations on the side of banks as well as increasing costs on the side of regulators and supervisors. They emphasized that increasing regulatory costs cause problems, especially for smaller banks because they spend a relatively large amount of their income on compliance. Six interviewees (29% of the total) explicitly stated that current regulations protect large banks, and three of them explained that these protections prevent better alternatives to be developed, that is, these protections cause high entry barriers and hinder innovation, for example, E6 and E20:

. . . it all seems to me as if it has all been designed or maybe not designed intentionally but perhaps unintentionally to favour large banks. Bank regulation, financial regulation is ultimately a part of public policy. This should not be designed to favour big players over small players. And it should not be designed to protect the position of one sector of the commercial or financial market over other sectors. (E6)

Some regulation is necessary for institutions that take deposits that are other people's money. Management cycles are very short-lived and bank managers have very short horizons and tend to do crazy stuff sometimes. But I also believe that some of the current regulations are just there to protect the existing players and these players don't provide really good services. I mean it's amazing how bad some of these services are. For example, how expensive it is to make an international transaction, how long it takes. It is just crazy. That financial institutions survive that provide such bad service clearly shows

that some regulations are just protecting them against the entry of innovative players. (E20)

Three interviewees (14% of the total) argued that fintechs currently lack an incentive to compete with commercial banks, because it is easier to collaborate and take a part of the profits of banks, for example, *E3* explained:

The profitability of banks is still so high that fintechs prefer that banks exist. Banks have enormous profitability to share with new innovators who can skim it. If you have competition among all fintechs, banks and others, profitability decreases. That happened many times with monopolies. There are many people interested in maintaining the monopoly, not just the monopolists because they use the enormous profits to share with others. Now fintechs prefer this because if you introduce full competition, they would be forced to compete with other fintechs. They prefer now not to compete with banks. (E3)

Eight interviewees (38% of the total) argued that the increasing amount of complex regulation hinders market discipline. Not private entrepreneurs (bankers) and private investors (including account holders of banks), but public regulators assess risks and tell private banks how to manage their business, how to behave. In the second round of interviews, this view was succinctly summarized by central banker *E28*:

I sometimes consider it strange that we as regulators have to say how much solvency a bank must maintain. It should actually be a choice of their own. They now have 8 or 10 percent, they do what we say. However, they must determine it themselves. . . . We have created a system where the private entrepreneur no longer must make his own considerations, but they do what we think is right for them. But, in a market system in a general sense, people need to know themselves what good is. (E28, own translation)

Four interviewees explained – in line with the problem analysis in chapter 6 – in detail the relationships between risk-taking by banks, systemic financial crises, public protection mechanisms, moral hazards, and regulations (constraints). The interviewee who did this in most detailed was commercial banker *E21*:

So, on the one side, you incentivize excessive risk-taking with deposit insurance and the lender-of-last-resort function of the central banks. On the other side, you're unable to contain it with banking regulation. And that means you have a big build-up of systemic risk. I mean this balance sheet connectivity can come crashing down because it gets more and more unstable. It kind of increases, maybe not the likelihood but the severity of financial crises it definitely encourages. We've seen that in the past 40 years. The severity always goes

up and up and up. The second problem is also this kind of business cycle resource waste. Because the credit creation during the boom is incentivized by moral hazards and the extreme contraction leads to unemployment and idle resources in the economy. In both cycles, there is a lot of welfare loss. And the third is really on a kind of entire market level. It is increasing regulatory intervention although it has not the desired effect, it has a lot of undesired effects and those undesired effects are really undermining competition, the dynamics of the economy, keeping some big companies alive, suppressing meaningful innovation in the financial system and at the end leading to welfare losses for the entire society. So, I think those are three problematic aspects to this whole flawed regulatory framework. (E21)

The three interviewees who did not consider the current amount of regulation in their country (context) a problem were based in Sweden and Switzerland and worked in fintech, central banking and economic science. In their view, the current number of regulations is needed to stabilize the current monetary and financial system. This point was, however, also explicitly clarified by four interviewees who argued that the current amount and complexity of regulation is a problem. For example, E3 explained that in the current system “*where money is a risky asset [contractual money], you need regulations, you need protections. That is fully justified.*” In short, interviewees mentioned the consequences of the systemic protecting and constraining of banks by governments and generally agreed that complex regulation in the current system is required to realize stability.

When asked directly, most interviewees agreed that contractual liquidity is a fundamental cause of systemic financial crises (monetary fragility) and the systemic protecting and constraining of banks by governments. When asked directly, fourteen interviewees in the first round of interviews (67% of the total) considered contractual liquidity (to a greater or lesser extent) the cause of the two identified systemic problems, for example, E4:

I think the problem is that you have an unsafe asset [contractual money] that can be converted at par all the time into a safe asset [inherent money]. And I mean even if you listen to that, that sounds ridiculous. But through regulation, this is tried to be safe and tried to be offered its contractual liquidity. (E4)

In this reasoning, contractual money is fragile by design and cannot exist without public protection mechanisms. Two interviewees (10%) disagreed and referred (consistently) to the debt cycle. One of them worked in economic science and the other in commercial banking and fintech. In their view, debts for unproductive investments are the key problem. Five interviewees in the first round of interviews (24% of the

total) did not have a clear view, because of the difficulty and their unfamiliarity with the term contractual liquidity. Four of those interviewees worked in practice, that is, in commercial banking and finance or fintech start-ups. Not all interviewees were thus familiar with the word contractual liquidity. Some used other terms to describe the same construct. For example, E9 discussed the definition of contractual liquidity: “what you call contractual liquidity is an IOU. It’s a debt” and E3 called contractual liquidity “a promise to pay”. The key feature of this debt (liability) is that it is “checkable” (E9); that is, it is on demand exchangeable at par (1:1).

Interviewees had different views on the role of the market in systemic financial crises. Thirteen interviewees in the first round of interviews (62% of the total) argued that systemic financial crises occur because market regulation fails. Eight interviewees in the first round of interviews (38% of the total) argued that systemic financial crises, such as the crisis of 2007-9, are the result of a lack of market discipline in the monetary and financial system. The interviewees arguing that market regulation fails reasoned that banks predominantly focus on maximizing profits and maximizing shareholder value and that regulators assume that this will lead to stability. In their view, the systemic financial crisis of 2007-9 occurred because regulations were unable to limit (excessive) risk-taking by banks. Other interviewees argued that there is a lack of market discipline in the current monetary and financial system. They reasoned that bank deposits and money market instruments are fragile by design and can only exist on a large scale because of public protection mechanisms. Moreover, they argued that there is currently no real level playing field, because there are protection mechanisms for some financial institutions and issuers of money (banks) and not for others. Due to protections, investments in a bank (with risk) can be used as (risk-free) money, and consequently, account holders have very little (or even no) incentive to exercise market discipline. Market discipline was explained as the willingness of investors to fund a firm (a bank), based on information about the behaviour of the firm. In this reasoning, the transformation of a risky investment into safe money is unnatural and unstable, as explained by E1:

You are doing something unnatural in the monetary and financial system. The financial part is related to risks and is about financing something. And then you want to monetize certain titles, which are risk positions. This means that you only want to assess them on the nominal amount and not on the underlying or intrinsic value. So, you are doing something unnatural. So, the monetary and financial system is unnatural and therefore inherently unstable. You are forcefully holding up something. (E1, own translation)

The view that there is a lack of market discipline was in this research mainly expressed on the sides, for example, by the interviewees working at research departments of central banks and research NGOs in banking and finance.

10.2.2 Other systemic problems

Interviewees mentioned four other systemic problems. The openness of semi-structured interviews provided the interviewees with the opportunity to discuss additional systemic problems, to have a different view. The mentioned systemic problems can be categorized into three groups: 1) unsustainable development; 2) financial exclusion; 3) lack of productive lending, and; 4) lack of competition between currencies. Moreover, there were four interviewees in the first round (19% of the total) who argued that the current monetary and financial system does not have a systemic problem.

10.2.2.1 Sustainable development

Three interviewees in the first round of interviews (14% of the total) – and three interviewees in the second round of interviews (38% of the total) – argued that it is very hard, if not impossible, to realize sustainable development and/ or a circular economy with the current monetary and financial system. In this view, the current fractional reserve banking system has contributed to economic growth, because: 1) money as debt which stimulates production, and; 2) continuous inflation stimulates consumption. In the literature, similar and other sustainable/ circular critiques are developed by among others Huber and Robertson (2000), Lietaer *et al.* (2012), Daly (2013), Seyfang and Longhurst (2013), Dittmer (2015), van Egmond and de Vries (2016, 2018) and Mellor (2016).

10.2.2.2 Financial exclusion

Four interviewees in the first round of interviews (19% of the total) – and one interviewee in the second round (13% of the total) – mentioned financial exclusion and not serving the interest of poor economic agents as a key problem of the current system. Today, there are 1.7 billion adults and hundreds of millions of businesses globally who only have access to material cash and thus do not have a digital transaction account (BIS 2020). This is a problem of emerging countries and developed countries. For example, 7 per cent of Americans do not have a bank account, and 20 per cent of them rely on expensive non-bank services despite having a bank account (Ricks *et al.* 2018: 6; Baradaran 2015). Those non-bank payment providers charge 1.5 to 3.5 per cent of face value (*Ibid.*). Those interviewees explicitly connected the future design to financial inclusion and argued that a future design should focus on including people.

In the literature, similar and other social critiques are developed by among others Baradaran (2015), Bytтеbier (2015), Stiglitz (2016a, 2016b, 2017a), van ‘t Klooster (2017), Di Muzio and Robbins (2017), Mellor (2016), Ricks *et al.* (2018), WRR (2019) and Prasad (2021).

10.2.2.3 Lack of productive lending

Four interviewees in the first round (19% of the total) – and one interviewee in the second round (13% of the total) – argued that the shift in bank lending from productive loans to unproductive loans is a systemic problem. In the last decades, contractual money has increasingly been created to purchase existing real estate and financial assets and not to realize new capital goods. According to those interviewees, this leads to bubbles in real estate markets and financial markets. Section 6.7 discussed this shift in more detail.

10.2.2.4 Lack of competition between currencies

Two interviewees in the first round (5% of the total) emphasized the need for (and the lack of) competition and choice in currencies for economic agents as a systemic problem. In line with the theory of free banking, they argue that competition between private currencies will lead to stability. Section 4.4.2 explained this theory in more detail.

10.2.2.5 No systemic problem

Four interviewees in the first round (19% of the total) argued that the current monetary and financial system does not have a systemic problem. They reasoned that the current fractional reserve banking system has some problems, such as a vulnerability for liquidity problems, booms and busts and financial crises. However, in their opinion, these problems can be solved and are being solved within the current design (system).

10.2.3 Summary

In short, most interviewees considered systemic financial crises a systemic problem and the consequences of the systemic protecting and constraining of banks problematic. A minority of the interviewees connected both systemic problems. Moreover, it was found that there is a fundamental disagreement between interviewees arguing that systemic financial crises occur because ‘regulation of the market fails’ and interviewees arguing that ‘market discipline fails’. In addition, four other systemic problems were identified: 1) unsustainable development; 2) financial exclusion; 3) lack of productive lending, and; 4) lack of competition between currencies. Moreover, some interviewees had the view that the current monetary and financial system does not have a systemic problem, that is, that all the problems can be solved within the current design.

10.3 Different scenarios

Because of different problem definitions and analyses, interviewees had different views on desirable design interventions and the future of the monetary and financial system. Their views could be categorized into seven groups. Each group has a different problem analysis and prefers a different future scenario. The seven future scenarios are:

1. continue on the current path (4 interviewees);
2. more guidance by central banks (5 interviewees);
3. add public digital money as a means of payment (3 interviewees);
4. add public digital money as means of payment and store of value (5 interviewees);
5. full reserve banking (6 interviewees);
6. transform central banks into monetary authorities without a balance sheet (4 interviewees), and;
7. free banking (abolish central banks) (2 interviewees).

In some cases, scenarios slightly overlap. For example, some interviewees combined scenario 1 with scenario 3 and scenario 2 with scenario 3 or 4. Moreover, some interviewees considered a scenario as a required or logical first step to a next scenario. For example, scenario 4 was mentioned as a step to scenario 6. Interviewees preferring scenario 1, 2 and 3 generally argue that more regulation and better risk management by public central banks is needed. Interviewees preferring scenario 4, 5, 6 and 7 generally argue that more market discipline and privatizing risk management is needed.

A first group of interviewees advocated a scenario of continuing on the current path. They argued that the current system has no systemic problems and that the problems that exist can be solved within the current design, and therefore, they propose continuing on the existing path. A second group of interviewees advocated a scenario of more guidance by central banks. They generally confirmed the problem of systemic financial crises but emphasized that other systemic problems also must be solved and/or are more important. They mentioned predominantly unsustainable development, financial exclusion, and the rapid increase of ‘unproductive’ lending by banks in the last decades as other systemic problems. They argued that central banks should guide banks’ behaviour more via (green) credit guidance towards ‘productive’ lending and/or more regulations to guide the operations of banks. An example of the latter is the obligation to offer standard products and proposals to establish standard retail banks. In this scenario, risk management of central banks expands also into other areas such as climate change and inequality. A third group of interviewees advocated adding public digital currencies as a means of payment. They confirmed the problem of systemic financial crises and sometimes added financial exclusion as a systemic

problem. They propose the implementation of public digital money with a relatively low limit on the amount an economic agent can possess (e.g., 10,000 euro). A fourth group of interviewees advocated adding public digital money as a means of payment and a store of value. They generally confirmed the problem of systemic financial crises and the systemic protecting and constraining of banks, and sometimes added financial exclusion as a systemic problem. They proposed the implementation of public digital money without or with a relatively high limit on the amount an economic agent can possess (e.g., 100,000 euro). A fifth group of interviewees advocated full reserve banking. They generally confirmed the problems of systemic financial crises and the dynamics of protecting and constraining banks. Some of them added unsustainable development. They proposed the separation of banks into deposit banks and lending banks. In this scenario, the monetary authority is still organized as a central bank and still has a balance sheet that can be used to implement monetary policy. A sixth group of interviewees advocated a scenario of transforming central banks into monetary authorities without balance sheets. The key difference with the previous scenario is that the monetary authority has, in the long run, no balance sheet and, consequently, it is no longer able to function as lender-of-last-resort and is no longer involved in risk management. In this scenario, public digital money is, in the end state, an asset in a register. This design is similar to the design of several private cryptocurrencies (e.g., bitcoin). These interviewees emphasized that only if money no longer connects two balance sheets, the monetary system and financial system can be completely separated in a credible (time-consistent) way. A seventh group of interviewees advocated a scenario of abolishing central banks, much in line with the theory of free banking. In their view, systemic financial crises are mainly caused by mismanagement of the government and as a solution currency competition is proposed. Also, in this scenario, risk management is privatized. Table 10-1 relates the different problem analyses to future scenarios.

Table 10-1: Scenarios and systemic problems

		Identified systemic problems						
		Systemic financial crises	Systemic protecting and constraining	Unsustainable development	Financial exclusion	Lack of productive lending	Lack of competition between currencies	No systemic problem
Identified scenarios	1. Continue on the current path							x
	2. More guidance by central banks	x		x	x	x		
	3. Add public digital money as means of payment	x			x			
	4. Add public digital money as means of payment and store of value	x	x		x			
	5. Full reserve banking	x	x	x				
	6. Transform central banks into monetary authorities without balance sheets	x	x					
	7. Free banking (abolish central banks)	x					x	

In the remainder of this chapter, the views of those seven groups will be used to better understand commonalities and differences.

10.3.1 Different theories understanding systemic financial crises

Interviewees used different theories to explain the origin of systemic financial crises. Interviewees preferring scenario 1, 2 and 3 more often used arguments that predominantly reflect the debt cycle theory to explain systemic financial

crises. Interviewees preferring scenario 4, 5 and 6 more often used arguments that predominantly reflect the bank run theory to explain systemic financial crises. Three interviewees in the first round of interviews (14% of the total) combined arguments of both theories to explain systemic financial crises – in line with the contractual liquidity theory (see section 6.3.3). For example, a commercial banker (E21) stated:

I think those two interpretations basically look at the same coin from different sides. I mean on the one side this ample liquidity creates a lot of incentives to balance sheet expansion. And on the other side if balance sheets contract, this dries up the entire liquidity. So, I really think, I mean money and contractual liquidity that is created on the balance sheets. What we were, for example, seeing in the run-up of 2008, we saw those shadow banking channels create vast amounts of contractual liquidity, meaning building and expanding their balance sheets. Starting with the very kind of still risky and long-term mortgage-backed securities transforming them within their channels into money market mutual funds or other very short-term and perceived safe debts that kind of served as inside money with contractual liquidity. So, I really think those two interpretations are looking at the same thing and are consistent with each other. (E21)

The interviewees connecting both theories preferred scenario 6. Those interviewees worked in central banking and commercial banking, whereas two of them combined this with a job in economic science. These interviewees combined practical knowledge of banking and theoretical concepts in their reasoning.

10.3.2 Different views on the system

Section 6.7 discussed four different views on the fragility of banks and recurrent systemic financial crisis in the literature: 1) systemic financial crisis are inherent to capitalist economies; 2) fragility is needed for liquidity creation and maturity transformation; 3) bank deposits with sequential service provide incentives for investors to monitor and discipline banks, and; 4) fractional reserve banking has on a systemic level three advantages over alternative systems - a) the quantity of money moves along with economic activity; b) new money enters where it is most needed, and; c) the system fulfils various desires of customers. Also, interviewees had fundamentally different views about those topics.

Three different views on the possibility to solve the problem of systemic financial crises. Eleven interviewees in the two rounds of interviews (37% of the total) argued that systemic financial crises are no longer possible when contractual liquidity has been completely substituted by inherent liquidity and market liquidity. Hence, in their

view, it is possible to solve the problem of systemic financial crises. These interviewees generally preferred scenario 5 and 6. Twelve interviewees in the two rounds of interviews (41% of the total) argued that the chance of a systemic financial crisis can be decreased significantly, that is, in their view, the problem of recurrent systemic financial crises cannot be solved completely. These interviewees generally preferred scenario 2, 3 and 4. Four interviewees in the two rounds of interviews (14% of the total) argued, in line with the debt cycle theory, that systemic financial crises are ‘inherent’ to capitalist economies, that is, in their view, the problem of systemic financial crises cannot be solved. These interviewees generally preferred scenario 1 and 2. Two interviewees in the two rounds of interviews (7% of the total) had no clear view. These different views will be discussed and analysed in more detail in section 10.5.2.2.

Two different views on liquidity creation and maturity transformation by banks.

In the view of interviewees preferring scenario 1 and 2, liquidity creation and maturity transformation are the essence of banks as well as the main source of fragility. Banks are “welfare-enhancing” (E8) because they bring together “two incompatible desires” (E17), that is, because banks “promise you that you can always access your savings” and “that you can take 30 years to repay your mortgage” (E17). Banks create liquidity (bank deposits) out of loans and transform maturity. In the view of those interviewees, this form of money creation is thus welfare enhancing and done by private banks. Interviewees preferring scenario 4, 5, 6 and 7 argued, in contrast, generally that maturity transformation is the result of public protection mechanisms – in line with the explanation and analyses of the current system in chapter 5 and 6. In their view, “it’s knowing that you can extend maturity transformation and there’s always the lender of last resort to back you up if it goes wrong” (E11); that is, “Without protections they [banks] cannot do it. It is the state that provides the liquidity to transform maturity” (E3). These interviewees argued that maturity transformation on the current (large) scale “came only after deposit insurance and lender of last resort facilities were implemented. Which means that it wasn’t implemented to protect maturity transformation, it was on the other way around” (E21). These interviewees also questioned if the current scale of maturity transformation is welfare-enhancing.

Two different views on (de)centralization. In the view of interviewees preferring scenario 1 and 2, the current fractional reserve system is decentral and enables decentral decision making. For example, E17 explained:

In the end, what banks do is a continuous process of liquidity creation and liquidity destruction. And that happens in response to people, who want to turn something illiquid into liquidity or, on the contrary, want to turn liquidity into something illiquid, and then you pay off a debt. That is a micro process. It is a

very sophisticated process that involves millions of transactions per year in the Netherlands alone. And I think that in the core you can do that best through a market process. It is, in contrast to what many people think, a very democratic process. (E17, own translation)

Because it is decentral, new money enters where it is most needed, according to those interviewees. In the view of interviewees preferring scenario 5 and 6, the current system is centralized because central banks and commercial banks on a central level and not individuals (lenders, investors) on a decentral level take most decisions. For example, E1 argued:

There is no optimization in the money allocation by banks. Just let the market do it. It is now centralized. If you want to optimize it, you must decentralize. (E1, own translation)

Two views on regulating and disciplining banks. Interviewees arguing there is a lack of market discipline proposed – logically - ‘more market’ or ‘more market discipline’ as the solution. In this view, markets regulate and discipline better than regulators:

In the 19th century, the average capital in the banks was between 30 and 40 per cent. They did not protect; they did not need to regulate because the market disciplined banks. People did not invest or lend to a bank that had less than 40 per cent capital. These are the requirements of the market. Markets regulate better. (E3)

It's market discipline. It makes sure that the market is asking critical questions and making critical decisions. (E5)

These interviewees argued that the task of the government in financial markets is not telling people what they should do with their money and where the risks are, but realizing transparency (for example, via a prospectus) and making clear the difference between safe money (which the state can offer) and investments. They propose decentralizing and privatizing risk management. In this view, there is a pivotal difference between regulation focussing on transparency and microprudential and conduct regulations. Interviewees arguing that market regulation failed proposed predominantly better risk management by public authorities and more regulations to guide banks. They also recommended higher capital ratios but think that this should be realized via regulations. In their view, the relatively high costs of regulation are justifiable because it prevents systemic financial crises from happening. They argue that the current monetary and financial system is less fragile, because of the ‘better’ risk management and regulations implemented after the financial crisis of 2007-9.

10.4 Generic design requirements evaluation

This section evaluates the initial requirements developed in chapter 7. In design science, interviews with experts are often used to evaluate requirements. The evaluation in this section is a first evaluation of the requirements. An iterative process is recommended for further evaluation. Interviewees widely supported six of the eight initial requirements. Based on their views, four of these six requirements were slightly adapted. Interviewees had fundamentally different views on two requirements, and therefore these two were rejected. Based on the consensus among the interviewees about the importance of aligning risk and reward, one requirement was added. The following subsections discuss the evaluation of the requirements.

10.4.1 Views on initial GDR 1: The government must ensure at least one public unit of account

All interviewees thought that one public unit of account is needed. The interviewees preferring scenario 1–6 as well as the interviewees preferring scenario 7 (free banking) thought that a general unit of account can realize positive network externalities for all economic agents, especially for accounting (bookkeeping). For example, to compare financial statements a general unit of account is convenient and efficient. Interviewees emphasized that a unit of account is something that people in a country (or group of countries in case of the euro) share (as explained in section 2.2 and 7.3). After the interviews, the word ‘public’ was replaced by ‘general’ in the first requirement to emphasize that the unit of account can be used within the public domain as well as within the private domain. Moreover, ‘at least’ was removed because interviewees agreed that one standard unit of account is beneficial for all economic agents.

Generic design requirement I: The government must ensure one general unit of account.

10.4.2 Views on initial GDR 2: The government must ensure at least one public currency

Almost all interviewees thought that one public currency is needed. Only the interviewees preferring scenario 7 argued that a public currency is not needed. In their view, the government should not regulate and at the same time compete with private currencies. All other interviewees confirmed that a public currency is needed. A public currency realizes in their view positive network externalities concerning (decentralized) payments (settlements) for all economic agents – in line with the reasoning in section 7.3.2. A standard means of payment smoothens exchange and improves the functioning of market economies. The main disagreement is about

who should be allowed to issue this public currency. Interviewees reasoning from scenario 5 and 6 argued that only an independent monetary authority on behalf of the government should be allowed to create public money in the long run because this would lead to a by design stable monetary system. Most interviewees reasoning from scenario 1, 2 and 3 argued that the public currency should be issued by private banks in a public-private construction (as explained in chapter 5). In short, most interviewees in this research agreed that a public currency, a standard means of payment, realizes positive network externalities for all economic agents. Therefore, the word ‘at least’ was removed from the second requirement after the interviews.

Generic design requirement II: The government must ensure one public currency.

10.4.3 Views on initial GDR 3: The government must ensure that the public currency has as low as possible transaction costs

All interviewees agreed that if the government decides to have a public currency, it must ensure low transaction costs of this currency. Interviewees used various terms to describe low transaction costs. For example, *E4* stated: “*The technical design of that currency should be state of the art*” because “*high transaction costs hamper economic activity.*” Interviewees emphasized, however, that low costs should not be the only aim. Robustness and resilience were also considered essential for the public currency. After the first round of interviews, ‘the public currency has as low as possible transaction costs’ was replaced by ‘the technical design of the public currency is state of the art to make transaction costs as low as possible.’ In the second round of interviews, two central bankers, *E28* and *E29* added two characteristics: secure and inclusive. Secure means that the transferred money arrives at the destined place (account, person). Inclusive means that all economic agents can have access to the currency. After the second round of interviews “secure” and “inclusive” were added to the third requirement, and “as low as possible transaction costs” was taken away. Section 7.3.3 categorized transaction costs in detail from a theoretical perspective. All interviewees agreed that if there is a public currency, it should be stable, secure, inclusive, and state of the art.

Generic design requirement III: The government must ensure that the technical design of the public currency is stable, secure, inclusive, and state of the art.

10.4.4 Views on initial GDR 4: The government must ensure that the public currency offers stable settlement power

All interviewees shared the view that stable settlement power is needed but disagreed about its definition. All interviewees agreed – also the interviewees preferring scenario 7 – that if the government manages a public currency, the aim should be stable settlement power. For example, *E11* stated: *“I think it’s essential that the state, slash the central bank, provides a stable currency. And I don’t think it’s something you can leave to the private sector completely.”* Some interviewees argued that 0% inflation should be the aim, others a little bit of inflation (1.5-2%), and others that inflation should at least be predictable. Interviewees preferring 0% reasoned that the number and the role of private digital assets (including cryptocurrencies) and the liquidity they offer will likely continue to increase in the digital age. When this happens, there will be more pressure on the monetary authority to realize stable settlement power of the public currency, that is, 0% inflation. If the public currency is subject to inflation, people can easily switch to private digital assets to store value. Four interviewees explicitly stated that they expect that the transaction costs (including switching costs) of digital forms of money will gradually move close to zero in the digital age because of the increased efficiency offered by digital technologies and economies of scale. Digital technologies will, according to them, thus contribute to an unbundling of the functions of money and ‘force’ the monetary authority to realize 0% inflation.

Generic design requirement IV: The government must ensure that the public currency offers stable settlement power.

10.4.5 Views on initial GDR 5: The government must ensure that the monetary authority is independent of the government.

Interviewees had fundamentally different views on the independence of the monetary authority. A small majority of interviewees in the first round (62% of total) considered a monetary authority independent of the government (day-to-day politics) and the connected freedom to conduct monetary policy by its governors as they wish essential. Those interviewees generally preferred scenario 1, 5, 6 or 7. The latter group preferred the abolishment of central banks but agreed that if there is monetary authority it should be independent of the government. Other interviewees (38% of total) argued that the monetary authority should be less independent. Those interviewees generally preferred scenario 2, 3 or 4. Three of them argued that the central banks should be involved in economic policy via credit guidance and/or greening central bank collateral (assessing those risks). Five others explicitly

proposed more regulations to guide the operations of banks. In the case of credit guidance, central banks guide the creation of contractual money out of bank loans towards specific economic activities and sectors. Interviewees mentioned productive economic activities (instead of real estate and financial markets) and ‘greening’ the economy. In the case of regulating the operations of banks, central banks and other regulators also determine the size and the kind of (standard) services banks offer and/or force banks to establish (standard) ‘safe’ retail banks. These interviewees arguing that the monetary authority should be less independent proposed more involvement in banks and more central risk management by public authorities. In other words, they do not advocate solving the systemic protecting and constraining banks by governments, but they propose intensifying these dynamics and steering the behaviour of banks in the ‘right’ direction.

The interviewees advocating an independent monetary authority had different views on how the monetary authority should function in the digital age and how independence should be organized. The three main topics interviewees had different views on are: 1) who should have access to the monetary authority?; 2) what is (are) the most effective monetary instrument(s)?, and; 3) does the monetary authority need a balance sheet? The first topic those interviewees had different views on is access to the central bank. Interviewees preferring scenario 1 and 2 generally thought that access to the central bank should not be changed, that is, only private banks should have access. Interviewees preferring scenario 3, 4, 5 and 6 suggested giving all economic agents directly or indirectly via deposit banks access to the central bank. This will be discussed in more detail in section 10.5.1. A second topic those interviewees had different views on is the monetary instrument. One of the reasons to advocate the introduction of public digital money mentioned by the interviewees is more effective monetary policy. In the current system, the base interest rate, eligible collateral, and quantitative easing are the main monetary instruments. These instruments are indirect and depend on monetary transmission mechanisms. Interviewees preferring scenario 4, 5 and 6 argued that more direct and effective monetary instruments are possible in the digital age. This will also be discussed in more detail in section 10.5.1. A third topic those interviewees had different views on is the need for a balance sheet in the long run. Interviewees preferring scenario 1, 2, 3, 4 and 5 think the monetary authority should have a balance sheet – as is the case today. Reasons mentioned are that you can offer interest on accounts at the central bank and that *“if you have a balance sheet, if you don’t give the money as a gift to the government, you can take the money out of circulation because you have assets.”* (E20). A disadvantage of having assets is that the MA is (‘forced’ to be) involved in risk management and this undermines its

neutrality and independence, according to interviewees preferring scenario 6. These interviewees argue that full reserve banking is “outdated” (E6). For example, E3 preferred a

CBDC where a central bank is an issuing entity that records and creates money but does not have a balance sheet. It has just a register because the money is the ownership of the people or the state. Money is not a liability. . . . That's important because that transmits the idea that money is a promise to pay. Money is a safe asset and what the state does, is registering that asset as it registers real estate property. And once the money is created, it is delivered to the owners who are the citizens, individually or collectively. The central bank or, better, the issuing entity in the new system, has no relation to money. It is neither a liability nor an asset of the issuing entity. Its first function is to register money. Another function is to determine the amount of money that must be created so that there is no inflation or deflation. This function is important, but it is not much different from what you have now. (E3)

In short, interviewees had different views on how the monetary authority should be organized in the digital age, and more fundamentally, also disagreed about the independence of the monetary authority. A large minority of the interviewees disputed generic design requirement 5. In their view, central banks should be more involved in the business of banks. For this reason, initial requirement 5 was rejected.

10.4.6 Views on initial GDR 6: Private currencies must be allowed as competitors, discipliners, and backup systems

Interviewees used different definitions of private currencies, but agreed that private currencies should be allowed, especially for the function as a store of value. Six interviewees argued that cryptocurrencies as bitcoin should not be labelled currencies because “they are assets” (E10). Four of them worked in central banking and supervision. In their view, “currencies in the traditional sense should be issued by the official sector only” (E10). There is, however, a broad consensus that people should have the freedom to invest in those private assets (currencies), for example E14, stated:

I am not for a prohibition. I am in favour that supervisors and regulators advise: ‘This is an investment. You have the risk of losing money and so on.’ But you decide if you want to invest in gold or cryptocurrencies. I don’t mind that because I think it is very good that people can do whatever they want. (E14)

Section 7.3.6 explained that there is a difference between the use of private currencies as a store of value and as a generally accepted means of payment/ medium of exchange. Six interviewees in the first round explicitly stated that private currencies are competitors to store value and alternative means of payment/ media of exchange in the case of mismanagement of public money. In the view of interviewees, it is “*not easy to use a private currency*” (E11), “*and therefore they will always be inferior in some ways unless you have a really badly managed state*” (E9). Interviewees preferring scenario 5 and 6 emphasized not to be against private money creation, but to publicly guarantee private money creation. This is a key difference with interviewees preferring fractional reserve banking. For example, E7 explained:

Sometimes people in the International Movement for Monetary Reform use this rhetoric of ‘taking away the power to create money from the bank’. But the important thing is to take away the subsidies and privileges of the banks. It’s the power to create government-backed money that should be taken away from the banks, not the power to create any kind of money. (E7)

After the second round of interviews, “(for the function as store of value)” and “(for the functions as medium of exchange and means of payments)” were added to this requirement to emphasize because interviewees distinguished between different roles private currencies can play for the different functions of public money.

Generic design requirement V: The government should allow private currencies (forms of liquidity) as discipliners for the function as store of value and as backup systems for the functions as medium of exchange and means of payment.

10.4.7 Views on initial GDR 7: Legal entities must be allowed to issue securities, to establish credit-debt relationships and to trade securities, credits, and debts.

Interviewees searched for the right formulation of the requirement for the financial system and had fundamentally different views on the level of freedom.

In the interviews, several variants of this requirement were discussed, but it was hard to find a formulation that interviewees in all working fields understood. Moreover, there was a pivotal disagreement between interviewees reasoning from scenario 1 and 2 and interviewees reasoning from scenario 5 and 6. The disagreement is whether or not the government should, in the long run, monetize and guarantee (some) private short-term debts, that is, liabilities of private (shadow) banks. In addition, there is, as explained in section 10.4.5, a fundamental disagreement between interviewees who argue that the central bank should guide bank lending and bank operations to

a larger extent and interviewees who argue that the monetary authority should be completely independent. In the view of the first group of interviewees, the freedom of legal entities to issue securities, to establish credit-debt relationships and to trade securities, credits and debts should be limited. Initial requirement 7 was thus disputed by a large minority (38% of interviewees in the first round).

10.4.8 Views on initial GDR 8: The government must accept only the public currency for tax payments

Almost all interviewees thought that the government should only accept the public currency for tax payments. Only interviewees preferring scenario 7 argued that taxation in different currencies is a good idea because this would give economic agents more freedom. In the case of free banking, a public currency does not exist. In the case of complementary currencies, the argument is that local or regional governments should accept a local or regional currency for tax payments in addition to the public currency. This will, however, lead to several problems in practice. For example, issuers of private currencies will lobby the government to accept their currency and acceptance of a particular private currency will distort the level playing field for private currencies. Interviewees preferring scenario 1 and 2 consider taxation in bank deposits (and settlement in central bank reserves) expressed in the public unit of account but created by private banks optimally. Interviewees preferring scenario 5 and 6 generally argue that the government should “*as the issuer and the backer of the currency*” (E4) only accept its own currency to realize a level playing field, to be neutral. In this research, almost all interviewees thus made a case for accepting only the public currency. The main dissension is thus about who should be allowed to create public money: private banks in a public-private partnership or only the monetary authority.

Generic design requirement VI: The government must accept only the public currency for tax payments.

10.4.9 Generic design requirement VII

All interviewees emphasized the importance of aligning risk and reward. A ninth requirement was added because almost all interviewees emphasized the importance of aligning risk and rewards for the well-functioning of the financial system and the economy. A feature of systemic financial crises is the misalignment of risk and reward. Seven interviewees argued explicitly that the interventions in financial markets via QE introduce new misalignments. The key disagreement between interviewees preferring scenario 1 and 2, interviewees preferring scenario 3 and 4, and interviewees preferring

scenario 5 and 6 is about how risk and reward should be aligned. The first argue that should happen via bail-in regulations, the second via the introduction of safe public digital money (a safe alternative) as a complement to bank deposits and money markets instruments and the latter via a complete separation of the monetary system and the financial system.

Generic design requirement VII: The government must ensure that risk and reward are aligned.

10.5 Generic design guidelines evaluation

This section evaluates the initial set of generic design guidelines developed in chapter 8. In this chapter, it was explained that digital technologies allow an update of public money to the digital age, significantly increased market liquidity in the last decades, and offer opportunities to realize instant and full disclosure of financial and non-financial data. Despite that some interviewees in this research had reservations about the guidelines and especially had different views on the extent the guidelines should be implemented, most of them agreed with the direction of the guidelines. Moreover, interviewees sometimes mentioned fundamentally different reasons why a guideline should be followed and how it should be implemented, that is, they proposed different design variables. The following three subsections report the general view of the interviewees on the guidelines, the identified arguments for/ possible benefits of the guidelines, the identified design variables related to the guidelines, and updates the guidelines.

10.5.1 Views on initial GDG 1

Most interviewees thought that public digital money (central bank digital currency/ digital cash) should be introduced. Twenty-five interviewees in the two rounds of interviews (86% of the total) argued that the introduction of public digital money is a good idea. Four interviewees in the two rounds (14% of the total) disagreed. They preferred scenario 1 or 2. The latter reasoned that safe liquidity already exists because of the central banks as LOLR and DIS and that “*we already have an electronic payment system*” (E18). These interviewees did not connect those protection mechanisms to moral hazards and the systemic protecting and constraining of banks by governments (as section 6.5 did) and warned moreover for political influence on the payments system. In their view, there is a risk that the payments system must compete with other expenses (e.g., healthcare). Other interviewees argued that if the monetary authority is independent and the budget is fixed by law, this influence can be limited.

10.5.1.1 Identified arguments

Interviewees used different arguments and reasonings to support the first guideline – the introduction of public digital money. Their arguments could be categorized into eight groups.⁶¹ There was thus consensus on a high level about the direction among the majority of the interviewees, but the rationale and claimed benefits differed. Almost all interviewees agreed with the first four arguments:

1. *Improving the stability of the payments system.* By providing access to a digital stable means of payment (or in other words, to a safe or risk-free asset, to the central bank, to the monetary authority), the stability of the payment system could improve and “secure buffers” (E6) for individuals as well as “liquidity buffers in society” (E1) could be realized.
2. *Reducing transaction costs*, that is, improving the efficiency of payments, especially for international transactions. Utilitarian arguments as more convenience, efficiency and security for the individual were often used. Section 7.3.3 categorized various transaction costs from a theoretical perspective.
3. *Preventing the disappearance of public money* and countering private initiatives as bitcoin and especially Facebook’s proposal for a global currency – first called Libra, and later called Diem.
4. *Improving financial inclusion* (explained in section 10.2.2.2).

Interviewees preferring scenario 4 generally emphasized a fifth argument:

5. *A disciplining effect on banks.* In this view, competition between public currencies and private currencies and assets has a disciplining effect on the issuers. If economic agents have a safe public digital alternative, banks must be more prudent, more transparent and offer account holders (investors) a return in line with the risks involved. For example, E13 stated: “*I think it will be a kind of modular system where CBDCs get a bigger role and give some cushioning to the system, which I find a better cushioning than all that micro-regulation*” (own translation).

Interviewees preferring scenario 4, 5 and 6 often mentioned a sixth argument:

6. *Realizing more effective monetary policy.* Interviewees mentioned four policy instruments that are, in their view, more direct and therefore more effective - these will be discussed in more detail in section 10.5.1.2.

61 The reasons mentioned by the interviewees can also be found in the literature on digital cash and CBDC. See, for example, Dyson and Hodgson 2016; Barrdear and Kumhof 2016; Andolfatto 2018; Berentsen and Schär 2018; Ricks *et al.* 2018; Adrian and Mancini-Griffoli 2019b; WRR 2019.

Interviewees preferring scenario 5 and 6 often mentioned a seventh argument:

7. *A precondition for deregulation (or re-regulation) and/ or liberalisation of the banking part of the financial system.* In other words, public digital money allows a clearer institutional order in which public and private affairs and responsibilities could be separated and risk management is privatized. This offers an alternative to systemic protecting and constraining of banks by governments.

Finally, some interviewees preferring scenario 4 and 6 gave an eight argument:

8. *Stimulating innovation.* Digital public money could be the basis for and trigger other forms of innovation. In this reasoning, a digital risk-free token, whether or not based on distributed ledger technology, could stimulate innovations in retail and wholesale markets.

In short, there was a broad consensus among the majority of interviewees that public digital money offers benefits for the function as means of payments (the first four identified arguments). The view of the interviewees on other arguments differed significantly.

10.5.1.2 Identified design variables

The interviewees mentioned several design variables related to the first generic design guideline – the introduction of public digital money. This shows that this guideline can be implemented in various ways and (important) design choices must be made in the coming decade(s). The variables reported below were suggested by at least three different interviewees.

- a. *The level of anonymity, privacy, and transparency.* The public monetary system in the digital age can be designed with various levels of anonymity, privacy, and transparency. On the one end, all information about transactions with public digital money could be made accessible to account holders only. On the other end, all transaction and account data can be made fully public, including the names of the account holders. In between these extremes, there are several options to give different access for different actors under certain conditions; government authorities, financial intermediaries, firms, and private individuals can get access to (n)either stocks and/(n)or flows of public digital money depending on the situation. Three interviewees explicitly proposed real-time insight in aggregate stocks and flows of public digital money for the monetary authority to realize stable settlement power of the public currency.

- b. *A limit on the amount of public digital money.* A limit can be used to balance the opposing functions as medium of exchange and store of value and as a monetary instrument to guide the transition.⁶²
- c. *Monetary policy instrument(s).* Interviewees emphasized that public digital money allows more direct and more effective policy instruments. Four monetary policy instruments mentioned in the interviews are: a) government spending to bring public digital money into circulation; b) direct transfers to citizens to bring public digital money into circulation (helicopter money); c) the interest rate on public digital money, and; d) a flexible limit on the amount of public digital money an account holder can possess (as discussed previously). Interviewees preferring scenario 5 and 6 proposed a), b) and d). Interviewees preferring scenario 3 and 4 proposed c) and d).
- d. *Accounting basis.* A design variable for the long run is if the monetary authority needs a balance sheet. Interviewees preferring scenario 6 questioned if a balance sheet is needed in the long run. They reason that in the case of full reserve banking and CBDC proposals, money is still contractual money connected to the balance sheet of a bank, the central bank instead of commercial banks. In their view, money is still risky and public and private affairs and responsibilities are still entangled. The central bank is still involved in risk management. These scholars generally consider scenario 4 and 5 as steps towards a monetary system without a balance sheet, towards a system based on inherent money in digital and material form.
- e. *Underlying technology.* Five interviewees argued that developing public digital money on distributed ledger technology (DLT) offers significant advantages, for example, the option of programmable money. Other interviewees did not have a clear view because it's unclear yet if DLT is currently the state-of-the-art technology for the monetary and financial system.
- f. *Public material inherent money (material cash).* Interviewees gave three arguments for phasing out material cash. First, a system without material cash is more efficient because the transport of material money is no longer needed. Second, if there is no material cash anymore, a negative interest rate on public digital money becomes a policy option. Third, if material cash is phased out and all transactions are digital, money laundering and tax evasion are more difficult.⁶³ Interviewees gave two arguments against banning material cash.⁶⁴ First, material cash is a backup system. It does not require any digital technology or electricity. In the case of a (large-scale) breakdown, material

62 In the literature, Wortmann (2016), Niepelt (2018), DNB (2020) and Bindseil (2020) discuss a limit.

63 See among others Berentsen and Schär (2016, 2018) in the literature.

64 See among others Rogoff (2016) and Häring (2018) in the literature.

cash is the best backup system. Second, material cash guarantees privacy, that is, it guarantees anonymous transactions. Material cash can be used in peer-to-peer transactions if payer and payee are physically in the place at the same moment. Settlement takes place without a trusted third party.

10.5.1.3 Summary

Based upon the analysis of the interviews, the conclusion is that initial generic design guideline 1 points in the right direction but could be improved. Inherent liquidity should be replaced by public digital money because most interviewees understood this term better and there is no consensus if public digital money should be implemented as pure inherent money or as public (central bank) contractual money. Moreover, the guideline was shortened to make it clearer. Table 10-2 shows the evaluated and updated first guideline, the identified arguments/ possible benefits, and the identified design variables. There is, as explained, no consensus on how these variables should be implemented.

Table 10-2: General design guideline 1, arguments and design variables

GDG 1: Develop and gradually introduce public digital money.
<i>Identified arguments:</i> 1) improving the stability of the payments; 2) reducing transaction costs; 3) preventing the disappearance of public money; 4) improving financial inclusion; 5) a disciplining effect on banks; 6) realizing more effective monetary policy; 7) a precondition for deregulation (or re-regulation) and/ or liberalisation of the banking part of the financial system, and; 8) stimulating innovation.
<i>Identified design variables:</i> a) the level of anonymity, privacy, and transparency; b) a limit on the amount of public digital money; c) monetary policy instrument(s); d) account basis; e) underlying technology, and; f) public material inherent money.

10.5.2 Views on initial GDG 2

Interviewees confirmed that the financial system should be based to a larger extent than today on securities offering market liquidity. Twelve interviewees in the two rounds of interviews (41% of the total) were positive about a complete substitution of contractual liquidity by market liquidity in the long run. These interviewees generally preferred scenario 5, 6 and 7. Sixteen interviewees (55% of the total) were positive about a partial substitution of contractual liquidity by market liquidity. These interviewees generally preferred scenario 1, 2, 3 and 4. One interviewee (3% of the total) had no clear view on this topic. Different views were held on how this change (the transition) should be organized. Interviewees preferring scenario 1, 2 and 3 generally argued that regulators should ‘force’ banks to hold more

capital. Interviewees preferring scenario 4, 5, 6 and 7 generally argued that investors (the market) should ‘force’ banks to hold more capital and should be responsible for risk management.

10.5.2.1 Identified arguments

Interviewees used different arguments and reasonings to support the second generic design guideline – moving the financial system towards funding based on market liquidity. The arguments they gave could be categorized into four groups. There was thus consensus on a high level about the direction among a majority of the interviewees, but the rationale and claimed benefits differed. Almost all interviewees agreed with a first argument:

1. *The alignment of risk and reward.* In this reasoning, it is essential that people know what they are holding (possessing), and this is considered a weakness in the current system. Bank deposits are considered safe money but are, in fact, also (or mainly) investments in banks. In a system completely based on inherent money and market liquidity, this misperception does not exist. Interviewees preferring scenario 5 and 6 emphasized that in such a system, financial intermediaries have to offer an incentive to invest, and this will solve the misperception. Interviewees preferring scenario 1 and 2 argue that more capital can solve this problem to a large extent.

Most interviewees agreed at least to some extent with a second argument:

2. *A significantly lower risk of systemic financial crises.* Eleven interviewees in the two rounds of interviews (37% of the total) argued that systemic financial crises are no longer possible when contractual liquidity has been completely substituted by inherent liquidity and market liquidity. Hence, in their view, it is possible to solve the problem of systemic financial crises. These interviewees generally preferred scenario 5 and 6. Twelve interviewees in the two rounds of interviews (41% of the total) argued that the chance of a systemic financial crisis can be decreased significantly, that is, in their view, the problem of recurrent systemic financial crises cannot be solved completely. These interviewees generally preferred scenario 2, 3 and 4. Four interviewees in the two rounds of interviews (14% of the total) argued, in line with the debt cycle theory, that systemic financial crises are ‘inherent’ to capitalist economies; that is, in their view, the problem of systemic financial crises cannot be solved. These interviewees generally preferred scenario 1 and 2. Two interviewees in the two rounds of interviews (7% of the total) had

no clear view. Moreover, according to interviewees preferring scenario 5 and 6, the risk of a crisis in the credit system is smaller for three reasons. First, there are fewer bubbles because financial intermediaries must persuade investors to attract money. Second, the question is how financial intermediaries are funded. This is in line with what the contractual liquidity theory suggests (see section 6.3.3). In the case financial intermediaries are only funded with equity, a financial crisis will become the equivalent of a stock market crash. People lose money in a stock market crash, but this does generally not lead to a domino effect as a bank run on contractual money. *E21* explained this as follow:

I mean you will have booms and busts. That's clear. Because people will always misinterpret developments and make wrong guesses about the future. But this will not lead to self-fulfilling booms and busts. So, in a dynamic economy, there will always be ups and downs. I think one example is the dot com bubble at the end of the 90s. Just very equity financed. It then busted, but it didn't lead to a financial crisis because it was equity financed. A lot of people lost money, but from a social perspective, a lot of money was pumped into the future and kind of put the seats in for all those companies that are, although having a lot of flaws, making our life as consumers pretty great. (E21)

Third, there will be fewer bubbles, because there will be more maturity matching. Three interviewees explicitly stated that maturity matching might be superior to maturity transformation. For example, *E24* argued:

If you are going to match maturities, I don't think it will suddenly lead to a huge decrease in credit. In fact, I think that we will get more reasonableness in the market and cease creating bubbles. Precisely because we transform so easily, we create so many mortgages and inflate prices. (E24, own translation)

Interviewees preferring scenario 4, 5 and 6 generally gave two other arguments:

3. *Market liquidity requires less regulation, and this will result in more competition and innovation in the long run.* In this reasoning, the second guideline could offer an alternative to the systemic protecting and constraining of banks by governments. Combined with the first guideline, this could lead to a new role of the government in the long run. For example, *E28* explained: “*Your government task is no longer protecting people at private institutions but offering them an alternative that is safe*” (own translation). In parallel, risk management is privatized.

4. *The alignment of responsibility and freedom* - connected to the alignment of risk and reward. In the case of more market liquidity, less government involvement (via protection mechanisms, regulations, and risk management) is needed, and this will improve the alignment of risk and reward as well as the alignment of responsibility and freedom. For example, E5 explained:

Freedom without responsibility is a problem. Those two things must go together: freedom and responsibility. And the intervention of the government is often to somehow give freedom but somehow shield the responsibilities that come with it. (E5)

The interviewees mentioning this reason generally considered taking personal responsibility also key for solving social problems and realizing sustainable development. E21 explained the possible positive consequences for the allocation of money if people must, or are ‘forced’ to, take responsibility most clearly:

But if you have a completely decentralized financial system, that completely runs on market liquidity and where you don't have those intermediate balance sheet structuring and extending the entire financial system. Then you have no chance of not knowing where your money is going, right? There's one thing of not knowing that you invest in a weapon manufacturer or an industry polluting the environment. It's another thing exactly knowing that you do that, right? I think most people would refrain from doing so, pushing up the funding costs of those unwanted businesses and having a positive impact on society. (E21)

In this view, decentralization is needed to align risk and reward as well as freedom and responsibilities, that is, in the words of E1: “people must consciously make certain investments and be exposed to the risk of the investments they enter.” Transparency is required to realize these alignments. This will be discussed in more detail in section 10.5.3.1.

Some interviewees questioned if all economic agents are interested and/ or are able to take responsibility for their investments. In this research, five interviewees in the two rounds of interviews (17% of the total) made this point. They preferred scenario 1, 2 or 3. For example, E17 and E25 explained:

But in my view, you should not demand from every saver that he also has to pay attention in his spare time to ‘how is my bank doing?’ Many people are not able to do that. That certainty must just be there. (E17, own translation)

. . . given the complexity of the financial market, I also wonder whether the

average Dutch person should go investing his pension money. I think they can better leave that to a party that is regulated but has more knowledge than the average Dutch person. (E25, own translation)

Interviewees preferring scenario 4, 5 and 6 generally argued that continuous monitoring and investing (pension) money/ savings are not needed for three reasons. First, supervision and regulation of financial intermediaries will still exist. Second, in the long run, it is likely that a significantly larger part of economic agents is financially literate. Today, similarly, a considerably larger part of the population is alphabetic than in the past, that is, in the long run it is likely that more economic agents are able to take responsibility. Third, public digital money offers safety by design. Those interviewees generally considered a safe asset (public digital money (GDG 1) a precondition for moving towards more market liquidity (GDG 2). Six interviewees argued that the introduction of digital public money will ‘automatically’ lead to more funding based on market liquidity (GDG 2). This expected disciplining effect is in line with the theory of free banking.

Interviewees had a mixed view on the possibility and desirability of completely separating public and private affairs and responsibilities. A complete separation is an important aspect of scenario 5 and 6. Sixteen interviewees in the two rounds of interviews (55% of the total) argued that a complete separation is possible and desirable in the long run. Eight interviewees (28%) argued that it is desirable but impossible (or very hard to realize). One interviewee argued that it might be possible but undesirable. Four interviewees had no clear view. Interviewees arguing that it is impossible stated that it might be possible on the drawing board (in theory) but in practice, there is a political moral hazard. In the case of a crisis in the financial system, politicians are inclined to support the people losing money. Those interviewees in the end do not believe that a ‘perfect’ system exists. This view was clearly described by E23:

I have come to the conclusion that there is simply no perfect solution. And that is a bit what I often sense in the solutions that are being proposed, they come a bit from the idea that if we separate public and private completely, that we then have the ultimate solution and that those supervisors then can go home. I definitely support disentangling public and private more because it offers all kinds of possibilities and reduces the chance of abuse. But I do not think that you will enter paradise with that and that there will be no more problems or financial crises. (E23, own translation)

The interviewees preferring scenario 6 emphasized that a complete separation is only possible in a credible way if the monetary authority no longer has a balance sheet.

Five preconditions for a complete separation were proposed: 1) the availability of sufficient reserves of (run-proof) public digital money and a safe payments system (in line with GDG 1); 2) the availability of an instrument/ mechanism to add public digital money directly (section 10.5.1.2 discussed possible new monetary instruments); 3) supervision focusing on transparency (of risks) (in line with GDG 3); 4) the (gradual) phasing out of DIS and LOLR (section 10.5.2.2. discussed these design variables), and; 5) the implementation of time-consistent rules. In the case of recurrent problems in the financial system, a rule was suggested that investments are only allowed when economic agents have a buffer of public digital money.

Interviewees considered the transition a key problem of scenario 4, 5, 6 and 7.

Underlying scenario 4, and especially 5, 6 and 7 lies the question of how to move into the proposed direction responsibly. In the interviews, seven interviewees in the two rounds (24% of the total) mentioned the transition as the key problem. A stepwise implementation and instant (overnight) transition were suggested as transition paths. Five interviewees proposed a gradual increasing limit on public digital money as a transition path.

10.5.2.2 Identified design variables

The interviewees mentioned several design variables related to the second generic design guideline – moving the financial system towards funding based on securities offering market liquidity. This shows that this guideline can be implemented in various ways and (important) design choices must be made in the coming decade(s). The variables reported below were suggested by at least three different interviewees.

- a) *The funding of financial intermediaries.* A design choice in scenario 5 and 6 is if financial intermediaries should be allowed to fund themselves only with equity securities as in proposals for ‘limited purpose banking’⁶⁵ or also with long-term debt securities and/ or deposits offering *conditional* (limited) contractual liquidity. Figure 12-3 visualizes a standard balance sheet of a financial intermediary in a system without *unconditional* contractual liquidity.

⁶⁵ See, for example, Kotlikoff 2010, 2018; Cochrane 2014

Assets	Financial intermediary + Equity	Liabilities
Public digital money	Equity/ long-term debt/ securities based on conditional contractual liquidity	
Bonds		
Shares		
Loans		

Figure 10-1: Design variable the funding of financial intermediaries

Five interviewees explicitly proposed a prohibition on unconditional contractual liquidity and reflected on the possibilities of conditional contractual liquidity and the influence on systemic financial crises. For example, *E1* stated:

You should fund yourself with a certain security and it may well contain: ‘You get it back on that date.’ Or even: ‘You get it back when you ask for it, but it may be that I have to deduct a little.’ You can only no longer claim nominally. But you will get all kinds of gradations in that. If you are going to prohibit something there, there will come all kinds of gradations of what is allowed and what isn’t. Crisis situations can always arise from that. But if you want to prevent that they become systemic crises, that they move into the monetary system, I point again to the societal liquidity buffers in the form of abstract money. There is no longer a chain that breaks through these buffers. These are inert. They are just there. They always remain standing. Some pieces are lost because risks smash and there someone will suffer a loss. This is not a societal problem because it is not a house of cards that can undermine the entire system. (E1, own translation)

A connected design choice is if contractual liquidity between two parties should be allowed.

The argument for only equity is, according to interviewees, that this decreases the risk of a systemic financial crisis most significantly. Equity aligns easier with ‘real’ economic circumstances, and this improves stability.⁶⁶ In the case of shares, the owner

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 66 See for example Mian and Sufi (2014), Turner (2016: 192), Corneo (2017: 169) and Bats and Houben (2020: 2) in the literature.

participates in profits as well as losses. If there are temporary problems, shareholders do not get dividends and the share price falls. In contrast, loans and bonds have fixed repayments and this makes it more difficult to take into account ‘real’ circumstances. The argument for allowing long-term loans and bonds is that they are easier to monitor than shares. In the case of significant losses, a haircut has to be negotiated. What kind of contracts should be allowed, and especially what forms of conditional contractual liquidity should be allowed, is an interesting topic for further research in which contributions of legal scholars are required. This research focuses on the possibility offered by digital technologies and emphasizes that these technologies have increased market liquidity in recent decades and that this offers new possibilities.

- b) *Deposit insurance schemes.* Five interviewees preferring scenario 4, 5 or 6 explicitly stated that the introduction of public digital money could be an alternative for deposit insurance schemes.⁶⁷ In their view, deposit insurance schemes can be (stepwise) abolished if the general public has access to safe public digital money. Two interviewees suggested a solution in between, e.g., the introduction of public digital money and a reduction of DIS. For example, access to public digital money till 40.000 euro and a DIS of 60.000 euro. An option is to add a percentage to DIS, e.g., 90%. This would mean that all economic agents have the option to store 94.000 euros safely.
- c) *The function of lender-of-last-resort.* The interviewees preferring scenario 6 propose to abolish the function of lender-of-last-resort in the long run. Because the monetary authority no longer has a balance sheet, it is no longer able to provide loans. This design variable is connected to the design variables ‘monetary instrument’ and ‘accounting basis’ (discussed in section 10.5.1.2).
- d) *Tools and rules to improve the functioning of a financial system based on market liquidity.* Interviewees preferring scenario 5 and 6 proposed tools and rules to increase financial literacy and risk awareness. For example, a financial driving licence, an obligatory prospectus (a priori advice) and an obligatory reserve of public digital money before an economic agent is allowed to invest. Interviewees emphasized that, especially in the beginning, information, and education about the difference between risk-free money (public digital money without reward) and risk-bearing private currencies (assets) and securities (with a chance of reward) is needed.

⁶⁷ In the literature, this argument can be traced back to Tobin (1985, 1987)

10.5.2.3 Summary

In short, although not all interviewees thought the financial system should be based completely on securities offering market liquidity, there is a broad consensus that it is desirable to move into the direction of more market liquidity, especially in currency areas where bank-based financing dominates today – for example, in the euro area. After the interviews, generic design guideline 2 was updated. A more active sentence was formulated because most interviewees argued that the government needs to take a leading role in structuring the market, in determining the institutional order. Moreover, the guideline was shortened. Table 10-3 shows the evaluated and updated second guideline, the identified arguments/ possible benefits, and the identified design variables.

Table 10-3: General design guideline 2, arguments and design variables

GDG 2: Move the financial system towards funding based on securities offering market liquidity.
<i>Identified arguments:</i> 1) the alignment of risk and reward; 2) a significantly lower risk of systemic financial crises; 3) less regulation will realize more competition and innovation, and; 4) the alignment of responsibility and freedom.
<i>Identified design variables:</i> a) the funding of financial intermediaries; b) deposit insurance schemes; c) the function of lender-of-last-resort, and; d) tools and rules to improve the functioning of a financial system based on market liquidity.

10.5.3 Views on initial GDG 3

Most interviewees supported to some extent a shift of financial regulation towards transparency. Twenty interviewees in the two rounds of interviews (69% of the total) agreed to a large extent with a shift from microprudential and conduct regulations towards transparency. Those interviewees generally preferred scenario 4, 5, 6 and 7. Eight interviewees (34%) agreed to some extent and expressed doubts. One interviewee disagreed. The interviewees expressing doubts and disagreeing preferred scenario 1, 2 and 3.

10.5.3.1 Identified arguments

Interviewees used two arguments to support the third generic design guideline – moving financial regulation towards transparency:

1. *Transparency is a prerequisite for market discipline.* In this view, more transparent information improves the ability of investors to exercise market discipline. Three interviewees mentioned the third pillar of Basel II and III, which is about enhancing risk disclosure and market discipline. Most interviewees agree

on connecting the third guideline to more funding based on securities offering market liquidity (GDG 2) and/ or to the gradual introduction of digital inherent money (GDG 1). For example, E27 connected the three guidelines:

I think that micro-prudential requirements can actually be divided into two. Namely, on the one hand, the requirement that is aimed at safeguarding public liquidity, so the money role. And another part of the micro-prudential requirements is to protect investors in the sense of: "There is a certain relationship of trust that needs to be secured in a certain way." You could indeed do that much better by saying: "No, you just have to be transparent. You have to make clear what the risks are in your product or in your financial instrument." That is the right approach for supervising market liquidity. And if you are talking about the other role that micro-prudential supervises, you could simply design that much more from blank government guarantees by saying that the government is the counterparty in your primary financial instrument, namely money. (E27, own translation)

Interviewees preferring scenario 4, 5 and 6 argued that a market-based financial system not only requires but also enforces transparency. When economic agents invest in securities offering market liquidity, they will demand more information than in the case they invest in liabilities offering unconditional contractual liquidity.

2. *Transparency is a prerequisite for keeping managers of banks accountable.* Four interviewees explicitly referred to the opacity of banks in the current system and argued that more transparency is needed and possible if the system is to a larger extent based on market liquidity and if digital technologies are used. When more transparency is realized, it is easier to keep the managers of banks responsible.

Some interviewees questioned if all economic agents are interested and/ or are able to deal with transparency and to execute market discipline. Five interviewees preferring scenario 1, 2 and 3 questioned if people would be able and interested in dealing with transparency and executing market discipline – in line with the doubt of the ability of economic agents to take responsibility for their investments (see section 10.5.2). Examples are E25 and E26:

I think that many people are not going to analyse all institutions themselves. Those reports are already available now. There is transparency. We are very transparent about what each health insurer reimburses and how much you pay for it. How many people switch? Who reads it at all? (E25, own translation)

So, I'm pretty pessimistic about what we can and should expect from

the consumer in terms of how critical he is going to be towards financial institutions. I think you can hardly expect anything from it. I find it very scary to base the system and its safety partly on the consumer who is going to enforce things . . . (E26, own translation)

Interviewees preferring scenario 4, 5 and 6 proposed a priori advice (via an obligatory prospectus for financial intermediaries) and real-time disclosure of data to lower information asymmetries. In addition, they emphasize the importance of risk-free public digital money (GDG 1) because this form of money does not require any financial regulation and monitoring by economic agents. Moreover, the third guideline does not propose to abolish microprudential regulation completely. It proposes to move into the direction of less microprudential regulation and more attention to increasing transparency (with the help of digital technologies). In other words, a focus on the third pillar of Basel II and III.

10.5.3.2 Identified design variables

Interviewees emphasized that variables of the third guideline depend particularly on the funding of financial intermediaries (discussed in section 10.5.2.2). If contractual liquidity will continue to exist as in scenario 1, 2, and 3, some opaqueness is likely needed. In a system with unconditional contractual liquidity, complete transparency can cause a bank run because in the case holders of unconditional contractual money know that a couple of borrowers bankrupt in sequence, they may move their contractual money to another bank or withdraw their contractual money. A certain level of non-transparency is thus a good thing in the current system, as explained for example by E17:

And that there is a certain intransparency, not for the regulator, but for the general public, that is precisely one of the stabilizing factors. The downside is, of course, that if very big crap is also kept out of sight and that you notice at a certain moment: “Damn, they should have told this earlier.” That is why it is good that the regulators look at that micro-level at individual files. (E17, own translation)

There is thus a connection between (the variables of) GDG 2 and GDG 3. The more the system is moved towards funding based on market liquidity, the more regulation can be moved towards transparency.

10.5.3.3 Summary

In short, although interviewees doubted to what extent regulation should change, most interviewees considered moving into the direction of more transparency and

more responsibility for investors desirable. After the interviews, initial generic design guideline 3 was shortened and made more active. Table 10-4 shows the evaluated and updated third guideline, the identified arguments/ possible benefits, and the identified design variables.

Table 10-4: General design guideline 3, arguments and design variables

GDG 3: Move financial regulation towards transparency.
<i>Identified arguments:</i> 1) a prerequisite for exercising market discipline, and; 2) a prerequisite for holding bank managers accountable.
<i>Identified design variable:</i> a) the level of transparency depends on the funding of financial intermediaries (GDG 2).

10.6 Conclusion

The interviews were useful to identify and understand the different views of the interviewees, to evaluate and refine the problem analysis, the requirements, and guidelines, and allowed the identification of different scenarios. The interviews provided six main insights. First, most interviewees agreed that recurrent systemic financial crises are a systemic problem, and that contractual liquidity is a main cause. Second, there is a fundamental difference between interviewees with the view that systemic financial crises happen because ‘the regulation of the market failed’ and interviewees claiming that systemic financial crises happen because of ‘a lack of market discipline’ in the monetary and financial system. Third, there was no consensus on ‘the’ systemic problems. In addition to the problems of recurrent systemic financial crises and the systemic protecting and constraining of banks by governments, four other systemic problems were identified in the interviews: 1) unsustainable development; 2) financial exclusion; 3) lack of productive lending, and; 4) lack of competition between currencies. Moreover, a minority of the interviewees argued that the current monetary and financial system does not have a systemic problem. Fourth, because of different problem analyses, interviewees advocated different scenarios. Seven future scenarios were identified: 1) continue on the current path; 2) more guidance by central banks; 3) add public digital money as a means of payment; 4) add public digital money as means of payment and store of value; 5) full reserve banking; 6) transform central banks into monetary authorities without balance sheets, and; 7) free banking (abolish central banks). Fifth, although there are thus fundamental differences, almost all interviewees except those preferring scenario 7 supported seven generic design requirements that demarcate the design space:

- GDR I: The government must ensure one general unit of account.
- GDR II: The government must ensure one public currency.

- GDR III: The government must ensure that the technical design of the public currency is stable, secure, inclusive and state of the art.
- GDR IV: The government must ensure that the public currency offers stable settlement power.
- GDR V: The government should allow private currencies (forms of liquidity) as discipliners for the function as store of value and as backup systems for the functions as medium of exchange and means of payment.
- GDR VI: The government must accept only the public currency for tax payments.
- GDR VII: The government must ensure that risk and reward are aligned.

Sixth, almost all interviewees supported to at least some extent three generic design guidelines:

- GDG 1: Develop and gradually introduce public digital money.
- GDG 2: Move the financial system towards funding based on securities offering market liquidity.
- GDG 3: Move financial regulation towards transparency.

Those guidelines aim to give direction to the development of the monetary and financial system in the digital age and are the main artifact of this thesis.

Interviewees preferring scenario 1 and 7 generally did not support GDG 1, the others supported. All interviewees supported to at least some extent with GDG 2 and GDG 3. It was found that a key disagreement between interviewees preferring scenario 1, 2 and 3, and interviewees preferring scenario 4, 5, 6 and 7 is that the view of the first is that governments should implement regulation to oblige banks to fund themselves more with long-term debt and equity and be more transparent and the view of the latter is that the system should be structured in a way that investors ('the market') will force banks to do this. Table 10-5 summarizes the views of the interviewees preferring different scenario on the three generic design guidelines.

Table 10-5: Future scenarios and generic design guidelines

	GDG 1: Develop and gradually introduce public digital money.	GDG 2: Move the financial system towards funding based on securities offering market liquidity.	GDG 3: Move financial regulation towards transparency.
1. Continue on the current path	Generally do not support, contractual money should continue to dominate. Some propose private deposit banks.	Support, supervisors should force banks to hold more capital and should be involved in risk management.	Support, supervisors should force banks to be more transparent.
2. More guidance by central banks	Generally support, CBDC or a public deposit bank proposed with a relatively low limit to improve financial inclusion.	Support, supervisors should force banks to hold more capital and should be involved in risk management.	Support, supervisors should force banks to be more transparent.
3. Add public digital money as means of payment	Support, CBDC with a relatively low limit. Money continues to be a claim on the central bank.	Support, supervisors should force banks to hold more capital and should be involved in risk management.	Support, supervisors should force banks to be more transparent.
4. Add public digital money as a means of payment and store of value	Support, CBDC without or with a relatively high or no limit. Money continues to be a claim on the central bank.	Support, investors should force banks to hold more capital and should be responsible for risk management.	Support, investors should force banks to be more transparent.
5. Full reserve banking	Support, private deposit banks without a limit. Money continues to be a claim on the central bank.	Support, investors should force banks to hold more capital and should be responsible for risk management.	Support, investors should force banks to be more transparent.
6. Transform central banks into monetary authorities without balance sheets	Support, with a relatively high or without a limit. Money is in the long-term pure inherent money.	Support, investors should force banks to hold more capital and should be responsible for risk management.	Support, investors should force banks to be more transparent.
7. Free banking (abolish central banks)	Do not support, only private currencies should exist.	Support, investors should force banks to hold more capital and should be responsible for risk management.	Support, investors should force banks to be more transparent.

The next chapter summarizes the main findings of this research, evaluates the research approach, and gives recommendations.



11

Main findings, reflections,
and recommendations

11. Main findings, reflections, and recommendations

11.1 Introduction

This final chapter summarizes the main findings, reflects, and gives recommendations. Firstly, section 11.2 discusses the main findings concerning the research into reference foundations, problem analyses, requirements, and guidelines. Subsequently, section 11.3 reflects on the research methodology and section 11.4 on the role of the researcher. Finally, section 11.5 gives recommendation for further research and section 11.6 practical recommendations.

11.2 Main findings

The monetary and financial system is a complex system and, today, digital technologies bring new threats to and offer new opportunities for the design of this system. The contribution of this thesis is threefold. First, different theories on money, the functioning of banking and the problem of systemic financial crises have been researched through an extensive literature review and balance sheets. Second, those theories have been used to develop design requirements and guidelines. Finally, the consensus and key dissensions about the systemic problem(s) of the current monetary and financial system, requirements and guidelines among experts have been identified through semi-structured interviews. This research process results in seven widely supported requirements that demarcated the design space and three widely supported guidelines that aim to give direction within the design space, that is, to the future development of the monetary and financial system. Two benefits of the application of design science have been that this methodology helped or ‘forced’ the researcher to make implicit assumptions explicit and to think and work in a sequence of activities, i.e., from reference foundations (part I, chapter 2-5) to problem explication to requirements, and finally to guidelines (part II, chapter 6-10).

In the research into reference foundations, a taxonomy consisting of four characteristics was developed: I. legal-economic basis: *inherent money – credit money*; II. issuer: *public – private*; III. form: *material – non-material*, and; IV. accessibility: *universal – limited* (chapter 2). This taxonomy provided clear definitions and conceptual clarity in this research and could realize the same in other research. A pivotal insight was that contractual money is a specific form of credit money, a form that offers unconditional contractual liquidity. Moreover, two (opposing) theories on the origin and nature of money were examined (chapter 3). It was concluded that the two theories aim to explain and understand different monetary system designs. Theories focussing on the market and the function of money as medium of exchange predominantly aim to explain and understand the emergence and functioning of monetary systems based on

inherent money. Theories focussing on the state and the function of money as unit of account predominantly aim to explain and understand the emergence and functioning of monetary systems based on *credit money*. It was concluded that the central issuer has a fundamentally different position in both systems. In monetary systems based on inherent money, the central issuer only provides a medium of exchange to support the economy and is not actively involved in the financial system. In credit money systems, the central issuer provides a liability and is, consequently, via its ledger also involved in non-monetary activities. Most current literature is about understanding and improving the current bank-based contractual money system. Only some scholars explore future monetary system designs based on public inherent money (e.g., McMillan 2014 and Ricks 2016). In practice, the role of inherent money became more significant last decade, because most private cryptocurrencies (e.g., bitcoin and ethereum) are forms of private digital inherent money.

Further, in this part of this study, design features of three different (theoretical) banking systems were identified: a) the main design feature of fractional reserve banking is the creation of contractual money out of bank loans; b) the main design features of full reserve banking are separating contractual money and the financial system and not publicly insuring private financial institutions, and; c) the main design features of free banking are currency competition and not publicly insuring private monetary and financial institutions (chapter 4). A pivotal observation was that path dependency played an important role in the development of the current fractional reserve banking system. In the case of a systemic financial crises, decision makers generally choose to bailout issuers of contractual money (banks), to extend public protection mechanisms for contractual money and to implement more regulations to guide the behaviour of issuers of contractual money above implementing a proposal to change path. There have been several proposals to change path – e.g., full reserve banking and free banking – but politicians generally considered the benefits too uncertain. The design features of the three systems and the insight that politicians generally prefer small steps were used in part II and could also be used in future research. Finally, the explanation of the current contractual money system with the help of balance sheets and the examination of three theories of banking provided the insight that the credit creation theory of banking pays sufficient attention to the *monetary* function of banks (chapter 5). Commercial (shadow) banks are monetary-financial institutions creating contractual money out of bank loans. This investigation into the functioning of the current system provided the foundation for the question about the causes and social consequences of systemic financial crises and could realize the same in other research.

The research into the systemic problems of the current monetary and financial system started with literature research into the cause and social consequences of systemic financial crises (chapter 6). It was concluded that contractual liquidity is a main cause of systemic financial crisis. A combination of the debt cycle theory and bank run theory of systemic financial crisis, the contractual money, theory was elaborated to emphasize that contractual money (credit offering *unconditional* contractual liquidity) is fragile by design. A key question from a financial stability perspective is how debts are funded, with contractual money– backed up with public protection mechanisms – or with securities offering market liquidity. Four social consequences of systemic financial crises were identified: 1) direct fiscal costs; 2) indirect fiscal and economic costs; 3) loss of credibility and legitimacy, and; 4) a systemic dynamic of protecting and constraining banks by governments at the core of market economies. The underlying driver of this latter dynamics is that new regulations as well as new public protection mechanisms and central bank interventions in the financial system generally create new moral hazards and thus indirectly introduce the need for more and ‘better’ regulations. The dynamics of protecting and constraining banks by governments has become a systemic problem in itself. If the aim is to solve systemic financial crises and the dynamics alternatives for unconditional contractual liquidity have to be explored, developed and implemented.

In the empirical investigation, almost all interviewees confirmed that recurrent systemic financial crises are a systemic problem, and that contractual liquidity is a main cause. Their views as to why systemic financial crises occur, however, differed: some claimed that ‘the regulation of the market failed’, whilst others argued that it results from ‘a lack of market discipline’ in the current monetary and financial system. Mainly the latter group considers the systemic dynamics of protecting and constraining banks by governments a systemic problem that needs to be solved. Moreover, the problem analysis of this research widened because some interviewees argued that there are other (more) important systemic problems as, for example, financial exclusion and unsustainable development. A key difficulty in researching future direction is that there are fundamentally different views on ‘the’ main problem(s) of the current system.

Eight initial GDRs were drafted based on the theoretical thinking put forward in part I and two additional reference foundations: 1) the principle of market economies to generally prefer decentral decision making above central decision making, because this is the most efficient way to allocate resources in many cases, and; 2) the principle that governments should only apply central decision making (coordination) and only set central standards if positive network externalities can be realized for all economic agents (chapter 7). Interviewees confirmed six of the eight initial GDRs as correct

and had different views about two initial GDRs: 1) the degree of independence of the monetary authority, and; 2) whether or not the government should, in the long run, monetize and guarantee liabilities of private (shadow) banks. As a result, those two requirements were disputed. This resulted in six widely supported GDRs:

- GDR I: The government must ensure one general unit of account.
- GDR II: The government must ensure one public currency.
- GDR III: The government must ensure that the technical design of the public currency is stable, secure, inclusive and state of the art.
- GDR IV: The government must ensure that the public currency offers stable settlement power.
- GDR V: The government should allow private currencies (forms of liquidity) as discipliners for the function as store of value and as backup systems for the functions as medium of exchange and means of payment.
- GDR VI: The government must accept only the public currency for tax payments.

In the interviews, one new GDR was found that was supported by almost all interviewees:

- GDR VII: The government must ensure that risk and reward are aligned.

These seven requirements demarcate the design space and provide boundaries for searching for future directions.

Three initial GDGs were drafted based on the research into reference foundations and the opportunities offered by digital technologies. These technologies offer the possibility: 1) to update public digital money to the digital age; 2) to base the financial system to a larger extent on market liquidity, and; 3) to focus financial regulation on instant and full disclosure of financial and non-financial data. A large majority of interviewees thought that the initial GDGs pointed in the right direction but could be improved. In addition to the seven widely supported GDRs, three widely supported GDGs were found. These three GDGs are the outcome of the main research question and the main artifact of this thesis:

- GDG 1: Develop and gradually introduce public digital money.
- GDG 2: Move the financial system towards funding based on securities offering market liquidity.
- GDG 3: Move financial regulation towards transparency.

The GDGs can be used to guide the long-term development of the monetary and financial system in the digital age.

Moreover, in the analyses of the interviews, seven scenarios were identified that can be used as instruments to (better) understand future developments as well as the three developed GDGs. The seven scenarios are: 1) continue on the current path; 2) more guidance by central banks; 3) add public digital money as a means of payment; 4) add public digital money as means of payment and store of value; 5) full reserve banking; 6) transform central banks into monetary authorities without balance sheets, and; 7) free banking (abolish central banks).

Interviewees preferring scenario 1 and 7 generally did not support GDG 1 and interviewees preferring scenario 2, 3, 4, 5 and 6 generally supported GDG 1. In scenario 2 and 3, public digital money would be implemented with a relatively low limit on the amount an economic agent can possess (e.g., 10,000 euro). In scenario 4, 5 and 6, public digital money would be implemented with a relatively high (e.g., 100,000 euro) or no limit on the amount an economic agent can possess. Moreover, almost all interviewees supported GDG 2 and GDG 3. The views differed on the mechanism to implement these two guidelines and to what extent these guidelines should be implemented. Interviewees preferring scenario 1, 2 and 3 argued governments should implement regulation to oblige banks to fund themselves more with long-term debt and equity, and to be more transparent. Interviewees preferring scenario 4, 5, 6 and 7 argued, in contrast, that the system should be structured in such a way that investors ('the market') are able to force banks to hold more capital and to be more transparent. In this view, public digital money (GDG 1) is a mechanism to realize market discipline.

In short, although interviewees sometimes had fundamentally different views on the systemic problems of the current system and the future design, there was to a large extent consensus that the three GDGs point into the right direction and could be used to guide the development of the monetary and financial system in the digital age.

11.3 Reflection on the design science research methodology

In this research, design science opened a new way of viewing the monetary and financial system. Design science considers complex systems artifacts that can be designed. Viewing the monetary and financial system as an artifact having problems and requirements that should not be violated provides boundaries for searching for ways to improve this system. Design science, however, also admits that complex systems are rigid in the short-term, i.e., changing the design requires interventions

of which the effects become effective and visible in the long-term (chapter 1). Socio-technical systems as the monetary and financial system cannot really be designed but can only be gradually and stepwise moved into a desired direction.

The guidelines as the main outcomes of this design science research are generic. This genericness fits well to broad and complex research topics as the digital future of the monetary and financial system. The novelty and genericness of the research approach made it hard for interviewees to add requirements and guidelines to the initial lists. Consequently, the lists of developed requirements and guidelines are likely not complete. If design science is more often applied in economic science, a learning curve could be realized. Experts will learn to view and discuss the monetary and financial system in terms of an artifact having problems, requirements, and guidelines. The design science methodology helped the researcher to think and work in a sequence of iterative and interactive design activities. This helped to identify and understand different streams of monetary thinking. Based on research into reference foundations, three steps in design science research were taken: explicate the problem, develop requirements, and develop guidelines. This was a valuable approach and is likely also valuable for other (economic) research into complex and multidisciplinary topics. The design science part of this research started with examining systemic financial crises and during the research process, the scope of the problem analysis widened.

The design science methodology consists of different steps: (1) explicate the problem; (2) define requirements; (3) design and develop an artifact; (4) demonstrate the artifact; and (5) evaluate the artifact. This thesis only took the first three steps. It is unlikely that in the case of research into large systems as the monetary and financial system as a whole the latter two steps could be taken. But in the case of designing parts of large systems, all steps could be taken. For example, the design science approach could be used to further develop public digital money. The identified design variables (section 10.5.1.2) could be used as input for such a research.

Finally, it has to be remarked that the time dimension is relevant for this design science research into the monetary and financial system because the practices, theories and views of experts evolve over time. Two aspects are pivotal. Firstly, digital technologies develop rapidly, and this continuously leads to new practices, opportunities, risks, and theoretical proposals. This also means that the guidelines will change in the future if a new GPT emerges. Secondly, common sense about important design aspects evolves over time. For example, since the 1980s, the idea that monetary authority should be as independent as possible gradually became common sense among experts. After the

systemic financial crises of 2007-9, central banks started to intervene on a large scale in the monetary and financial system and as a consequence, some scholars started to question the independence of the central banks, and today, some scholars propose to politicize central banks further.

11.4 Reflection on the role of the researcher

Design science requires a different role from the researcher, as the researcher wants to give direction to the development of a complex system. A design science researcher not only observes a system but also wants to shape it. The methodology forces researchers to deal differently with theories and data. This brings the risks of not taking into account the various perspectives and that the view of the researcher becomes leading. In this research, reference foundations have been examined as broad as possible and interviewees were selected based on five criteria (chapter 9) to include as many as possible streams of monetary thinking. However, the preference(s) of the researcher still played a role in this research. After the financial crisis of 2007-9, the researcher became increasingly interested in full reserve banking (inspired) proposals and free banking (inspired) proposals. The preference for principles of market economies in the financial system could be considered a normative view – a personal preference. An alternative view is to consider banks as semi-public institutions. In this case, not (only) private economic agents but public central banks take several (if not most decisions) in financial risk management and as a consequence monetary policy becomes, due to path dependencies, likely increasingly politicized. Moreover, there is a risk that elected politicians increasingly rely on unelected central bankers.

11.5 Further research

Future research could start with a broader view on the systemic problems of the current monetary and financial system and use open interviews instead of semi-structured interviews. This would allow interviewees to express their view more freely. Specially to understand interviewees with different problem analyses and therefore proposing different design interventions, open interviews are recommendable. In future research, also experts in more countries could be interviewed. In this research, experts in the Netherlands, Sweden, Switzerland, and the U.K. were interviewed. This criterion was chosen because in those four countries research and political-societal debates had become advanced last decade. Interviewing experts in other countries and possibly especially interviewing experts in countries with less developed monetary and financial institutions and a less developed monetary and financial systems would likely lead to different insights. Those countries, for example, often do not have a digital bank-based payment infrastructure and could possibly leapfrog developed systems by implementing public digital money.

Further research could investigate for which activities the creation of contractual money should be allowed and how to regulate the creation of contractual money, elaborating on the research of on the one hand among others Cochrane (2014), McMillan (2014) and Ricks (2016), and on the other hand among others Beck *et al.* (2012) and Bezemer *et al.* (2018). Schumpeter (1934) considered the creation of new credit money pivotal for realizing “new combinations” and moving means of production from existing producers to new innovative entrepreneurs. In his view, banks create and allocate new money for “new combinations” on behalf of society. In today’s economic practice, commercial banks do generally not create new contractual money for innovative entrepreneurs and even not for existing ‘productive’ enterprises. Most new contractual money is directly channelled towards real estate markets and financial markets. Moreover, in the digital age, contractual money is increasingly created by ‘unchartered’ shadow banks (as money market funds and stable coins issuers) and connected to different kind of (securitized) loans. A pivotal question is when it is, from an economic perspective, useful to issue contractual money, when it is not useful and when it is better to issue less fragile forms of liquidity (inherent money and securities offering market liquidity).

Further research could apply other (more common and specific) methodologies to the generic outcomes of this explorative thesis – requirements, guidelines and identified design variables – to make them more specific. This would certainly add to our understanding of the complex and novel topic that the design of the monetary and financial system in the digital age is. Other methodologies mentioned in the interviews were simulations, digital games, modelling and scenario planning with multidisciplinary working groups.

Finally, more generally, design science could be applied more often in economic research into complex and multidisciplinary topics. Possible interesting applications are the greening of the tax system and the specification of the outcomes of this thesis. For example, the design variables of public digital money could be specified further with design science. The methodology consists of different steps. This is a valuable approach to unravel complexities and to identify dissensions and consensus among different streams of economic thinking. The smaller the scope of the system, the more likely it is that all five steps of design science can be taken.

11.6 Practical recommendations

Finally, three recommendations are given: 1) structurally use the three generic design guidelines to inform and evaluate policies, regulations and (monetary) reform

proposals; 2) start empirical experiments with public digital money, and; 3) explore further if scenario 6 – transforming central banks into monetary authorities without balance sheets – is in the long run the most desirable scenario.

The first recommendation is to structurally use the three generic design guidelines to inform and evaluate policies, regulations and (monetary) reform proposals. Changing a complex system as the monetary and financial system is, requires implementing many small steps over a long period. The developed GDGs can be used to check if proposed steps move the monetary and financial system consistently into the desired long-term direction. In this process, reactions on design interventions have to be evaluated continuously.

A second recommendation is to start empirical experiments with public digital money and the underlying technologies, and to take into account the relationship with and effects on GDG 2 and GDG 3 in these experiments. In practice, this would mean giving economic agents access to a central bank digital currency or accounts at (public or private) deposit banks with a limit (and/or a negative interest rate above a certain amount) to minimize the risks of the experiments. The experiments will add empirical data and practical experience to a topic that till this moment mainly has been theoretical. Today, several countries are researching digital public money, for example, the Bank of England researches bitcoin and the Sveriges Riksbank e-krona. Some countries have already moved to the next phase, for example, the People's Bank of China started implementing the digital yuan and Nigeria implemented a CBDC, the eNaira, in 2021. In these experiments, little attention has been paid to the two other GDGs until now.

A third recommendation is to explore further if scenario 6 – transforming central banks into monetary authorities without a balance sheet – is in the long run the most desirable scenario. Scenario 6 is rarely mentioned in the literature but was proposed by some interviewees, is most in line with the theoretical analyses of and opportunities offered by digital technologies discussed in this thesis and could be the long-term result if the GDGs are followed consistently. In this scenario, monetary authorities would in the end provide public digital inherent money (and material if desired and decided) to society, and private economic agents would be responsible for investing and (financial) risk management. As a consequence, and in line with the theoretical principles explained in chapter 7, positive network effects for all economic agents would be realized in the monetary system and decision making would be completely decentralized in the financial system. From a financial stability

perspective, the main advantage of public digital inherent money is that it is not based on contractual liquidity and, as a consequence, systemic financial crises can no longer occur in the public monetary system. In the (theoretical) end situation, public digital inherent money would provide liquidity buffers and compete freely with private forms of money (based on inherent liquidity) and securities (based market liquidity), i.e., the advantages of full reserve banking as well as free banking would be combined. Moreover, in such a system, it will be more difficult for elected politicians (legislators) to rely on monetary authorities.

References

References

- Accenture (2017). Fintech - did someone cancel the revolution? *Report*. Available at: https://www.accenture.com/_acnmedia/PDF-57/Accenture-Fintech-Did-Someone-Cancel-The-Revolution.pdf (accessed 30 August 2019).
- Admati, A.R. (2016). It takes a village to maintain a dangerous financial system. Forthcoming in Herzog, L. (ed.) (2016). *Just Financial Market: Finance in a Just Society*. Oxford: Oxford University Press. Retrieved from: <http://bankersnewclothes.com/wp-content/uploads/2016/06/Takes-a-Village-May-2016.pdf>
- Admati, A.R., and M.F. Hellwig (2013). *The Bankers' New Clothes: What's Wrong with Banking and What to Do about It*. Princeton University Press.
- Adrian, T., and T. Mancini-Griffol (2019a). The rise of digital money. *IMF Fintech Notes* 19/01. Available at: <https://www.imf.org/en/Publications/fintech-notes/Issues/2019/07/12/The-Rise-of-Digital-Money-47097> (accessed 20 December 2019).
- Adrian, T., and T. Mancini-Griffoli (2019b). Central bank digital currencies: 4 questions and answers. *IMF Blog* 12 December. Available at: <https://blogs.imf.org/2019/12/12/central-bank-digital-currencies-4-questions-and-answers/> (accessed 20 December 2019).
- Aglietta, M. (2018). *Money: 5,000 Years of Debt and Power*. London: Verso.
- Ahmat, N., and S. Bashir (2017). Central bank digital currency: a monetary policy perspective. *Bank Negara Malaysia Staff Insights* 2017/ 11. Retrieved from: http://www.bnm.gov.my/index.php?ch=en_publication&pg=en_staffinsight&ac=45&bb=file
- Aigner, E., M. Aistleitner, F. Glötzl, and J. Kapeller (2018). The focus of academic economics: before and after the crisis. *Institute for New Economic Thinking Working Paper* 75. Available at: https://www.ineteconomics.org/uploads/papers/WP_75_Focus_of_academic_economics.pdf (accessed 30 July 2018).
- Ali, R., J. Barrdear, R. Clews, and J. Southgate (2014). The economics of digital currencies. *Bank of England Quarterly Bulletin* Q3: 276-286. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/digital-currencies/the-economics-of-digital-currencies>
- Alliance for Lobbying Transparency and Ethics Regulation in the EU (2018). Corporate capture in Europe. *Report*. Available at: https://www.alter-eu.org/sites/default/files/documents/corporate_capture_web_1.pdf (accessed 30 August 2019).
- Alkaya, M. (2018). 100% veilig sparen en betalen. Tweede Kamer Initiatiefnota 35107. Retrieved from: <https://zoek.officielebekendmakingen.nl/kst-35107-3.pdf>
- Andersen, E.S. (2009). *Schumpeter's Evolutionary Economics. A Theoretical, Historical and Statistical Analysis of the Engine of Capitalism*. London: Anthem Press.
- Andolfatto, D. (2018). Assessing the impact of central bank digital currency on private banks. *Federal Bank of St. Louis Working Paper* 2018-026C. Available at: <https://research.stlouisfed.org/wp/more/2018-026>

Aristotle. *The Nicomachean Ethics*. Translated by D. Ross (1980 [2009]). Oxford: Oxford University Press.

Aristotle. *The Politics and the Constitution of Athens*. Edited by S. Everson (1996 [2013]). Cambridge (UK): Cambridge University Press.

Arnon, A. (2011). *Monetary Theory and Policy from Hume and Smith to Wicksell*. New York: Cambridge University Press.

Askari, H., and N. Krichene (2016). 100 per cent reserve banking and the path to a single-country gold standard. *The Quarterly Journal of Austrian Economics* 19(1): 29-64. Retrieved from: [https://mises-media.s3.amazonaws.com/100%20Per cent%20Reserve%20Banking%20and%20the%20Path%20to%20a%20Single%20Country%20Gold%20Standard.pdf](https://mises-media.s3.amazonaws.com/100%20Per%20cent%20Reserve%20Banking%20and%20the%20Path%20to%20a%20Single%20Country%20Gold%20Standard.pdf)

Atkinson, T., D. Luttrell, and H. Rosenblum (2013). How bad was it? The costs and consequences of the 2007-09 financial crisis. *Dallas Fed Staff Papers* 20, July. Retrieved from: <https://www.dallasfed.org/~media/documents/research/staff/staff1301.pdf>

Bacchetta, P. (2017) The sovereign money initiative in Switzerland: an assessment. *Swiss Finance Institute Research Paper* 17-25, August 30. Available at: <https://ssrn.com/abstract=2994926>

Bagehot, W. (1873 [1999]). *Lombard Street: A Description of the Money Market*. New York: Wiley.

Ball, L.M. (2018). *The Fed and Lehman Brothers: Setting the Record Straight on a Financial Disaster*. Cambridge: Cambridge University Press.

Bank of England (2015). Old money new money. *Presentation BoE/CCBS Chief Economists' Workshop*, 19 May. London: Bank of England.

Bank of England (2018). Further details about M0 data. *Website Bank of England*. Available at: <https://www.bankofengland.co.uk/statistics/details/further-details-about-m0-data> (accessed 9 July 2018, last updated 13 March 2018).

Baradaran, M. (2015). *How the Other Half Banks. Exclusion, Exploitation, and the Threat to Democracy*. Harvard, MA: Harvard University Press.

Barrdear, J., and M. Kumhof (2016). The macroeconomics of central bank issued digital currencies. *Bank of England Staff Working Paper* 605. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2016/the-macroeconomics-of-central-bank-issued-digital-currencies>

Bats, J.V., and A.C.F.J. Houben (2017). Bank-based versus market-based financing: Implications for systemic risk. *De Nederlandsche Bank Working Paper* 577. <http://dx.doi.org/10.2139/ssrn.3086504>

Bats, J.V., and A.C.F.J. Houben (2020). Bank-based versus market-based financing: Implications for systemic risk. *Journal of Banking and Finance* 114(105776): 1-13. <https://doi.org/10.1016/j.jbankfin.2020.105776>

Bech, M., and R. Garratt (2017). Central bank cryptocurrencies. *BIS Quarterly Review*, September: 55–70. Retrieved from: https://www.bis.org/publ/qtrpdf/r_qt1709f.pdf

Beck, T., B. Büyükkarabacak, F. K. Rioja, and N. T. Valev (2012). Who gets the credit? And does it matter? Household vs. firm lending across countries. *The BE Journal of Macroeconomics* 12(1): article 2. <https://doi.org/10.1515/1935-1690.2262>.

Bell, S. (2000). Do taxes and bonds finance government spending? *Journal of Economic Issues* 34(3): 603-620, <https://doi.org/10.1080/00213624.2000.11506296>

Bell, S. (2001). The role of the state and the hierarchy of money. *Cambridge Journal of Economics* 25(2): 149–63.

Benes, J., and M. Kumhof (2012). The Chicago Plan Revisited. *IMF Research Department Working Paper* 12/202. Retrieved from: <https://www.imf.org/external/pubs/ft/wp/2012/wp12202.pdf>

Benigno, P., and R. Robatto (2019). Private money creation, liquidity crises, and government interventions. *Journal of Monetary Economics*, in press: corrected proof. <https://doi.org/10.1016/j.jmoneco.2019.07.005>

Berentsen, A., and F. Schär (2016). The fallacy of a cashless society. In Beer, C., E. Gnan, and U.W. Birchler (2016). Cash on trial. *SUERF Conference Proceedings* 2016/1: 14-19.

Berentsen, A., and F. Schär (2018). The case for central bank electronic money and the non-case for central bank cryptocurrencies. *Federal Reserve Bank of St. Louis Review*, Second Quarter 100(2): 97-106. <https://doi.org/10.20955/r.2018.97-106>

Berkeley, A., J. Ryan-Collins, R. Tye, A. Voldsgaard, and N. Wilson. (2022). The self-financing state: An institutional analysis of government expenditure, revenue collection and debt issuance operations in the United Kingdom. *UCL Institute for Innovation and Public Purpose Working Paper Series* 2022-08. Available at: <https://www.ucl.ac.uk/bartlett/public-purpose/publications/2022/may/self-financing-state-institutional-analysis> (accessed 21 June 2022).

Bernanke, B.S. (2009). Reflections on a year of crises. *Speech at the Federal Reserve Bank of Kansas City's Annual Economic Symposium*, Jackson Hole, WY, August 21. Retrieved from: <https://www.federalreserve.gov/newsevents/speech/bernanke20090821a.htm>

Bernanke, B.S. (2010). Implications of the financial crisis for economics. *Speech at the Conference co-sponsored by the Center for Economic Policy Studies and the Bendheim Center for Finance*, Princeton (NJ): Princeton University, September 24. Available at: <https://www.federalreserve.gov/newsevents/speech/bernanke20100924a.htm>

Bernanke, B.S. (2012). Some reflections on the crisis and the policy response. *Speech at the Russell Sage Foundation and The Century Foundation Conference on Rethinking Finance*, New York, NY, April. Retrieved from: <https://www.federalreserve.gov/newsevents/speech/bernanke20120413a.htm>

Bernanke, B.S. (2018). The real effects of the financial crises. *Brookings Papers on Economic Activity Conference Draft*, September 13-14. Retrieved from: https://www.brookings.edu/wp-content/uploads/2018/09/BPEA_Fall2018_The-real-effects-of-the-financial-crisis.pdf

Bernanke, B.S., T. Geithner, and H. Paulson (2019). *Firefighting. The Financial Crisis and its Lessons*. New York: Penguin Books.

Bertocco, G. (2009). The relationship between saving and credit from a Schumpeterian perspective. *Journal of Economic Issues* 43(3): 607-640. <https://doi.org/10.2753/JEI0021-3624430303>

Bezemer, D. (2012). Finance and growth: when credit helps, and when it hinders. *Paper presented at the Institute of New Economic Thinking Annual Conference: 'Rethinking Economics and Politics'*, Berlin, 12-14 April. Retrieved from: <https://www.ineteconomics.org/uploads/papers/bezemer-dirk-berlin-paper.pdf>

Bezemer, D. (2014). Schumpeter might be right again: the functional differentiation of credit. *Journal of Evolutionary Economics* 24(5): 935-950. <https://doi.org/10.1007/s00191-014-0376-2>

Bezemer, D., and L. Zhang (2014). From boom to bust in the credit cycle: the role of mortgage credit. *Research Institute SOM Working Paper series*. Groningen: University of Groningen, Faculty of Economics and Business. Retrieved from: https://www.rug.nl/research/portal/files/19400441/14025_GEM_def.pdf

Bezemer, D., and M. Hudson (2016). Finance is not the economy: reviving the conceptual distinction. *Journal of Economic Issues* 50(3): 745-768. <https://doi.org/10.1080/00213624.2016.1210384>

Bezemer, D., M. Grydaki, and L. Zhang (2016). More mortgages, lower growth? *Economic Inquiry* 54(1): 652-674. <https://doi.org/10.1111/ecin.12254>

Bezemer, D., J. Ryan-Collins, F. van Lerven, L. and Zhang (2018). Credit where it's due: A historical, theoretical and empirical review of credit guidance policies in the 20th century. *UCL Institute for Innovation and Public Purpose Working Paper* 2018-11. Available at: <https://www.ucl.ac.uk/bartlett/public-purpose/wp2018-11>

Bharosa, N., and M. Janssen (2015). Principle-based design: a methodology and principles for capitalizing design experiences for information quality assurance. *Journal of Homeland Security and Emergency Management* 12(3): 469-496. <https://doi.org/10.1515/jhsem-2014-0073>

Bholat, D., J. Grant, and R. Thomas (2015). Monies: joining economic and legal perspectives. *Bankunderground Paper* August 23. Retrieved from: <https://ssrn.com/abstract=2649543>

Bindseil, U. (2020). Tiered CBDC and the financial system. *ECB Working Paper Series* 2351.

Birch, D.G.W. (2020). *The Currency Cold War: Cash and Cryptography, Hash Rates and Hegemony*. London: London Publishing Partnership.

Bikas, K. (2018). How has bank lending fared since the crisis? *Positive Money blog*, 5 June 2018. Available at: <http://positivemoney.org/2018/06/how-has-bank-lending-fared-since-the-crisis/> (accessed 6 June 2018).

Biondi, Y. (2017). Banking, money and credit: a systemic perspective. *Paper for First Festival for New Economic Thinking, Young Scholars Initiative (YSI) - Finance, Law and Economics*, 17 October. <https://dx.doi.org/10.2139/ssrn.3054525>

Biondi, Y., and F. Zhou (2017). Interbank credit and the money manufacturing process. A systemic perspective on financial stability. *Financial Regulation Research Lab (Labex ReFi) Working Paper*, 27 February. <https://dx.doi.org/10.2139/ssrn.2924402>

BIS CPMI (2015). Digital currencies. *Report by Committee on Payments and Market Infrastructures*, November. Retrieved from: <https://www.bis.org/cpmi/publ/d137.pdf>

BIS (2018). Central bank digital currencies. *Report by Committee on Payments and Market Infrastructures and Markets Committee*, March. Retrieved from: <https://www.bis.org/cpmi/publ/d174.htm>

BIS (2020). Central banks and payments in the digital era. *Annual Economic Report Chapter III*, June 24. Available at: <https://www.bis.org/publ/arpdf/ar2020e3.pdf> (accessed 8 July 2020).

BIS (2021). Annual Economic Report, June (accessed 17 August 2021). Available at: <https://www.bis.org/publ/arpdf/ar2021e.pdf>

Bjerg, O. (2014). *Making Money: The Philosophy of Crisis Capitalism*. London: Verso.

Bjerg, O. (2017). Designing new money – the policy trilemma of central bank digital currency. *Copenhagen Business School (CBS) Working Paper*, June. <http://dx.doi.org/10.2139/ssrn.2985381>

Blair, M.M. (2017). A simple fix for a complex problem? Comments on Morgan Ricks, The money problem: rethinking financial regulation. *Accounting, Economics, and Law: A Convivium, De Gruyter* 8(2): 1-5.

Blakeley, G. (2019). *Stolen. How to Save the World from Financialisation*. London: Repeater Books.

Bloomberg (2017). Bitcoin, beware: Citigroup's CEO predicts state-sponsored digital currencies. 8 November. Available at: <https://www.bloomberg.com/news/articles/2017-11-08/corbat-sees-governments-issuing-digital-currencies-after-bitcoin> (accessed 30 January 2018).

BNP Paribas (2007). BNP Paribas Investment Partners temporally suspends the calculation of the Net Asset Value of the following funds: Parvest Dynamic ABS, BNP Paribas ABS EURIBOR and BNP Paribas ABS EONIA. *Press release*, August 9. Available at: <https://group.bnpparibas/en/press-release/bnp-paribas-investment-partners-temporally-suspends-calculation-net-asset-funds-parvest-dynamic-abs-bnp-paribas-abs-euribor-bnp-paribas-abs-eonia> (accessed 18 November 2015).

Böhme, R., N. Christin, B. Edelman, and T. Moore (2015). Bitcoin: economics, technology, and governance. *Journal of Economic Perspectives* 29(2): 213-38. <http://dx.doi.org/10.1257/jep.29.2.213>

Bollier, D. and P. Conaty (2015). Democratic money and capital for the commons: strategies for transforming neoliberal finance through commons-based alternatives. *A Report on a Commons Strategies Group Workshop*, Berlin, 8-10 September. Retrieved from: https://www.boell.de/sites/default/files/democratic_money_capital_for_the_commons_report_january2016.pdf

Boonstra, W. (2013). *Geld speelt (g)een rol*. Amsterdam: VU University Press.

Boonstra, W. (2018). *Geld. Wat is het, wat doet het, waar komt het vandaan?* Amsterdam: VU University Press.

Boonstra, W., and L. van Goor (2021). *The Basics of Money and Banking. From Ancient Coins to Credit and Crypto*. Amsterdam: VU University Press.

Boot, A. (2021). De dominantie van de overheid in het economisch proces moet stoppen. *Economisch Statistische Berichten* 106(4799): 314-317. Available at (accessed 17 August 2021): <https://esb.nu/esb/20065095/de-dominantie-van-de-overheid-in-het-economisch-proces-moet-stoppen>

Booth, J. (2020). *The Price of Tomorrow. Why Deflation Is the Key to an Abundant Future*. Stanley Press.

Borio, C.E., P. Disyatat, M. Juselius, and P. Rungcharoenkitkul (2018). Monetary policy in the grip of a pincer movement. *Bank of International Settlements Working Paper* 706. Retrieved from: <https://www.bis.org/publ/work706.pdf>

Bordo, M.D., and A.T. Levin (2017). Central bank digital currency and the future of monetary policy. *NBER Working Paper* 23711. Retrieved from: <https://www.nber.org/papers/w23711.pdf>

Bordo, M.D., and P.L. Siklos (2017). Central banks: evolution and innovation in historical perspective. *NBER Working Paper* 23847. Retrieved from: <https://www.nber.org/papers/w23847.pdf>

Boston Consulting Group (2017). Staying the course in banking. *Global Risk Report*. Available at: http://image-src.bcg.com/BCG_COM/BCG-Staying-the-Course-in-Banking-Mar-2017_tcm9-146794.pdf

Bouchaud, J.-P. (2008). Economics needs a scientific revolution. *Nature* 455(7217): 1181.

Braun, B. (2016). Speaking to the people? Money, trust, and central bank legitimacy in the age of quantitative easing. *Review of International Political Economy* 23(6): 1064-1092. <https://doi.org/10.1080/09692290.2016.1252415>

Bresnahan, T. F. and M. Trajtenberg (1992). General purpose technologies “engines of growth?” *NBER Working Paper* 4148. Retrieved from: <https://www.nber.org/papers/w4148>

Brunnermeier, M.K., and D. Niepelt (2019). On the equivalence of private and public money. *NBER Working Paper* 25877. Retrieved from: <https://www.nber.org/papers/w25877>

Brunnermeier, M.K., H. James, and J.-P. Landau (2019). The digitalization of money. *NBER Working Paper* 26300. Retrieved from: <https://www.nber.org/papers/w26300>

Byttebier, K. (2015). *Nu het Gouden Kalf Verdronken is. Van Hebzucht naar Altruïsme als Hoeksteen voor een Nieuwe Monetaire Wereldorde*. Antwerpen and Apeldoorn: Maklu.

Buiter, W. (2009). Negative nominal interest rates: three ways to overcome the zero lower bound. *NBER Working Paper* 15118. Retrieved from: <https://www.nber.org/papers/w15118.pdf>

Buiter, W. (2018). The financial system ten years after the financial crisis: lessons learnt. *Note based on remarks made at the NAEC Group Meeting at the OECD*, 13 September. Retrieved from: http://www.oecd.org/naec/10-years-after-the-crisis/W_Buiter_NAEC_14_Sept_2018.pdf

Buitink, P., and R. van der Linde (2019). De econoom aan zet voor bankrekening zonder kredietrisico. *ESB Special Nieuw Geld* 104(4769): 21-23, 17 January.

Bundesbank (2017). Anmerkungen zu einer 100-prozentigen Deckung von Sichteinlagen durch Zentralbankgeld. *Deutsche Bundesbank Monatsbericht* April, 69(4): 33-36. English version available at: <https://www.bundesbank.de/en/tasks/topics/how-money-is-created-667392>

Burgin, A. (2012). *The Great Persuasion: Reinventing Free Markets since the Depression*. Cambridge (MA): Harvard University Press.

Caballero R. (2010). Understanding the global turmoil: It's the general equilibrium, stupid. *VOX article*, 21 May. Retrieved from: <https://voxeu.org/article/it-s-general-equilibrium-stupid> (accessed 15 June 2016).

Caballero, R. J., and E. Farhi (2014a). The safety trap. *NBER Working Paper* 19927. Available at: <https://www.nber.org/papers/w19927>

Caballero, R. J., and E. Farhi (2014b). On the role of safe asset shortages in secular stagnation. *VOX article*, 11 August. Retrieved from: <https://voxeu.org/article/role-safe-asset-shortages-secular-stagnation> (accessed 15 June 2016).

Camera, G. (2017). A perspective on electronic alternatives to traditional currencies. *Sveriges Riksbank Economic Review* 1: 126-148. Retrieved from: <https://ssrn.com/abstract=2902721>

Carney, M. (2019). The growing challenges for monetary policy in the current international monetary and financial system. *Speech at Jackson Hole Symposium*, August 23.

Carpenter, S., and S. Demiralp (2012). Money, reserves, and the transmission of monetary policy: Does the money multiplier exist? *Journal of Macroeconomics* 34(1): 59-75.

Capie, F. (2002). Learning to avoid financial crises: the Bank of England. *City University Business School Paper*. Retrieved from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.199.8242&rep=rep1&type=pdf> (Accessed 31 July 2018).

Carstens, A. (2018). My message to young people: stop trying to create money. *Translation of an Interview in the Basler Zeitung*, 25 June 2018. Available at: <https://www.bis.org/speeches/sp180704a.htm> (Accessed 6 June 2018).

Carruthers, B.G., and S. Babb (1996). The color of money and the nature of value: Greenbacks and gold in postbellum America. *The American Journal of Sociology* 101(6): 1556-1591. <https://doi.org/10.1086/230867>

Castillo-Montoya, M. (2016). Preparing for Interview Research: The Interview Protocol Refinement Framework. *The Qualitative Report* 21(5): 811-831. Retrieved from: <https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=2337&context=tqr>

Cayne, J.E. (2010). Testimony of James E. Cayne before the Financial Crisis Inquiry Commission. *Testimony*, May 5. Available at: http://fcic-static.law.stanford.edu/cdn_media/fcic-testimony/2010-0505-Cayne.pdf (accessed 5 October 2018).

Cencini, A., and S. Rossi (2015). *Economic and Financial Crises. A New Macroeconomic Analysis*. London: Palgrave Macmillan.

Cerqueira Gouveia, O., E. Dos Santos, S. Fernández de Lis, A. Neut, and J. Sebastián (2017). Central bank digital currencies: assessing implementation possibilities and impacts. *BBVA Working Paper* 17/04 March. Retrieved from: https://www.bbvaresearch.com/wp-content/uploads/2017/09/WP_CBDC_mod.pdf

Chamley, C., L.J. Kotlikoff, and H. Polemarchakis (2012a). Limited-purpose banking – moving from ‘trust me’ to ‘show me’ banking. January

Chamley, C., L.J. Kotlikoff, and H. Polemarchakis (2012b). Limited-purpose banking – moving from ‘trust me’ to ‘show me’ Banking. *American Economic Review* 102(3): 113-19. <https://doi.org/10.1257/aer.102.3.113>

Chari, V.V., and C. Phelan (2014). On the social usefulness of fractional reserve banking. *Journal of Monetary Economics* 65: 1–13. <https://doi.org/10.1016/j.jmoneco.2014.04.008>

Chiarella, C., P. Flaschel, F. Hartmann and C. Proaño (2011). Stock market booms, endogenous credit creation and the implications of broad and narrow banking for macroeconomic stability. *New School for Social Research Working Paper* 7. Retrieved from: http://www.economicpolicyresearch.org/econ/2011/NSSR_WP_072011.pdf

Clayton, J. (2017). Statement on cryptocurrencies and initial coin offerings. *SEC statement* 11 December 2017. Available at: <https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11> (accessed 16 August 2018).

Clegg, D. and R. Barker (1994). *Case Method Fast-Track: A RAD Approach*. Boston (MA): Addison-Wesley.

Cliffe, M., and T. Brosens (2014). De geldscheppingsparadox. *ING Economisch Bureau*. Available at: https://www.ing.nl/Images/ING_EBZ_Geldscheppingsparadox_tcm7-162773.pdf (accessed 17 October 2017).

Cliffe, M., and T. Brosens (2018). The money creation paradox. *ING Global Economics*, 25 May 2018. Available at: https://think.ing.com/uploads/reports/Money_paradox2.pdf (accessed 19 August 2019).

Cobden Centre (2010). Public attitudes to banking. *Report*. Available at: <http://www.cobdencentre.org/2010/06/public-attitudes-to-banking/> (accessed 17 October 2017).

Cochrane, J. (2014). Toward a run-free financial system. *Working Paper*, April 15. Retrieved from: http://faculty.chicagobooth.edu/john.cochrane/research/papers/run_free.pdf

Cochrane, J. (2019). Central bank independence. *Remarks presented at the “ECB and its Watchers” conference*, March 17. Available at: <https://johnhcochrane.blogspot.com/2019/03/central-bank-independence.html?spref=tw> (accessed 14 August 2019).

Coe, D., and A. Pettifor (2014). Bringing money back from “the underworld”. *Prime Policy Research in Macroeconomics*. Available at: <http://www.primeeconomics.org/wpcontent/uploads/2014/03/Bringing-money-back-FINAL.pdf> (accessed 1 May 2016).

Cœuré, B. (2018). The future of central bank money. *Speech at the International Center for Monetary*

and *Banking Studies*, Geneva, 14 May. Available at: https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180514_4.en.html (accessed 12 June 2019).

Coinmarketcap (2021). Today's cryptocurrency prices by market cap. Available at: <https://coinmarketcap.com/> (accessed 3 February 2021).

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: firm-level evidence from the 2008-9 financial crisis. *Quarterly Journal of Economics* 129(1): 1-59. <https://doi.org/10.1093/qje/qjt031>

Contessi and El-Ghazaly (2011). Banking crisis around the world: different government, different responses. *The Regional Economist* 19: 11-16. Federal Reserve Bank of St. Louis.

Cooper, R., and A. John (1988). Coordinating coordination failures in Keynesian models. *Quarterly Journal of Economics* 10(3): 441-463. <https://doi.org/10.2307/1885539>

Coppola, F. (2019). Libra isn't just a cryptocurrency, it's a threat to national sovereignty. *Wired*, October 16. Available at: <https://www.wired.co.uk/article/facebook-libra-politics> (accessed 4 November 2019).

Corneo, G. (2017). *Is Capitalism Obsolete? A Journey through Alternative Economic Systems*. Cambridge (MA)/ London: Harvard University Press.

Corporate Europe Observatory (2014). The fire power of the financial lobby. A Survey of the Size of the Financial Lobby at the EU level. *Report*. Available at: https://corporateeurope.org/sites/default/files/attachments/financial_lobby_report.pdf (accessed 30 August 2019).

Corporate Europe Observatory (2016). The ECB's 'quantitative easing' funds multinationals and climate change. 12 December. Available at: <https://corporateeurope.org/economy-finance/2016/12/ecb-quantitative-easing-funds-multinationals-and-climate-change> (accessed 29 January 2018).

Corporate Europe Observatory (2017). European Central Bank has bought more climate-trashing bonds. 23 June. Available at: <https://corporateeurope.org/economy-finance/2017/06/european-central-bank-has-bought-more-climate-trashing-bonds> (accessed 31 January 2018).

Croitoru, A. (2012). Schumpeter, J.A., 1934 (2008), *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle*, New Brunswick (U.S.A) and London (U.K.): Transaction Publishers. A review to a book that is 100 years old. *Journal of Comparative Research in Anthropology and Sociology* 3(2): 137-148.

Coughlan, J., M. Lycett, and R.D. Macredie (2003). Communication issues in requirements elicitation: a content analysis of stakeholder experiences. *Information and Software Technology* 45(8): 525-537. [https://doi.org/10.1016/S0950-5849\(03\)00032-6](https://doi.org/10.1016/S0950-5849(03)00032-6)

Daly, H. (2013). Nationalize money, not banks. *Centre for the Advancement of Steady State Economics blog*. Available at: <http://steadystate.org/nationalize-money-not-banks/> (accessed 9 February 2017).

Dalton, G. (1982). Barter. *Journal of Economic Issues* 16(1): 181-190. <https://doi.org/10.1080/00213624.1982.11503968>

David, P.A. (1985). Clio and the Economics of QWERTY. *The American Economic Review*, 75 (2): 332–337.

Davidson, P. (1972). Money and the real world. *The Economic Journal* 82(325): 101-115. <https://doi.org/10.2307/2230209>

Davidson, P. (1994). *Post Keynesian Macroeconomic Theory*. Brookfield (VT): Edward Elgar Publishing Company.

Davies, G. (2002). *A History of Money*. Cardiff: University of Wales Press.

Davies, R., and B. Tracey (2014). Too big to be efficient? The impact of implicit subsidies on estimates of scale economies for banks. *Journal of Money, Credit and Banking* 46(s1), 219–253. <https://doi.org/10.1111/jmcb.12088>

De Marco, M., R. Fiocca, and F. Ricciardi (2010). The ecology of learning-by building: bridging design science and natural history of knowledge. In Winter, R., J. L. Zhao, and S. Aier (Eds.) (2010). *Global Perspectives on Design Science Research*. Berlin and Heidelberg: Springer, pp 154-166.

De Roover, R. (1974). *Business, Banking and Economic Thought in Late Medieval and Early Modern Europe. Selected Studies*. Ed. Kirshner, J. Chicago: University of Chicago Press.

De Vries, B. (2020). *Ontspoort Kapitalisme*. Amsterdam: Prometheus.

DeGrauwe, P. (2008). Returning to Narrow Banking. *CEPS Commentary*, 14 November. Available at: <http://aei.pitt.edu/11562/> (accessed 12 October 2016).

Dell’Ariccia, G., C. Ferreira, N. Jenkinson, L. Laeven, A. Martin, C. Minoiu, A. Popov (2018). Managing the sovereign-bank nexus. *European Central Bank Working Paper Series* 2177, September. Retrieved from: <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2177.en.pdf>

Demirgüç-Kunt, A., E. Kane, and L. Laeven (2014). Deposit insurance database. *IMF Working Paper* 14/118. Retrieved from: https://www.imf.org/~media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2014/_wp14118.ashx

Desan, C. (2013). Creation stories: myths about the origin of money. *Harvard Public Law Working Paper* 13-20, 30 July. Retrieved from: <http://nrs.harvard.edu/urn-3:HUL.InstRepos:11689088>

Desan, C. (2014). *Making Money; Coin, Currency, and the Coming of Capitalism*. Oxford: Oxford University Press.

Desan, C. (2016). Money as a legal institution. In Fox, D., and W. Ernst (eds) (2016). *Money in the Western Legal Tradition Middle Ages to Bretton Woods*. Oxford: Oxford University Press, pp 18-40.

Di Muzio, T., and R.H. Robbins (2017). *An Anthropology of Money*. New York: Routledge.

Diamond, D.W., and P.H. Dybvig (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy* 91(3): 401-419. <http://dx.doi.org/10.1086/261155>

Diamond, D.W. (1984). Financial intermediation and delegated monitoring. *The Review of Economic Studies* 51(3): 393-414. <https://www.jstor.org/stable/2297430>

Diamond, D.W., and R.G. Rajan (2001). Liquidity risk, liquidity creation, and financial fragility: a theory of banking. *Journal of Political Economy* 109(2): 287-327. <https://www.jstor.org/stable/10.1086/319552>

Dittmer, K. (2015). 100 per cent reserve banking: A critical review of green perspectives. *Ecological Economics* 109: 9-16.

DNB (2011). Overheidssteun aan financiële instellingen. *DNBulletin*. Available at: www.dnb.nl/nieuws/nieuwsoverzicht-en-archief/dnbulletin-2011/index.jsp

DNB (2012). Het schaduwbankwezen: een verkenning voor Nederland. *DNB Occasional Studies* 10(5). Retrieved from: https://www.dnb.nl/binaries/DNB_OS_10-05_WEB_tcm46-281218.pdf

DNB (2015). Visie op de structuur van de Nederlandse bankensector: stabiliteit en efficiëntie door diversiteit en concurrentie. *Report*. Amsterdam: DNB. Retrieved from: https://www.dnb.nl/binaries/DNB-rapport%20Visie%20op%20de%20structuur%20van%20de%20Nederlandse%20bankensector_tcm46-323322.pdf

DNB (2020). Central bank digital currency. *Occasional Studies* 20-01. Retrieved from: https://www.dnb.nl/en/binaries/Os%20Central%20Bank%20Digital%20Currency_tcm47-388408.PDF

Dodd, N. (2014). *The Social Life of Money*. Princeton: Princeton University Press.

Dods (2014). Parliamentary perceptions of the banking system. *Monitoring poll*. Available at: <https://www.positivemoney.org/wp-content/uploads/2014/08/Positive-Money-DodsMonitoring-Poll-of-MPs.pdf> (accessed 29 January 2018).

Dods (2017). Dods MP poll for Positive Money. Available at: <http://act.positivemoney.org/page/-/MP%20POLL%20RESULTS%202017.pdf>. (accessed 29 January 2018).

Dow, S., G. Johnsen, and A. Montagnoli (2015). A critique of full reserve banking. *Sheffield Economic Research Paper Series* 2015008. Available at: https://www.sheffield.ac.uk/polopoly_fs/1.448817!/file/paper_2015008.pdf (accessed 9 February 2017).

Drechsler, I, A. Savov, and P. Schnabl (2017). The deposits channel of monetary policy. *Quarterly Journal of Economics* 132: 1819-1876. <https://doi.org/10.1093/qje/qjx019>

Drechsler, I, A. Savov, and P. Schnabl (2020). Banking on deposits: maturity transformation without interest rate risk. *NBER Working Paper* 24582. Retrieved from: <https://www.nber.org/papers/w24582>

Drehmann, M., C.E.V. Borio, and K. Tsatsaronis (2012). Characterising the financial cycle: don't lose sight of the medium term! *BIS Working Paper* 380. Retrieved from: <https://www.bis.org/publ/work380.pdf>

- Duffie, D. (2010a). The failure mechanics of dealer banks. *Journal of Economic Perspectives* 24(1): 51-72. <https://www.doi.org/10.1257/jep.24.1.51>
- Duffie, D. (2010b). Presidential address: asset price dynamics with slow-moving capital. *Journal of Finance* 65(4): 1237-1267. <https://doi.org/10.1111/j.1540-6261.2010.01569.x>
- Dyson, B., and G. Hodgson (2016). Digital cash. Why central banks should start issuing electronic money. *Paper*, January. London: Positive Money.
- Dyson, B., G. Hodgson, and F. van Lerven (2016). A response to critiques of ‘full reserve banking’. *Cambridge Journal of Economics* 40: 1351–1361. <https://doi.org/10.1093/cje/bew036>
- Disyatat, P. (2010). The bank lending channel revisited. *Bank for International Settlements, Working Papers* 297.
- Earle, J., C. Moral, and Z. Ward-Perkins (2016). *The Econocracy: The Perils of Leaving Economics to the Experts*. Oxford: Oxford University Press.
- EBA (2014). Report to the European Commission on the perimeter of credit institutions established in the Member States. *Report*, 27 November. Retrieved from: <https://eba.europa.eu/documents/10180/534414/2014+11+27+-+EBA+Report+-+Credit+institutions.pdf>
- ECB (2012). Manual on MFI balance sheet statistics, April. Frankfurt: ECB. Retrieved from: <https://www.ecb.europa.eu/pub/pdf/other/manualmfibalancesheetstatistics201204en.pdf>
- Eichengreen, B. (2019). From commodity to fiat and now to crypto: what does history tell us? *NBER Working Paper* 25426. Retrieved from: <http://www.nber.org/papers/w25426>
- Engelen, E. (2015). Komt een topeconoom op tv... *Me Judice*, October 5. Available at: <https://www.mejudice.nl/artikelen/detail/komt-een-topeconoom-op-tv> (accessed 7 July 2018).
- Ezzamel, M., and K. Hoskin (2002). Retheorizing accounting, writing and money with evidence from Mesopotamia and ancient Egypt. *Critical Perspectives on Accounting* 13(3): 333-367. <https://doi.org/10.1006/cpac.2001.0500>
- Faure, A.P. (2013). Money creation: empirical evidence of endogeneity. *Paper* 22 May. <http://dx.doi.org/10.2139/ssrn.2262687>
- Ferguson, N. (2019). Je kan je laatste dollar erom verwedden dat ons geld digitaal wordt. *Financieel Dagblad* 15 September. Available at: <https://fd.nl/opinie/1316988/je-kan-je-laatste-dollar-erom-verweden-dat-ons-geld-digitaal-wordt> (accessed 17 September 2019).
- Fernández-Villaverde, J., and D. Sanches (2016). Can currency competition work? *NBER Working Paper* 22157. Retrieved from: <https://www.nber.org/papers/w22157.pdf>
- Fernández-Villaverde, J., D. Sanches, L. Schilling, and H. Uhlig (2020). Central bank digital currency: central banking for all? *Federal Reserve Bank of Philadelphia Working Paper* 20-19. <https://doi.org/10.21799/frbp.wp.2020.19>

Fiedler, S., K.-J. Gern, D. Herle, S. Kooths, U. Stolzenburg, and L. Stoppok (2018). Virtual currencies. *In-depth Analysis requested by the European Parliament's Committee on Economic and Monetary Affairs* July 2018. Retrieved from: http://www.europarl.europa.eu/cmsdata/149902/KIEL_FINAL%20publication.pdf

Financial Stability Board (2018). Global shadow banking monitoring report 2017. *Report*, 5 March. Retrieved from: <http://www.fsb.org/wp-content/uploads/P050318-1.pdf>

FINMA (2018). Guidelines for enquiries regarding the regulatory framework for initial coin offerings (ICOs). *Guidelines* 16 February. Available at: <https://www.finma.ch/en/~media/finma/dokumente/dokumentencenter/myfinma/1bewilligung/fintech/wegleitung-ico.pdf?la=en&hash=9CBB35972F3ABCB146FBF7F09C8E8E453CE600C> (accessed 13 August 2018).

Fisher, I. (1922). *The Purchasing Power of Money, its Determination and Relation to Credit, Interest and Crises*. New York: Macmillan.

Fisher, I. (1933). The debt-deflation theory of great depressions. *Econometrica* 1: 337-57. <https://www.doi.org/10.2307/1907327>

Fisher, I. (1935). *100% Money*. New York: Adelphi Company.

Fisher, I. (1936). 100% money and the public debt. *Economic Forum* Spring / April-June: 406-420. Available at: [http://realmoneyecon.org/lev2/images/pdfs/100per cent money.pdf](http://realmoneyecon.org/lev2/images/pdfs/100per%20cent%20money.pdf)

Fisher, I., P. H. Douglas, F. D. Graham, E. J. Hamilton, W. I. King, and C. R. Whittlesey (1939). *A Program for Monetary Reform*. Available at: <http://sensiblemoney.ie/data/documents/A-Program-for-Monetary-Reform-.pdf> (accessed 29 January 2018)

Flaschel, P., F. Hartmann, C. Malikane, and W. Semmler (2010). Broad Banking, Financial Markets and the Return of the Narrow Banking Idea. *Journal of Economic Asymmetries* 7(2): 105-137. <https://doi.org/10.1016/j.jeca.2010.02.006>

Fontana, G., and M. Sawyer. (2016). Full reserve banking: more 'cranks' than 'brave heretics.' *Cambridge Journal of Economics* 40(5): 1333-1350. <https://doi.org/10.1093/cje/bew016>

Focardi, S.M. (2018). *Money. What It Is, How It's Created, Who Gets It, and Why It Matters*. London/ New York: Routledge.

Foundry (2016). The advent of crypto banking. A new paradigm for central and commercial banking. *Report*, November. Retrieved from: https://www.foundry.co.za/wp-content/uploads/2017/09/The_Advent_of_Crypto_Banking.pdf

Friedman, M. (1960). *A Program for Monetary Stability*. New York: Fordham University Press.

Friedman, M., and A. J. Schwartz (1963). *A Monetary History of the United States 1867-1960*. Princeton: Princeton University Press.

Friedman, M. (1969 [2006]). *The Optimum Quantity of Money*. New Brunswick (NJ): Transaction.

Friedman, M. (1962 [2002]). *Capitalism and Freedom*. Chicago and London: The University of Chicago Press.

Friedman, M. (1991). The island of stone money. *The Hoover Institution Working Paper in Economics* E-91-3.

Friedman, M. (1999). Full interview on anti-trust and tech. *Interview*. Available at: <https://www.youtube.com/watch?v=mlwxdyLnMXM>

Fuld, R. (2008). Testimony to Congress on Lehman Brothers Bankruptcy. Testimony, October 6. Available at: <https://www.americanrhetoric.com/speeches/richardfuldlehmanbrosbankruptcytestimony.htm> (accessed 5 October 2018).

Gallup (2014). ‘Americans’ ratings of CDC down after Ebola crisis’, 20 November. Available at: <https://news.gallup.com/poll/179522/americans-ratings-cdc-down-ebola-crisis.aspx> (accessed 3 August 2018).

Gambacorta, L., J. Yang, and K. Tsatsaronis. (2014). Financial structure and growth. *BIS Quarterly Review*, March: 21-35. Available at: https://www.bis.org/publ/qtrpdf/r_qt1403e.pdf

Gertler, M., and S. Gilhirst (2018). What happened: financial factors in the Great Recession. *Journal of Economic Perspectives* 32(3): 3-30. <https://doi.org/10.1257/jep.32.3.3>

Geva, B. (2011). *The Payment Order of Antiquity and the Middle Ages*. Oxford and Portland (OR): Hart Publishing.

Gibb, T. (1997). Towards the engineering of requirements. *Requirements Engineering* 2(3):165–169. <https://doi.org/10.1007/BF02802774>

Gnan, E., and D. Masciandaro (2018). Do we need central bank digital currencies? Economics, technology and institutions. In Gnan, E., and D. Masciandaro (eds.) (2018). Do we need central bank digital currency? *SUERF Conference Proceedings* 2018/2, 8-22. Available at: https://www.suerf.org/docx/s_cf0d02ec99e61a64137b8a2c3b03e030_7025_suerf.pdf

Goldkuhl, G., and M. Lind (2010). A multi-grounded design research process. In Winter, R., J. L. Zhao, and S. Aier (Eds.) (2010). *Global Perspectives on Design Science Research*. Berlin and Heidelberg: Springer, pp 45-60.

Gomez, C. (2017). Mr. Bacchetta, the Swiss Banking Association and the economic science: an ill-assorted love triangle. *Reply to Bacchetta (2017)*. Available at: https://www.vollgeld-initiative.ch/fa/img/English/2018_01_25_Christian_Gomez_Reply_Bacchetta_The_Sovereign_Money_Initiative_in_Switzerland.pdf (accessed 21 August 2018).

Goodhart, C.A.E. (1998). The two concepts of money: implications for the analysis of optimal currency areas. *European Journal of Political Economy* 14(3): 407–32. [https://doi.org/10.1016/S0176-2680\(98\)00015-9](https://doi.org/10.1016/S0176-2680(98)00015-9)

Goodhart, C.A.E. (1999). Myths about the lender of last resort. *International Finance* 2(3): 339-360. Retrieved from: <https://notendur.hi.is/ajonsson/kennsla2006/Myth-lender.pdf>

Goodhart, C.A.E. (2009). The continuing muddles of monetary theory: a steadfast refusal to face facts. *Economica* 76(s1): 821–830. <https://doi.org/10.1111/j.1468-0335.2009.00790.x>

Goodhart, C.A.E., and M. Jensen (2015). A commentary on Patrizio Lainà's 'Proposals for full-reserve banking: a historical survey from David Ricardo to Martin Wolf'. *Economic Thought* 4(2): 20-31. Retrieved from: <http://et.worlddeconomicsassociation.org/files/WEA-ET-4-2-GoodhartJensen.pdf>

Goodhart, L.M. (2015). Brave new world? Macro-prudential policy and the new political economy of the Federal Reserve'. *Review of International Political Economy* 22(2): 280–310.

Görmez, Y. and C.H. Budd (2004). Electronic money free banking and some implications for central banking. *Central Bank Review* 1: 67-105. Retrieved from: <https://core.ac.uk/download/pdf/6462833.pdf>

Gorton, G. (2010). *Slapped by the Invisible Hand: The Panic of 2007*. New York: Oxford University Press.

Gorton, G. (2012a). *Misunderstanding Financial Crisis: Why We Don't See Them Coming*. New York: Oxford University Press.

Gorton, G. (2012b). Some reflections on the recent financial crisis. *NBER Working Paper* 18397. Available at: <https://www.nber.org/papers/w18397.pdf>

Gorton, G., and A. Metrick (2012). Securitized banking and the run on repo. *Journal of Financial Economics* 104(2): 343-78. <https://doi.org/10.1016/j.jfineco.2011.03.016>

Gorton, G., T. Laarits and A. Metrick (2018). The run on repo and the Fed's response. *NBER Working Paper* 24866. Available at: <https://www.nber.org/papers/w24866>

Gorton, G. (2019). Comments on “Is the financial system sufficiently resilient: a research programme and policy agenda” in Tucker (2019). Is the financial system sufficiently resilient: a research programme and policy agenda. BIS Working Paper 792, June, 25-33.

Graeber, D. (2009). Debt, violence, and impersonal markets: Polanyian meditations. In Hann, C., and K. Hart (eds.) (2009). *Market and Society: The Great Transformation Today*, 106-132. Cambridge: Cambridge University Press.

Graeber, D. (2011 [2014]). *Debt: The First 5,000 Years*. New York: Melville House Publishing.

Greenbaum, S.I., A.V. Thakor, and A.W.A. Boot (2016). *Contemporary Financial Intermediation*. London: Elsevier.

Grierson, P. (1977). *The Origins of Money*. London: Athlone.

Gurley, J., and E.S. Shaw (1960). *Money in a Theory of Finance*. Cambridge (UK): Cambridge University Press.

Haldane, A.G., and V. Madouros (2012). The dog and the frisbee. *Speech given at Economic Policy Symposium The Changing Policy Landscape*, Federal Reserve Bank of Kansas City. Retrieved from: <https://www.bis.org/review/r120905a.pdf>

Haldane, A.G. (2013). Have we solved ‘too big to fail’? *Voxeu.org Article*, 17 January. Available at: <https://voxeu.org/article/have-we-solved-too-big-fail> (accessed 30 August 2019).

Haldane, A.G., and P. Booth (2014). On being the right size. *Journal of Financial Perspectives* 2(1), 13–25.

Haldane, A. (2015). How low can you go? *Speech given at Portadown Chamber of Commerce in Northern Ireland*, 18 September. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/news/2015/september/how-low-can-you-go-speech-by-andy-haldane>

Hancock, D., and D.B. Humphrey (1998). Payment transactions, instruments and systems: a survey. *Journal of Banking & Finance* 21: 1573-1624. Retrieved from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.515.1365&rep=rep1&type=pdf>

Häring, N. (2013). The veil of deception over money: how central bankers and textbooks distort the nature of banking and central banking. *Real-World Economics Review* 63: 2-18. Retrieved from: <http://www.paecon.net/PAEReview/issue63/whole63.pdf>

Häring, N. (2018). Brave new money: Paypal, WeChat, Amazon Go – A Totalitarian World Currency in the Making. *Book chapter*. Available in English at: <http://norberthaering.de/en/32-english/news/1008-book-english> (accessed 1 September 2018).

Hart, K. (1986) Heads or tails? Two sides of the coin. *Man* 21(4): 637-656. <https://www.jstor.org/stable/2802901>

Hauser, A. (2021). Bigger, broader, faster, stronger? How much should tomorrow’s central bank balance sheets do – and what should we leave to financial markets? Some principles for good parenting. *Speech at the International Finance and Banking Society*, Oxford, 13 September. Available at: <https://www.bankofengland.co.uk/-/media/boe/files/speech/2021/september/bigger-broader-faster-stronger-speech-by-andrew-hauser.pdf?la=en&hash=4474416D7BCF5354440D0CC3978CFFC72DBE7287> (accessed 28 September 2021)

Hayek, F.A. (1945). The use of knowledge in society. *American Economic Review* 35(4):519-530.

Hayek, F.A. (1960). *The Constitution of Liberty*. London and Chicago: Routledge & Kegan Paul.

Hayek, F.A. (1976). Choice in currency. *Occasional Paper* 48. London: Institute of Economic Affairs.

Hayek, F.A. (1990). *Denationalisation of Money — The Argument Refined*. Sussex: The Institute of Economic Affairs.

Hayes, A. (2016). Decentralized banking: Monetary technocracy in the digital age. In Tasca, P., T. Aste, L. Pelizzon, and N. Perony (eds.) (2016). *Banking Beyond Banks and Money: A Guide to Banking Services in the Twenty-First Century*. Switzerland: Springer International Publishing, 121-131.

He, D., R. Leckow, V. Haksar, T. Mancini-Griffoli, N. Jenkinson, M. Kashima, T. Khiaonarong, C. Rochon, and H. Tourpe (2017). Fintech and financial services: initial considerations. *IMF Staff Discussion Note* 17/05. Retrieved from: <https://www.imf.org/~media/Files/Publications/SDN/2017/sdn1705.ashx>

Helpman, E. (ed.) (1998). *General Purpose Technologies and Economic Growth*. Cambridge (MA): MIT Press.

Hevner, A., March, S. T., Park, J., and Ram, S. (2004). Design science in information systems research. Version accepted for publication in *MIS Quarterly*.

Hevner, A., and S. Chatterjee (2010). *Design Research in Information Systems: Theory and Practice*. Springer.

Hicks, J. R. (1967). *Critical Essays in Monetary Theory*. Oxford: Clarendon Press.

Hileman, G., and M. Rauchs (2017). Global blockchain benchmarking study, 22 September. Cambridge: Cambridge Centre for Alternative Finance. Available at SSRN: <https://ssrn.com/abstract=3040224> or <http://dx.doi.org/10.2139/ssrn.3040224>

Hill, J. (2018). *Fintech and the Remaking of Financial Institutions*. London: Elsevier.

Hitzler, R., A. Honer, and C. Maeder (1994). *Expertenwissen. Die institutionalisierte Kompetenz zur Konstruktion von Wirklichkeit*. Wiesbaden: Vieweg+Teubner Verlag.

Hodgson, G.M. (2009). The great crash of 2008 and the reform of economics. *Cambridge Journal of Economics* 33(6): 1205-1221. https://www.jstor.org/stable/23601942?seq=1#page_scan_tab_contents

Hockett, R.C. and S.T. Omarova (2016). The finance franchise. *Cornell Legal Studies Research Paper* 16-29. <http://dx.doi.org/10.2139/ssrn.2820176>

Hockett, R.C. (2019). Money's past is fintech's future: wildcat crypto, the digital dollar, and citizen central banking. *Stanford Journal of Blockchain Law & Policy*, June 28. Available at: <https://stanford-jblp.pubpub.org/pub/wildcat-crypto-fintech-future> (accessed 28 May 2020).

Hodgson, G.M., U. Mäki, and D. McCloskey (1992). Plea for a pluralistic and rigorous economics. *American Economic Review* 82 (2): xxv.

Hodgson, G.M. (2013). *From Pleasure Machines to Moral Communities. An Evolutionary Economics without Homo Economicus*. Chicago and London: The University of Chicago Press.

Hoenig, T. (2016). A capital conflict. *Speech to the NABE and the OECD Global Economic Symposium*, Paris, May 23. Available at: <https://www.fdic.gov/news/news/speeches/spray2316a.pdf>

Holmstrom, B. (2015). Understanding the role of debt in the financial system. *BIS Working Paper* 479, January.

Howard, D.H. (1977). The denationalization of money: a review. *International Finance Discussion Paper* 102. Retrieved from: <https://www.federalreserve.gov/pubs/ifdp/1977/102/ifdp102.pdf>

Huber, J., and J. Robertson (2000). *Creating New Money: A Monetary Reform for the Information Age*. London: New Economics Foundation.

Huber, J. (2013a). *Monetäre Modernisierung. Zur Zukunft der Geldordnung: Vollgeld und Monetative*. Marburg: Metropolis.

Huber, J. (2013b). Modern money and sovereign currency. *Book Manuscript*. Retrieved from: https://www.researchgate.net/publication/312496026_Modern_Money_and_Sovereign_Currency

Huber, J. (2014). Modern money theory and new currency theory. *Real-world economics review* 66: 38-57. Retrieved from: www.paecon.net/PAERReview/issue66/Huber66.pdf

Huber, J. (2017). *Sovereign Money. Beyond Reserve Banking*. Cham: Palgrave Macmillan.

Hudson, M. (2000). Mesopotamia and Classical Antiquity. *American Journal of Economics and Sociology* 59(5): 4-25. <https://doi.org/10.1111/1536-7150.00083>

Hudson, M. (2004). The archaeology of money: debt versus barter theories In Wray, L.R. (ed.) (2004). *Credit and State Theories of Money*. Cheltenham and Northampton: Edward Elgar Publishing, 99–127.

Humphrey, C. (1985). Barter and economic disintegration. *Man* 20(1): 48-72. <https://www.jstor.org/stable/2802221>

IEEE Computer Society (1998). IEEE Recommended practice for software requirements specifications. *Report* 20 October.

IMF (2012). Growth Resuming, Dangers Remain. *World Economic Outlook*. Retrieved from: <https://www.imf.org/en/Publications/WEO/Issues/2016/12/31/Growth-Resuming-Dangers-Remain>

IMF (2016). Debt, use it wisely. *Fiscal monitor*. Retrieved from: <https://www.imf.org/en/Publications/FM/Issues/2016/12/31/Debt-Use-it-Wisely>

Ingham, G. (2004). *The Nature of Money*. Cambridge (UK): Polity Press.

Ingham, G. (2009). Notes on revisiting the credit theory of money. Nanterre, September. Available at: https://www.economix.fr/uploads/source/doc/colloques/2009_cartelier/Ingham.pdf. (accessed 29 January 2018).

Innes, A.M. (1913). What is money. *The Banking Law Journal*, May: 377-408. Available at: <https://www.community-exchange.org/docs/what%20is%20money.htm> (accessed 16 March 2016).

Innes, A.M. (1914). The credit theory of money. *The Banking Law Journal*, January: 151-168.

Issing, O. (1999). Hayek, currency competition and the European Monetary Union. *Speech at Annual Hayek Memorial Lecture hosted by the Institute of Economics affairs*, London, May 27. Available at: <http://iea.org.uk/sites/default/files/publications/files/upldbook19pdf.pdf> (accessed 15 October 2017).

Issing, O., J. Stark, and H. Schlesinger (2019). *Memorandum on ECB Monetary Policy*, October 4.

Ivashina, V., and D.S. Scharfstein (2010). Bank lending during the financial crisis of 2008. *Journal of Financial Economics* 97(3): 319-38. <https://doi.org/10.1016/j.jfineco.2009.12.001>

Jackson, A., and B. Dyson (2012). *Modernising Money. Why Our Monetary System Is Broken and How It Can Be Fixed*. London: Positive Money.

Jakab, Z., and M. Kumhof (2015). Banks are not intermediaries of loanable funds - and why this matters. *Bank of England Working Paper* 529. Retrieved from: <https://www.bankofengland.co.uk/working-paper/2015/banks-are-not-intermediaries-of-loanable-funds-and-why-this-matters>

Jakab, Z., and M. Kumhof (2019). Banks are not intermediaries of loanable funds – facts, theory and evidence. *Bank of England Working Paper* 761. Retrieved from: <https://www.bankofengland.co.uk/working-paper/2018/banks-are-not-intermediaries-of-loanable-funds-facts-theory-and-evidence>

Jarke, M., P. Loucopoulos, K. Lyytinen, J. Mylopoulos, W. Robinson (2011). The brave new world of design requirements. *Information Systems* 36(7): 992-1008. <https://doi.org/10.1016/j.is.2011.04.003>

Jevons, W. Stanley (1875 [1896]). *Money and the Mechanism of Exchange*. New York: D. Appleton and Company.

Johannesson, P., and E. Perjons (2014). *An Introduction to Design Science*. Cham: Springer.

Johnson, H.G. (1974). Major issues in monetary economics. *Oxford Economic Papers* 26(2): 212-225. <https://doi.org/10.1093/oxfordjournals.oep.a041279>

Joób, M. (2014). The sovereign money initiative in Switzerland. *World Economics Association Newsletter* 4(3): 6-7. Available at: <http://www.worldeconomicsassociation.org/files/newsletter/Issue4-3.pdf> (accessed 9 February 2017).

Jordà, O., M. Schularick, and A. Taylor (2013). When credit bites back: leverage, business cycles and crisis. *Journal of Money, Credit and Banking* 45: 3-28. <https://doi.org/10.1111/jmcb.12069>

Jordà, O., M. Schularick, and A. Taylor (2014). The great mortgaging: housing finance, crises and business cycles. *NBER Working Paper* 20501. Retrieved from: <https://www.nber.org/papers/w20501.pdf>

Jordan, T.J. (2018). How money is created by the central bank and the banking system. *Speech at Swiss National Bank*, 16 January. Available at: https://snb.ch/en/mmr/speeches/id/ref_20180116_tjn/source/ref_20180116_tjn.en.pdf (accessed 11 February 2018).

Judson, R. (2018). Big note, small note: central bank digital currency and cash. In Gnan, E., and D. Masciandaro (eds.) (2018). Do we need central bank digital currency? *SUERF Conference Proceedings* 2018/2, 33-45. Available at: https://www.suerf.org/docx/s_cf0d02ec99e61a-64137b8a2c3b03e030_7025_suerf.pdf (accessed 18 May 2019).

Kahn, C.M., and W. Roberds (2009). Why pay? An introduction to payments economics. *Journal of Financial Intermediation* 18(1): 1-23. <https://doi.org/10.1016/j.jfi.2008.09.001>

Kane, E.J. (2013). The inevitability of shadow banking. *INET Research Draft*, April 22. Retrieved from: <https://www.ineteconomics.org/uploads/papers/InevitabilityofShadowyBanking.pdf>

Kareken, J.H., and N. Wallace (1977). Deposit insurance and bank regulation: a partial equilibrium exposition. *Federal Reserve Bank of Minneapolis Research Paper* 16.

Kashyap, A.K., R. Rajan, and J.C. Stein (2002). Banks as liquidity providers: an explanation for the coexistence of lending and deposit-taking. *The Journal of Finance* LVII(1): 33-73. <https://doi.org/10.1111/1540-6261.00415>

Kay, J. (2009). Narrow Banking: The Reform of Banking Regulation. *CSFI Report*, 15 September. Available at: <https://static1.squarespace.com/static/54d620fce4b049bf4cd5be9b/t/5532be2de4b07fb5e0478c7d/1429388845292/Narrow+Banking%2C+the+reform+of+banking+regulation%2C+by+John+Kay.pdf> (accessed 12 October 2016).

Keen, S. (2011). *Debunking Economics: The Naked Emperor Dethroned?* London: Zed Books.

Keen, S. (2017). *Can We Avoid Another Financial Crisis?* Cambridge: Polity Press.

Ketterer, J.A., and G. Andrade (2016). Digital central bank money and the unbundling of the banking function. *Inter-American Development Bank Discussion Paper* 449. Available at: <https://pdfs.semanticscholar.org/07e6/8429c3d09c9cc507c3ad22408c13d6c7aa29.pdf> (accessed 30 August 2019).

Keynes, J.M. (1924). *Tract on Monetary Reform*. London: Macmillan.

Keynes, J.M. (1930 [2011]). *A Treatise on Money*. Mansfield Centre (CT): Martino Publishing.

Keynes, J.M. (1936 [2008]). *The General Theory of Employment, Interest and Money*. BN Publishing.

Kim, J. (2014). Money is rights in rem: a note on the nature of money. *Journal of Economic Issues* 48(4): 1005-1019. DOI: 10.2753/jei0021-3624480407

Kindleberger, C.P. (1984 [2006]). *A Financial History of Western Europe*. Abingdon: Routledge.

Kindleberger, C.P., and R. Aliber (2005). *Manias, Panics and Crashes. A History of Financial Crises*. New York: Palgrave Macmillan.

King, M. (2010). Banking – from Bagehot to Basel, and back again. *Speech at the Second Bagehot Lecture*, New York, 25 October. Available at: <https://www.bis.org/review/r101028a.pdf> (accessed 5 March 2015).

King, M. (2016). *The End of Alchemy: Money, Banking and the Future of the Global Economy*. London: Little, Brown.

Klein, M. (2017). Central bank digital currencies – The application of distributed ledger technology by central banks. *Universität Giesen Paper submitted to Prof. Christina Bannier*, November.

Klomp, J., and J. de Haan (2010). Inflation and central bank independence: a meta-regression analysis. *Journal of Economic Surveys* 24(4): 593-621. <https://dx.doi.org/10.1111/j.1467-6419.2009.00597.x>

Knapp, G.F. (1924). *The State Theory of Money*. London: MacMillan.

- Knight, F. H. (1921). *Risk, Uncertainty and Profit*. Boston/ New York: Houghton Mifflin Company.
- Knight, F., G. Cox, A. Director, P. Douglas, A. Hart, L. Mints, H. Schultz, and H. Simons. (1933). Memorandum on Banking Reform. Franklin D. Roosevelt Presidential Library, President's Personal File 431, March 1933. Reproduced in Phillips, R.J (1995 [2015]). *The Chicago Plan & New Deal Banking Reform*. Milton Park and New York: Routledge, 191-199.
- Kohn, M. (1999). Bills of exchange and the money market to 1600. *Dartmouth College, Department of Economics Working Paper* 99-04, February. <https://dx.doi.org/10.2139/ssrn.151849>
- Kolly, M.-J., J. Müller, and S. Wimmer (2017). Am Anfang stand ein Bankenkollaps. Dann kam die Regulierung – und hörte nicht mehr auf. *Neue Zürcher Zeitung*, 10 August 2017. Available at: <https://www.nzz.ch/wirtschaft/40-jahre-bankenregulierung-unter-der-lupe-die-worte-welche-die-naechste-finanzkrise-verhindern-sollen-ld.1304103> (accessed 5 June 2018).
- Kotlikoff, L. (2010). *Jimmy Stewart is Dead: Ending the World's Ongoing Financial Plague with Limited Purpose Banking*. Hoboken, NJ: John Wiley & Sons.
- Kotlikoff, L. (2018). The big con - reassessing the “great” recession and its “fix”. *NBER Working Paper* 25213. Retrieved from: <https://www.nber.org/papers/w25213>
- KPMG (2016). Money Issuance. Alternative Monetary Systems. *KPMG-report commissioned by the Icelandic Prime Minister's Office*. Retrieved from: <https://assets.kpmg.com/content/dam/kpmg/is/pdf/2016/09/KPMG-MoneyIssuance-2016.pdf>
- Kregel, J. (2012). Minsky and the Narrow Banking Proposal: No Solution for Financial Reform. *Levy Economics Institute of Bard College, Public Policy Brief* 125. Retrieved from: http://www.levyinstitute.org/pubs/ppb_125.pdf
- Kumhof, M., and Z. Jakab (2016). The truth about banks. *IMF Finance & Development* March: 50-53. Retrieved from: <https://www.imf.org/external/pubs/ft/fandd/2016/03/pdf/kumhof.pdf>
- Kumhof, M, and C. Noone (2018). Central bank digital currencies – design principles and balance sheet implications. *Bank of England Staff Working Paper* 725. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2018/central-bank-digital-currencies-design-principles-and-balance-sheet-implications>
- La Roche, J. (2015). Lloyd Blankfein: It's going to be ‘very hard’ to disrupt Goldman Sachs because it's so heavily regulated. *Business Insider UK*, May 20. Available at: <http://uk.businessinsider.com/goldman-launches-podcast-on-itunes-2015-5?international=true&r=UK&IR=T> (accessed 6 June 2017).
- Landau, J-P., and A. Genais (2019). Digital currencies. An exploration into technology and money. *Report to M. Bruno Le Maire, Minister of Economy*. Retrieved from: <https://www.economie.gouv.fr/files/files/2019/ENG-synthese-ra-crypto-monnaies-180705.pdf>
- Lagarde, C. (2017). Central banking and fintech – a brave new world? *Speech at Bank of England Conference*, 29 September. Available at: <https://www.imf.org/en/News/Articles/2017/09/28/sp092917-central-banking-and-fintech-a-brave-new-world> (accessed 26 January 2018).

Lagarde, C. (2018). An even-handed approach to crypto-assets. *IMF blog*, 16 April 2018. Available at: <https://blogs.imf.org/2018/04/16/an-even-handed-approach-to-crypto-assets/> (accessed 7 July 2018).

Lainà, P. (2015). Proposals for full-reserve banking: a historical survey from David Ricardo to Martin Wolf. *Economic Thought* 4(2): pp. 1-19. Retrieved from: <http://et.world-economics-association.org/files/WEA-ET-4-2-Laina.pdf>

Lawson, T. (2006). The nature of heterodox economics. *Cambridge Journal of Economics* 30 (4): 483-505. <https://www.jstor.org/stable/23601875>

Lawson, T. (2013). What is this ‘school’ called neoclassical economics? *Cambridge Journal of Economics* 37(5): 947-983. <https://doi.org/10.1093/cje/bet027>

Lawson, T. (2015). *Essays on the Nature and State of Modern Economics*. London: Routledge.

Lawson, T. (2016). Social positioning and the nature of money. *Cambridge Journal of Economics* 40(4): 961-996. <https://doi.org/10.1093/cje/bew006>

Lerner, A.P. (1947). Money as a creature of the state. *American Economic Review* 37(2): 312-17. <https://www.jstor.org/stable/1821139>

Levine, M. (2019). The Fed versus the narrow bank. *Bloomberg Opinion*, 8 March. Available at: <https://www.bloomberg.com/opinion/articles/2019-03-08/the-fed-versus-the-narrow-bank#footnote-3> (accessed 12 March 2019).

Lietaer, B, C. Arnspenger, S. Goerner, and S. Brunnhuber (2012). Money and sustainability: the missing link. *Report from the Club of Rome to Finance Watch and the World Business Academy*, March.

Lipton, A. (2015). Modern monetary circuit theory, stability of interconnected banking network, and balance sheet optimization for individual banks. Available at: <https://arxiv.org/pdf/1510.07608.pdf>

Lo, A.W. (2012). Reading about the financial crisis: a twenty-one-book review. *Journal of Economic Literature* 50(1): 151-78. <https://doi.org/10.1257/jel.50.1.151>

Low, K.F.K., and E. Teo (2016). Legal risks of owning cryptocurrencies. In Chuen, D.L.K, and R. Deng (eds.) (2016). *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 1*, 225-247. London: Academic Press.

Luttrell, D., H. Rosenblum, and J. Thies (2012). Understanding the risks inherent in shadow banking: a primer and practical lesson learned. *Federal Reserve Bank of Dallas Staff Papers* 18, November 2012. Retrieved from: <https://www.dallasfed.org/~media/documents/research/staff/staff1203.pdf>

Lynch, D., and L. Lundquist (1996). *Digital Money: The New Era of Internet Commerce*. New York: Wiley.

MacDonald, T.J., D.W.E. Allen, and J. Pots (2016). Blockchains and the boundaries of self-organized economies: predictions for the future of banking. In Tasca, P., T. Aste, L. Pelizzon, and N. Perony (eds.) (2016). *Banking Beyond Banks and Money: A Guide to Banking Services in the Twenty-First Century*. Switzerland: Springer International Publishing, 279-296.

Marglin, S.A. (2008). *The Dismal Science. How Thinking Like an Economist Undermines Community*. Cambridge (MA) and London: Harvard University Press.

Marx, K. (1970). *A Contribution to the Critique of Political Economy*. New York: International Publishers.

Marx, K. (1867 [1909]). *Capital: A Critique of Political Economy. Volume I: The Process of Capitalist Production*. Chicago: Charles H. Kerr & Company.

Mattessich, R. (1994). Accounting as a cultural force: past, present and future. *European Accounting Review* 3(2): 354-374. <https://doi.org/10.1080/09638189400000024>

Mayer, T. (2018). How can the Euro survive? *Presentation at conference The Future of Money*, Frankfurt, 24 November. Sheets available at: <http://conference2018.monetative.de/wp-content/uploads/2018/12/Presentation-Thomas-Mayer-Flossbach-von-Storch-How-can-the-Euro-survive.pdf> (accessed 30 August 2019).

Mayer, T., and N.F. Tofall (2018). Währungswettbewerb zur Rettung des Euro. *Flossbach von Storch Research Institute, Kommentar zu Wirtschaft und Politik* 31/10/2018. Available at: https://www.flossbachvonstorch-researchinstitute.com/fileadmin/user_upload/RI/Studien/files/studie-181031-waeh-rungswettbewerb-zur-rettung-des-euro.pdf

McCulley, P. (2009). The shadow banking system and Hyman Minsky's Economic Journey. In Siegel, L. (ed.) (2009). *Insights into the Global Financial Crisis*. The Research Foundation of CFA Institute, 257-268.

McLeay, M., A. Radia, and R. Thomas (2014a). Money in the modern economy: An introduction. *Bank of England Quarterly Bulletin* Q1 2014. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/money-in-the-modern-economy-an-introduction.pdf?la=en&hash=E43CDFDBB5A23D672F4D09B13DF135E6715EEDAC>

McLeay, M., A. Radia, and R. Thomas (2014b). Money creation in the modern economy. *Bank of England Quarterly Bulletin* Q1 2014. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/money-creation-in-the-modern-economy>

McMillan, J. (2014). *The End of Banking. Money, Credit, and the Digital Revolution*. Zurich: Zero/One Economics.

Meaning, J., B. Dyson, J. Barker, and E. Clayton (2018). Broadening narrow money: monetary policy with a central bank digital currency. *Bank of England Staff Working Paper* 724. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2018/broadening-narrow-money-monetary-policy-with-a-central-bank-digital-currency.pdf>

Mehrling, P. (1999). The vision of Hyman P. Minsky. *Journal of Economic Behavior & Organization* 39: 129-158.

Mehrling, P. (2009). Natural hierarchy of money. *Lecture paper*. Available at: <http://www.perrymehrling.com/wp-content/uploads/2015/05/Lec-02-The-Natural-Hierarchy-of-Money.pdf> (accessed 26 January 2018).

Mehrling, P. (2010). *The New Lombard Street: How the Fed Became the Dealer of Last Resort*. Princeton: Princeton University Press.

Mehrling, P. (2012a). The inherent hierarchy of money. *Prepared for Duncan Foley festschrift volume, and conference* April 20-21. Available at: https://ieor.columbia.edu/files/seasdepts/industrial-engineering-operations-research/pdf-files/Mehrling_P_FESeminar_Sp12-02.pdf (accessed 21 June 2022).

Mehrling, P. (2012b). A money view of credit and debt. *Paper prepared for the "Economics of Credit and Debt" session at the INET/CIGI 'False Dichotomies' conference*, Waterloo, Ontario, Canada, 18 November. Available at: https://www.cigionline.org/sites/default/files/inet2012mehrling_ameyviewofcreditanddebt.pdf (accessed 21 June 2022).

Mehrling, P. (2013). The inherent hierarchy of money. In *Social Fairness and Economics*, edited by L. Taylor, A. Rezaei, and T. Michl, 294–304. New York and London: Routledge.

Mehrling, P. (2020). Payment vs. funding: the law of reflux for today. *Institute of New Economic Thinking Working Paper* 113. Available at: https://www.ineteconomics.org/uploads/papers/WP_113-Mehrling-Payment-vs-Funding.pdf (accessed 21 June 2022).

Meier, F. (2017). Money as accounting: historical and theoretical issues. *Master Thesis University of Fribourg*, October.

Meikle, S. (1994). Was Marx an economist? In P. Dunleavy, P., and J. Stanyer (eds) (1994) *Contemporary political studies*. Belfast: Proceedings of the Political Studies Annual Conference, 923-33.

Meikle, S. (1995). *Aristotle's economic thought*. Oxford: Clarendon Press.

Mellor, M. (2016). *Debt or Democracy: Public Money for Sustainability and Social Justice*. London: Pluto Press.

Menand, L. (2022). *The Fed Unbound. Central Banking in a Time of Crisis*. New York: Columbia Global Reports.

Menger, K. (1871 [1976]). *Principles of Economics*. Auburn (AL): Ludwig von Mises Institute.

Menger, K. (1892). On the origins of money. *The Economic Journal* 2(6): 239-255. <https://www.jstor.org/stable/2956146>

Mersch, Y. (2018). Virtual or virtueless? The evolution of money in the digital age. *Lecture at Official Monetary and Financial Institutions Forum*, London, 8 February 2018. Available at: <https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180208.en.html> (accessed 7 April 2018).

Mersch, Y. (2019). Money and private currencies: reflections on Libra. *Speech at the ESCB Legal Conference*, Frankfurt am Main, 2 September. Available at: <https://www.ecb.europa.eu/press/key/date/2019/html/ecb.sp190902-aedded9219.en.html> (accessed 3 September 2019).

Merton, R.C., and Z. Bodie (1993). Deposit insurance reform: a functional approach. *Carnegie-Rochester Conference Series on Public Policy* 38: 1-34. Retrieved from: <https://pdfs.semanticscholar.org/cdb1/362fa977e8cfc165fb043098288c423f68eb.pdf>

- Merton, R.K. (1948). The self-fulfilling prophecy. *Antioch Review* 8(2): 193-210. <https://www.jstor.org/stable/4609267>
- Meuser, M, and U. Nagel (2009). The expert interview and changes in knowledge production. In: Bogner A., Littig B., Menz W. (eds). *Interviewing Experts. Research Methods Series*. Palgrave Macmillan, London, pp 17-42.
- Mian, A., and A. Sufi (2014). *House of Debt: How They (and You) Caused the Great Recession, and How We Can Prevent It from Happening Again*. Chicago: University of Chicago Press.
- Mian, A., A. Sufi, and E. Verner (2017). Household debt and business cycles worldwide. *Quarterly Journal of Economics* 132(4): 1755-1817. <https://doi.org/10.1093/qje/qjx017>
- Miller, M.H. (1995). Do the M&M proposition apply to banks? *Journal of Banking and Finance* 19(3-4): 483-89. [https://doi.org/10.1016/0378-4266\(94\)00134-O](https://doi.org/10.1016/0378-4266(94)00134-O)
- Mills, D., K. Wang, B. Malone, A. Ravi, J. Marquardt, C. Chen, A. Badev, T. Brezinski, L. Fahy, K. Liao, V. Kargenian, M. Ellithorpe, W. Ng, and M. Baird (2016). Distributed ledger technology in payments, clearing, and settlement. *Federal Reserve Board Finance and Economics Discussion Series*, 2016-095. Retrieved from: <https://www.federalreserve.gov/econresdata/feds/2016/files/2016095pap.pdf>
- Milnes, A. (1919). *The Economic Foundations of Reconstruction*. London: Macdonald and Evans.
- Minsky, H.P. (1982a). *Can "It" Happen Again? Essays on Instability and Finance*. Armonk, NJ: M.E. Sharpe.
- Minsky, H.P. (1982b). Can "it" happen again? A reprise. *Hyman P. Minsky Archive*, paper 155. Retrieved from: https://digitalcommons.bard.edu/hm_archive/155
- Minsky, H.P. (1986a [2008]). *Stabilising an unstable economy*. New York: McGraw Hill.
- Minsky, H.P. (1986b). Money and crisis in Schumpeter and Keynes. In Wagener, H.-J., and J.W. Drukker (eds.) (1986). *The Economic Law of Motion of Modern Society*. Cambridge: Cambridge University Press, 112-122.
- Minsky, H.P. (1992a). The financial instability hypothesis. *Levy Economics Institute Working Paper* 74. Retrieved from: <http://www.levyinstitute.org/pubs/wp74.pdf>
- Minsky, H.P. (1992b). Stabilizing an unstable economy: testing the institutional structure. *Hyman P. Minsky Archive*, paper 459. Retrieved from: https://digitalcommons.bard.edu/hm_archive/155/
- Minsky, H.P. (1994a). Financial instability and the decline (?) of banking: public policy implication. *Hyman P. Minsky Archive*, paper 88. Retrieved from: https://digitalcommons.bard.edu/hm_archive/88
- Minsky, H.P. (1994b). Regulation and supervision. *Hyman P. Minsky Archive*, paper 443. Retrieved from: https://digitalcommons.bard.edu/hm_archive/443/

Minsky, H.P. (1994c). The financial system in the decade ahead: what should banks do? Setting the policy agenda. *Hyman P. Minsky Archive*, paper 71. Retrieved from: https://digitalcommons.bard.edu/hm_archive/71/

Minsky, H.P. (1994d). Issues in bank regulation and supervision. *Hyman P. Minsky Archive*, paper 72. Retrieved from: https://digitalcommons.bard.edu/hm_archive/72/

Minsky, H.P. (1994e). Outline for issues in bank regulation and supervision. *Hyman P. Minsky Archive*, paper 73. Retrieved from: https://digitalcommons.bard.edu/hm_archive/73/

Minsky, H.P. (1995a). Reforming banking in 1995: repeal of the Glass Steagall Act, some basic issues. *Hyman P. Minsky Archive*, paper 59. Retrieved from: https://digitalcommons.bard.edu/hm_archive/59/

Minsky, H.P. (1995b). Sources of financial fragility: financial factors in the economics of capitalism. *Hyman P. Minsky Archive*, paper 69. Retrieved from: https://digitalcommons.bard.edu/hm_archive/69/

Minsky, H.P. (2008). Securitization. *The Levy Economics Institute of Bard College Policy Note* 2008/2.

Mishkin, F.S. (2004). *The Economics of Money, Banking, and Financial Markets*. 7th edition. Boston: Addison Wesley.

Mitchell, W.F., L.R. Wray, and M. Watts (2016.) *Modern Monetary Theory and Practice: An Introductory Text*. Callaghan: Centre for Full Employment and Equity.

Morgan, E.V. (1965). *A History of Money*. Baltimore (MD): Penguin books.

Motivaction International, and Sustainable Finance Lab (2016). Knowledge about who creates money low amongst international population. Available at: <https://xs.motivaction.nl/fileArchive/?f=115280&o=5880&key=9444> (accessed 17 June 2020).

Moe, T.G. (2018). Financial instability and money creation. A review of Morgan Ricks: The money problem. *Accounting, Economics, and Law: A Convivium, De Gruyter* 8(2): 1-16.

Moutot, P. (2017). Morgan Ricks: “The money problem: rethinking financial regulation”. *Accounting, Economics, and Law: A Convivium, De Gruyter* 8(2): 1-11.

Musgrave, R.A. (1957). A multiple theory of budget determination. *FinanzArchiv* 17(3): 333–343.

Musgrave, R.A. (1959). *The Theory of Public Finance*. New York: McGraw-Hill.

Nakamoto, S. (2008). Bitcoin: a peer-to-peer electronic cash system. *Whitepaper*, 31 October. Retrieved from: <https://bitcoin.org/bitcoin.pdf>

New York Times (2008). Greenspan concedes error on regulation. *Article*, 23 October. Available at: <https://www.nytimes.com/2008/10/24/business/economy/24panel.html>

Niepelt, D. (2018). Central bank digital currencies – what difference does it make? in Gnan, E., and D. Masciandaro (eds.) (2018). Do we need central bank digital currency? *SUERF Conference Proceedings* 2018/2, 99-112. Available at: https://www.suerf.org/docx/s_cf0d02ec99e61a-64137b8a2c3b03e030_7025_suerf.pdf (accessed 18 May 2019).

Nietlisbach, S. (2015). Vollgeldreform. *Master Thesis* Universität Zürich. Available at: http://www.vollgeld-initiative.ch/fa/img/Texte_Dokumente_deutsch/Vollgeld_Masterarbeit_-_Silvan_Nietlisbach_-_Publikationsversion.pdf (accessed 12 March 2016).

Nicolaisen, J. (2017). Challenges for the payment system. *Speech at Finance Norway's payments conference*, 16 November. Available at: <https://www.norges-bank.no/en/Published/Speeches/2017/2017-11-16-nicolaisen/> (accessed 30 January 2018).

Norges Bank (2018). Central bank digital currencies. *Norges Bank Paper* 1. Retrieved from: <https://static.norges-bank.no/contentassets/166efadb3d73419c8c50f9471be26402/nbpapers-1-2018-centralbankdigitalcurrencies.pdf?v=05/18/2018121950&ft=.pdf>

Norman, B., R. Shaw, and G. Speight (2011). The history of interbank settlement arrangements: exploring central banks' role in the payment system. *Bank of England Working Paper* 412. Retrieved from: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2011/the-history-of-inter-bank-settlement-arrangements-exploring-central-banks.pdf?la=en&hash=7289DF09F98158E5C99ECB7F8C86D9C3305FB0F8>

North, D.C. (1990). *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge University Press.

North, D.C. (1991). Institutions. *The Journal of Economic Perspectives* 5(1): 97–112. <https://doi.org/10.1257/jep.5.1.97>

Nugroho, I.B. (2018). Evaluation of central bank-issued digital currency (CBDC) implementation designs using transaction cost economics perspective. *Master Thesis Delft University of Technology*. Retrieved from: <https://repository.tudelft.nl/islandora/object/uuid%3A72f55a50-0906-4b11-b95b-add3f0cd63b0>

OECD (2019). Beyond growth: towards a new economic approach. Report of the Secretary General's Advisory Group on a New Growth Narrative. Available at: [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=SG/NAEC\(2019\)3&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=SG/NAEC(2019)3&docLanguage=En) (accessed 15 March 2020).

Offermann, P., S. Blom, M. Schönherr, U. Bub (2010). Artifact types in system design science – a literature review. In Winter, R., J. L. Zhao, and S. Aier (Eds.) (2010). *Global Perspectives on Design Science Research*. Berlin and Heidelberg: Springer, pp 78-92.

Ordóñez, M.F. (2018a). The future of banking: secure money and deregulation of the financial system. *Speech at the Areces Foundation*, 6 February. Available at: http://sgfm.elcorteingles.es/SGFM/FRA/recursos/doc/AGORA/220802394_542018121416.pdf

Ordóñez, M.F. (2018b). *The Future of Banking: Secure Money and Deregulation of the Financial System*. E-book: Flash Ensayo.

Ordóñez, M.F. (2020). The CBDC revolution. *Introductory speech Monetative Conference*, October 15. Available at: https://www.fidefundacion.es/dinero/The-CBDC-revolution_a104.html

Paine, A.B. (2017). *Mark Twain: A Biography*. Sheba Blake Publishing.

Panetta, F. (2018). 21st century cash: Central banking, technological innovation and digital currencies. *Keynote at SUERF/BAFFI CAREFIN Centre Conference 'Do we need central bank digital currencies? Economics, technology and psychology'*. Available at: <https://www.bis.org/review/r180607c.pdf> (accessed 19 August 2019).

Peck, J., and K. Shell (2003). Equilibrium bank runs. *Journal of Political Economy* 111(1): 103-123. <https://doi.org/10.1086/344803>

Phillips, R.J. (1992). The Chicago Plan and New Deal Banking Reform. *The Jerome Levy Economics Institute of Bard College Working Paper* 76. Retrieved from: <http://www.levyinstitute.org/pubs/wp76.pdf>

Phillips, R.J. (1995 [2015]). *The Chicago Plan & New Deal Banking Reform*. Milton Park and New York: Routledge.

Piirainen, K., R. A. Gonzalez, and G. Kolfshoten (2010). Quo vadis, design science? – a survey of literature. In Winter, R., J. L. Zhao, and S. Aier (Eds.) (2010). *Global Perspectives on Design Science Research*. Berlin and Heidelberg: Springer, pp 94-107.

PINE Maastricht (2019). Evidence suggests that UM's teaching on how banks work is flawed – and why this matters a lot! *An Open Letter to the Dean and all Economics Professors of the School of Business and Economics at Maastricht University (UM)*. Available at: <https://pinemaastricht.files.wordpress.com/2019/02/pine-open-letter-to-um.pdf> (accessed 5 July 2019).

Positive Money (2018). Polling: 10 years after the financial crisis, the British public still don't trust banks. *Blog* August 16. Available at: <https://positivemoney.org/2018/08/british-public-dont-trust-banks/> (accessed 30 August 2019).

Pozsar, Z., T. Adrian, A. Ashcraft, and H. Boesky (2010). Shadow banking. *Federal Reserve Bank New York Staff Report* 458. Retrieved from: https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr458_July_2010_version.pdf

Pozsar, Z., T. Adrian, A. Ashcraft, and H. Boesky (2013). Shadow banking. *Federal Reserve Bank New York Policy Review*, December: 1-16. Retrieved from: <https://www.newyorkfed.org/medialibrary/media/research/epr/2013/0713adri.pdf>

Prasad, E.S. (2021). *The Future of Money: How the Digital Revolution Is Transforming Currencies and Finance*. Cambridge (MA): Harvard University Press.

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon* 9(5): 1-6. <https://doi.org/10.1108/10748120110424816>

Prescott, E.C., and R. Wessel (2016). Monetary Policy with 100 Per Cent Reserve Banking: An Exploration. *NBER Working Paper* 22431. Retrieved from: <https://www.nber.org/papers/w22431>.

Quiggin, A.H. (1949). *A Survey of Primitive Money: The Beginning of Currency*. London: Methuen.

Quinn, S. (1997). Goldsmith-banking: mutual acceptance and interbanker clearing in restoration London. *Explorations in Economic History* 34: 411–432. <https://doi.org/10.1006/exeh.1997.0682>

Quinn, S., and W. Roberds (2014). How Amsterdam got fiat money. *Journal of Monetary Economics* 66: 1–12. <https://doi.org/10.1016/j.jmoneco.2014.03.004>

Radar (2019). Groot draagvlak voor Nederlandse staatsbank. *Research results*. Available at: <https://radar.avrotros.nl/testpanel/uitslagen/item/groot-draagvlak-voor-nederlandse-staatsbank/> (accessed 30 August 2019).

Ravn, I. (2015). Explaining money creation by commercial banks: Five analogies for public education. *Real-World Economics Review* 71: 92–112. Retrieved from: <http://www.paecon.net/PAEReview/issue71/Ravn71.pdf>

Raworth, K. (2017). *Doughnut Economics*. London: Random House Business Books.

Reid, J., and C. Nicol (2017). The Future of money part 1 – The start of the end of fiat money? *Deutsche Bank Market Research, Thematic Research* 1 November 2017.

Reid, J., C. Nicol, N. Burns, and S. Chanda (2017). The next financial crisis. *Deutsche Bank Market Research, Long-Term Asset Return Study* 18 September 2018.

Reinhart, C.M., and K.S. Rogoff (2009). *This Time Is Different: Eight Centuries of Financial Folly*. Princeton, NJ: Princeton University Press.

Reinhart, C.M., and K.S. Rogoff (2013). Banking crises: an equal opportunity menace. *Journal of Banking & Finance* 37: 4557–4573. <https://doi.org/10.1016/j.jbankfin.2013.03.005>

Rethinking Economics (2019). Rethinking the role of banks in economics education. *Open letter*. Available at: <http://www.rethinkeconomics.org/journal/open-letter-rrob/> (accessed 3 January 2020).

Ricardo, D. (1823 [1951]). *The Works and Correspondence of David Ricardo. Volume 4: Pamphlets and Papers 1815–1823*. Cambridge: Cambridge University Press.

Ricks, M. (2016). *The Money Problem: Rethinking Financial Regulation*. Chicago/ London: The University of Chicago Press.

Ricks, M., J. Crawford, and L. Menand (2018). A public option for bank accounts (or central banking for all). *Vanderbilt Law Research Paper* 18-33, *UC Hastings Research Paper* 287, revised version December 2. <http://dx.doi.org/10.2139/ssrn.3192162>

Rogoff, K.S. (2016). *The Curse of Cash*. Princeton: Princeton University Press.

Rolnick, A.J., and W.E. Weber (1985). Inherent instability in banking: the free banking experience. *Federal Reserve Bank of Minneapolis Working Paper* 275. Retrieved from: <https://www.minneapolisfed.org/research/working-papers/inherent-instability-in-banking-the-free-banking-experience>

Romer, P. (2016). The trouble with macroeconomics. *Paper*, 14 September. Available at: <https://paulromer.net/wp-content/uploads/2016/09/WP-Trouble.pdf> (accessed 29 January 2017).

Roth, F., L. Jonung, and F.D. Nowak-Lehmann (2016). Crisis and public support for the Euro, 1990–2014. *Journal of Common Market Studies* 54(4): 944–60.

Ryan-Collins, J., T. Greenham, R. Werner, and A. Jackson (2011). *Where Does Money Come From? A Guide to the UK Monetary System and Banking System*. London: New Economics Foundation.

Ryan-Collins, J. (2016). Credit creation, monetary policy and the macroeconomy: three empirical studies. *PhD thesis University of Southampton*.

Ryan-Collins, J., and F. van Lerven (2018). Bringing the helicopter to ground: A historical review of fiscal-monetary coordination to support economic growth in the 20th century. *Institute for Innovation and Public Purpose Working Paper* 2018-08.

Rubin, H.J., and I.S. Rubin (2012). *Qualitative Interviewing: The Art of Hearing Data*. Thousand Oaks: Sage Publications.

Sanders, M. (2019). Privatiseren banken hard nodig. *ESB Special Nieuw Geld* 104(4769): 28-31, 17 January.

Santander InnoVentures (2015). Rebooting financial services. *The Fintech 2.0 Paper*. Available at: <http://santanderinnoventures.com/wp-content/uploads/2015/06/The-Fintech-2-0-Paper.pdf> (accessed 30 August 2019).

Schapiro, M.L. (2010). Testimony concerning the Lehman Brothers examiner's report. *Testimony before the House Financial Services Committee*, April 10. Available at: <https://www.sec.gov/news/testimony/2010/ts042010mls.htm> (accessed 5 October 2018).

Schaps, D.M. (2004). *The Invention of Coinage and the Monetization of Ancient Greece*. Michigan: The University of Michigan Press.

Schaps, D.M. (2006). The invention of coinage in Lydia, in India, and in China. *XIV International Economic History Congress, Helsinki*, session 30. Available at: <http://www.helsinki.fi/iehc2006/papers1/Schaps.pdf> (accessed 6 March 2016).

Schelling, T.C. (1980). *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.

Schjacht, H. (1967). *The Magic of Money*. Translated by Erskin, P. London: Oldbourne book.

Schmandt-Besserat, D. (1992). *Before Writing, Volume I: From Counting to Cuneiform*. Austin: University of Texas Press.

Schmandt-Besserat, D. (2012). Tokens as precursors of writing. In Grigorenko, E.L., E. Mambrino, and D.D. Preiss (Eds.) (2012). *Writing: A Mosaic of New Perspectives*. New York/ London: Psychology Press, pp 3-10.

Schularick, M., and A. M. Taylor (2012). Credit booms gone bust: monetary policy, leverage cycles, and financial crises, 1870-2008. *American Economic Review*, 102(2): 1029-61. <https://doi.org/10.1257/aer.102.2.1029>

Schumpeter, J. A. 1917. Das Sozialprodukt und die Rechenpfennige, *Archiv für Sozialwissenschaft und Sozialpolitik*, vol. 44, 627–715, transl. by A. Marget (1956) as ‘Money and the Social Product’, *International Economic Papers*, vol. 6, 148–211.

Schumpeter, J.A. (1934). *The Theory of Economic Development*. Cambridge, MA: Harvard University Press.

Schumpeter, J.A (1939). *Business cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process*. New York: McGraw-Hill.

Schumpeter, J.A. (1942 [1994]). *Capitalism, Socialism and Democracy*. London: Routledge.

Schumpeter, J.A. (1954 [1994]). *History of economic analysis*. New York: Oxford University Press.

Schwartz, A.J. (1987). Real and pseudo-financial crises. In Schwartz, A.J. (Ed.) (1987). *Money in Historical Perspective*. Chicago: Chicago University Press, pp 271-288.

Scorer, S. (2017). Beyond blockchain: what are the technology requirements for a Central Bank Digital Currency? *Bank Underground Blog*, September 13. Available at: <https://bankunderground.co.uk/2017/09/13/beyond-blockchain-what-are-the-technology-requirements-for-a-central-bank-digital-currency/> (accessed 8 December 2017).

SEC (2008). Chairman Cox letter to Basel Committee in support of new guidance on liquidity management. *Release 2008-48*. Retrieved from: <https://www.sec.gov/news/press/2008/2008-48.htm>

Semenova, A. (2009). Veblen's cumulative causation and the origins of money in Mesopotamia. In Berger, S. (ed.) (2009). *The Foundations of Non- Equilibrium Economics*. London and New York: Routledge, 178–194.

Semenova, A. (2011). The origins of money: evaluating chartalist and metallist theories in the context of Ancient Greece and Mesopotamia. *Dissertation in Economics and Social Science*. Kansas City (MO): University of Missouri-Kansas City. Retrieved from: <https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/10843/SemenovaOriMonEva.pdf>

Seyfang, G., and N. Longhurst (2013). Growing green money? Mapping community currencies for sustainable development. *Ecological Economics* 86: 65–77. <https://doi.org/10.1016/j.ecolecon.2012.11.003>

Sgambati, S. (2016). Rethinking banking. Debt discounting and the making of modern money as liquidity. *Journal of New Political Economy* 21(3): 274-290. <https://doi.org/10.1080/13563467.2016.1113946>

Sheard, P. (2013). Repeat after me: banks cannot and do not “lend out” reserves. *Standard&Poor's RatingsDirect Economic Research Report*, 13 August. Available at: <https://issuu.com/positivemoney/docs/sp-banks-cannot-and-do-not-lend-out> (accessed 30 August 2019).

Sifma (2020). Capital Markets Fact Book. *Report*, September. Available at: <https://www.sifma.org/wp-content/uploads/2020/09/US-Fact-Book-2020-SIFMA.pdf> (accessed 23 February 2021)

Sigurjonsson, F. (2015). Monetary Reform - A netter monetary system for Iceland. *Report commissioned by the Prime Minister of Iceland*. Available at: <http://eng.forsaetisraduneyti.is/media/Skyrslur/monetary-reform.pdf> (accessed 9 February 2017).

Simon, H. A. (1996). *The Sciences of the Artificial*. Cambridge (MA): MIT Press.

Simons, H. C. (1936). Rules versus authorities in monetary policy. *Journal of Political Economy* 44(1): 1-30. <http://dx.doi.org/10.1086/254882>

Simons, H., G. Cox, A. Director, P. Douglas, A. Hart, F. Knight, L. Mints & H. Schultz (1933). Banking and currency reform. Manuscript. [Reprinted in Samuels, W. (ed.) (1990). *Research in the History of Economic Thought and Methodology*. Archival Supplement, Volume 4. Greenwich, CT: JAI Press.

Skidelsky, R. (2015). What's wrong with economics? *Paper Institute for New Economic Thinking* April 2015. Available at: <https://www.ineteconomics.org/research/research-papers/whats-wrong-with-economics> (accessed 7 August 2018).

Skidelsky, R. (2018). *Money and Government. The Past and Future of Economics*. New Haven and London: Yale University Press.

Skingsley, C. (2016). Should the Riksbank issue e-krona? *Speech at FinTech Stockholm* 2016, 16 November. Available at: <https://www.bis.org/review/r161128a.pdf> (accessed 2 February 2017).

Smith, A. (1776 [1991]). *Wealth of Nations*. New York: Prometheus Books.

Soddy, F. (1926). *Wealth, Virtual Wealth and Debt: The Solution of the Economic Paradox*. London: George Allen & Unwin.

St. Louis Fed (2017). Financial crisis timeline. Available at: <https://www.stlouisfed.org/financial-crisis/full-timeline> (accessed 30 August 2019).

Stevens, A. (2017). Digitaal geld: bedreigingen en kansen voor het monetair beleid. *NBB Economisch Tijdschrift*, juni 2017: 79-93. Available at: https://www.nbb.be/doc/ts/publications/economic-review/2017/ecotijdi2017_h5.pdf (accessed 30 August 2019).

Stiglitz, J.E. (2011). A balanced debate about reforming macroeconomics. *Huffington Post Blog*, 25 May. Available at: https://www.huffingtonpost.com/joseph-e-stiglitz/a-balanced-debate-about-r_b_839078.html?guccounter=1 (accessed 12 March 2016).

Stiglitz, J.E. (2016a). *The Euro: How a Common Currency Threatens the Future of Europe*. London: Allen Lane.

Stiglitz, J.E. (2016b). The theory of credit and macro-economic stability. *NBER Working paper* 22837. Retrieved from: <https://www.nber.org/papers/w22837.pdf>

Stiglitz, J.E. (2017a). Macro-economic management in an electronic credit/financial system. *NBER Working paper* 23032. Retrieved from: <https://www.nber.org/papers/w23032.pdf>

Stiglitz, J.E. (2017b). Where modern macroeconomics went wrong. *NBER Working paper* 23795. Retrieved from: <https://www.nber.org/papers/w23795.pdf>

Stolte, L. (2017). The Bank of England: a dialectical project. *Master Thesis Delft University of Technology*.

Sveriges Riksbank (2017). The Riksbank's e-krona project. *Report 1*, September. Retrieved from: https://www.riksbank.se/globalassets/media/rapporter/e-krona/2017/rapport_ekrona_uppdaterad_170920_eng.pdf

Sveriges Riksbank (2018). The Riksbank's e-krona project. *Report 2*, October. Retrieved from: <https://www.riksbank.se/globalassets/media/rapporter/e-krona/2018/the-riksbanks-e-krona-project-report-2.pdf>

Taibbi, M. (2009). How Wall Street is using the bailout to stage a revolution. *Rolling Stone*, April 2, 2009. Available at: <https://www.rollingstone.com/politics/politics-news/how-wall-street-is-using-the-bailout-to-stage-a-revolution-177251/>

Thakor, A.V. (2015). The financial crisis of 2007–2009: Why did it happen and what did we learn? *Review of Corporate Finance Studies* 4(2): 155-205. <https://doi.org/10.1093/rcfs/cfv001>

The Wall Street Journal (2018). How Can the Field of Economics Diversify? Here Are Janet Yellen's Thoughts. *Blog* 2 November. Available at: <https://blogs.wsj.com/economics/2018/11/02/how-can-the-field-of-economics-diversify-here-are-janet-yellens-thoughts/> (accessed 14 November 2018)

Thornton, D. (2012). Monetary policy: why money matters and interest rates don't. *Federal Reserve Bank of St. Louis Working Paper* 2012-020A. Retrieved from: <https://files.stlouisfed.org/files/htdocs/wp/2012/2012-020.pdf>

Thornton, D. (2014). Monetary policy: Why money matters (and interest rates don't). *Journal of Macroeconomics* 40(C): 202-213. <https://doi.org/10.1016/j.jmacro.2013.12.005>

Thornton, H. (1802). *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain*. London: Hatchard.

Tieleman, J., De Muijnck, S., Kavelaars, M., & Ostermeijer, F. (2018). Thinking like an economist? A quantitative analysis of bachelor curricula in The Netherlands. *Rethinking Economics Report*. Available at: http://www.rethinkingeconomics.nl/uploads/5/3/2/2/53228883/thinking_like_an_economist.pdf (accessed 26 July 2018).

Tobin, J. (1985). Financial innovation and deregulation in perspective. *Bank of Japan Monetary and Economic Studies* 3(2): 19–29.

Tobin, J. (1987). The case for preserving regulatory distinctions. In Federal Reserve Bank of Kansas City (ed.): *Restructuring the Financial System*. Kansas City: Federal Reserve Bank of Kansas City, 167-183.

Tooze, A. (2018). *Crashed: How a Decade of Financial Crisis Changed the World*. London: Alan Lane.

Tucker, P. (2019a). Is the financial system sufficiently resilient: a research programme and policy agenda. *BIS Working Paper* 792, June.

Tucker, P. (2019b). *The Quest for Legitimacy in Central Banking and the Regulatory State*. Princeton: Princeton University Press.

Turner, A. (2012a). Credit creation and social optimality. *International Review of Financial Analysis* 25: 142-153. <https://doi.org/10.1016/j.irfa.2012.09.004>

Turner, A. (2012b). *Economics after the Crisis: Objectives and Means*. Cambridge, MA: MIT Press.

Turner, A. (2013). Credit, money and leverage: what Wicksell, Hayek and Fisher knew and modern macroeconomics forgot. *Conference Towards a Sustainable Financial System*, Stockholm School of Economics, 12 September. Available at: <https://cdn.evbu.com/eventlogos/67785745/turner.pdf> (accessed 2 October 2015).

Turner, A. (2016). *Between Debt and the Devil: Money, Credit, and Fixing Global Finance*. Princeton/ Oxford: Princeton University Press.

Tymoigne, E., and L.R. Wray (2005). Money: an alternative story. *Working Paper* 45. <https://dx.doi.org/10.2139/ssrn.1009611>

Tymoigne, E. (2014). Modern money theory, and interrelations between the treasury and central bank: the case of the United States. *Journal of Economic Issues* 48(3): 641-662. <https://doi.org/10.2753/JEI0021-3624480303>

Valencia, F., and L. Laeven (2012). Systemic banking crises database: an update. *IMF Working Paper* 12/163. Retrieved from: <https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Systemic-Banking-Crises-Database-An-Update-26015>

Van de Mieroop, M. (1992). *Society and Enterprise in old Babylonian Ur*. Berlin: Dietrich Reimer Verlag.

Van de Mieroop, M. (2014). Silver as a Financial Tool in Ancient Egypt and Mesopotamia. In Bernholz P., and R. Vaubel (eds) (2014). *Explaining Monetary and Financial Innovation*. Financial and Monetary Policy Studies 39, Springer International Publishing, pp 17-29.

Van der Linden, M.J., and C. van Beers (2017). Are private (digital) moneys (disruptive) social innovations? An exploration of different designs. *Journal of Social Entrepreneurship* 8(3): 302-319. <https://doi.org/10.1080/19420676.2017.1364287>

Van Dixhoorn, C. (2013). Full reserve banking: an analysis of four monetary reform plans. *Report*. Utrecht: Sustainable Finance Lab. Available at: <https://sustainablefinancelab.nl/wp-content/uploads/sites/334/2019/02/Full-Reserve-Banking-Dixhoorn-SFL.pdf> (accessed 30 August 2019).

Van Egmond, N.D., and B.J.M de Vries (2016). Monetary reform; dynamics of a sustainable financial-economic system. *Working Paper Utrecht University*, March. Retrieved from: https://www.uu.nl/sites/default/files/monetaire_hervorming_sfl-wp_maart_2016.pdf

Van Egmond, N.D., and B.J.M de Vries (2018). Monetary reform; dynamics of a sustainable financial-economic system. *Working Paper Utrecht University*, May. Retrieved from: <https://www.klaas-vanegmond.nl/wp-content/uploads/2018/05/Summary-WP-Egmond-de-Vries-may-2018.pdf>

- Van 't Klooster, J. (2017). How to make money: Distributive justice, finance, and monetary constitutions. *Submitted PhD Dissertation Gonville and Caius College*, November. Retrieved from: <https://www.repository.cam.ac.uk/bitstream/handle/1810/274911/Klooster-2018-PhD.pdf?sequence=1&isAllowed=y>
- Van 't Klooster, J. (2021). The political economy of central bank risk management. *PhD Dissertation*, University of Groningen.
- Visser, H., and L. van Goor (1997). *Inleiding tot het geld- en bankwezen*. Schoonhoven: Academic Service.
- Volkskrant (2018). De Zweedse e-krona: een munt voor onder je digitale matras. *Article*. Available at: <https://www.volkskrant.nl/economie/de-zweedse-e-krona-een-munt-voor-onder-je-digitale-matras-b6d69c28/> (accessed 30 August 2019).
- Von Mises, L. (1912 [1980]). *The Theory of Money and Credit*. Indianapolis (IN): Liberty Classics.
- Wallis, J. (2015). Structure and change in economic history: The ideas of Douglass North. *Voxeu Article*, 27 November. Available at (accessed 17 August 2021): <https://voxeu.org/article/ideas-douglass-north>
- Washington Post (2010). Former Bear Stearns executives blame collapse on 'self-fulfilling prophecy'. *Article* May 6. Available at: <http://www.washingtonpost.com/wp-dyn/content/article/2010/05/05/AR2010050505104.html?noredirect=on> (accessed 5 October 2018).
- Werner, R.A. (2012). Towards a new research programme on 'banking and the economy'— Implications of the Quantity Theory of Credit for the prevention and resolution of banking and debt crises. *International Review of Financial Analysis* 25: 1-17. <https://doi.org/10.1016/j.irfa.2012.06.002>
- Werner, R.A. (2014a). Can banks individually create money out of nothing? – The theories and the empirical evidence. *International Review of Financial Analysis* 36: 1-19. <https://doi.org/10.1016/j.irfa.2014.07.015>
- Werner, R.A. (2014b). How do banks create money, and why can other firms not do the same? An explanation for the coexistence of lending and deposit-taking. *International Review of Financial Analysis* 36: 71-77. <https://doi.org/10.1016/j.irfa.2014.07.015>
- Werner, R.A. (2016). A lost century in economics: Three theories of banking and the conclusive evidence. *International Review of Financial Analysis* 46: 361-379. <https://doi.org/10.1016/j.irfa.2015.08.014>
- White, L.H. (1995). *Free Banking in Britain. Theory, Experience and Debate, 1800-1845*. London: The Institute of Economic Affairs.
- Wicksell, K. (1898 [1962]). Interest and Prices. New York: Sentry Press. Available at: https://mises-media.s3.amazonaws.com/Interest%20and%20Prices_2.pdf?file=1&type=document (accessed 29 August 2018).
- Wigglesworth, R., and J. Rennison (2018). Bond trading: technology finally disrupts a \$50tn market. *Financial Times*, May 9. Available at: <https://www.ft.com/content/67e48ae4-4fab-11e8-9471-a083af05aea7> (accessed 23 February 2021).

- Wigglesworth, R. (2021). Bond trading finally dragged into the digital age. *Financial Times*, February 22. Available at: <https://www.ft.com/content/683effc4-993a-4baf-bc17-8ba70b96c06a?shareType=nongift> (accessed 23 February 2021).
- Williamson, O. (1979). Transaction-cost economics: the governance of contractual relations. *The Journal of Law and Economics*, 22(2), 233-261.
- Williamson, O. (1981). The economics of organization: The transaction cost approach. *American Journal of Sociology*, 87(3), 548-577.
- Withers, H. (1914). *The Meaning of Money*. New York: Dutton.
- Wolf, M. (2014). *The Shifts and the Shocks: What we've learned – and still have to learn – from the financial crisis*. London: Allen Lane.
- Wolf, M. (2018). Why so little has changed since the financial crash. *Financial Times*, September 4.
- World Bank (2019). Market capitalization of listed domestic companies (current US\$). World Bank Data. Available at: <https://data.worldbank.org/indicator/CM.MKT.LCAP.CD> (accessed 16 November 2020).
- Wortmann, E. (2016). A proposal for radical monetary reform. *Paper for conference International Society for the Intercommunication of New Ideas*, August. Available at: https://onsgeld.nu/onsgeld/2016/wortmann_radical_monetary_reform.pdf (accessed 9 February 2017).
- Wortmann, E. (2017). Deleverage without a crunch. *Draft Working Paper Ons Geld*. Available at: https://onsgeld.nu/onsgeld/2017/deleverage_without_crunch.pdf (accessed 17 October 2017).
- Wortmann, E. (2018). What is debt free money? *Working Paper Ons Geld* version 20180614. Available at: https://onsgeld.nu/wp-content/uploads/20180614_what_is_debt_free_money.pdf (accessed 2 December 2018).
- Wray, L.R. (2012). *Modern Money Theory. A Primer on Macroeconomics for Sovereign Monetary Systems*. London: Palgrave MacMillan.
- Wray, L.R. (1998). *Understanding Modern Money: The Key to Full Employment and Price Stability*. Cheltenham: Edward Elgar.
- Wray, L.R. (2015a). Debt-free money and banana republics. *New Economic Perspective Blog*, 19 December. Available at: <http://neweconomicperspectives.org/2015/12/debt-free-money-banana-republics.html> (accessed 18 January 2017).
- Wray, L.R. (2015b). Minsky on banking: Early work on endogenous money and the prudent banker. *Levy Economics Institute Working Paper* 827. Retrieved from: http://www.levyinstitute.org/pubs/wp_827.pdf
- WRR (2019). *Geld en Schuld. De Publieke Rol van Banken*. Den Haag: Wetenschappelijke Raad voor het Regeringsbeleid. Retrieved from: <https://www.wrr.nl/binaries/wrr/documenten/rapporten/2019/01/17/geld-en-schuld---de-publieke-rol-van-banken/rapport-100-geld-en-schuld-de-publieke-rol-van-banken.pdf>

Yamaguchi, K. (2010). On the Liquidation of Government Debt under a Debt-Free Money System: Modelling the American Monetary Act. *Paper presented at the 28th International Conference of the System Dynamics Society*, Seoul, Korea, 26 July. Available at: <https://bs.doshisha.ac.jp/attach/page/BUSINESS-PAGE-JA-53/26832/file/DBS-10-01.pdf>

Yamaguchi, K. (2011). Workings of a Public Money System of Open Macroeconomies: Modelling the American Monetary Act Completed. *Paper presented at the 7th Annual AMI Monetary Reform Conference*, Chicago, USA, 30 September. Revised version available at: <http://www.muratopia.org/Yamaguchi/doc/DesignOpenMacro.pdf>

Yamaguchi, K. (2014). *Money and Macroeconomic Dynamics: Accounting System Dynamics Approach*. Second Edition. Awaji Island, Japan: Japan Futures Research Center.

Yamaguchi, Y. & K. Yamaguchi (2016a). Head and tail of money creation and its system design failures. *JFRC Working Paper* No. 01-2016. Retrieved from: www.muratopia.net/research/papers/Head-and-Tail-2016%28WP%29.pdf

Yamaguchi, Y. & K. Yamaguchi (2016b). Peer-to-peer public money system. *JFRC Working Paper* No. 02-2016. Retrieved from: www.muratopia.net/research/papers/P2P-PM-System%28WP%29.pdf

Yamaguchi, Y. & K. Yamaguchi (2017). Peer-to-peer public money system. *Paper*. Retrieved from: <http://muratopia.org/Yamaguchi/doc/P2P-PM-System.pdf>

Yao, Q. (2018). A systematic framework to understand central bank digital currency. *Science China Information Sciences* 61: 033101. <https://doi.org/10.1007/s11432-017-9294-5>

Yellen, J.L. (2017). Inflation, uncertainty and monetary policy. *Speech at 59th annual meeting of the National Association for Business Economics*, 26 September, Cleveland, Ohio. Available at: <https://www.federalreserve.gov/newsevents/speech/yellen20170926a.htm> (accessed 7 January 2018).

Zarlenga, S. A. (2002). *The Lost Science of Money*. Valatie: American Money Institute.

Appendix

Appendix I: Protocol evaluation

Table A-1 presents the evaluated aspects and the comments of the researcher.

Table A-1: Protocol evaluation

	Aspect	Feedback
Interview Protocol Structure	The questions are relevant to answer research questions e) and f) and the general research question.	The questions have a good focus on the central issue of the thesis, worded in the two interconnected problems.
	The interview protocol has smooth transitions between topic areas.	
	Overall, interview is organized to promote conversational flow. The questions are logically structured.	The interview is easy build up for conversation. See my suggestions for changing the structure.
Writing of Interview Questions	Questions are concise.	Questions are structured in one strong sentence, where needed complemented with a short question to keep the question open or for explanation of the answer.
	Questions are easy to understand.	Surely for the experts to be interviewed. Questions are written in a clear voice and in accordance with the argumentation of the thesis presented in the summary send to the interviewees.
	Questions are free from spelling error(s).	Will be ok in the end.
	Questions are mostly open ended.	Half of the questions is fully open ended, the other half is open, but focusing on the topic in discussion.
	Questions are written in a non-judgmental manner.	The experts-interviewees will recognize the case the thesis is making, but they are not pressed into any direction.
Length of Interview Protocol	All questions are needed.	The questions at the start easily can take too much time. If they can be put and answered beforehand in written form, this will be preferable.
	The questions can be discussed within 60 minutes.	Questionable, it will be very easy to spend more time on them. Make it possible to lengthen the interview with 30 minutes, in accordance with the interviewee.

Appendix II: Interview protocols

Table A-2 present the Dutch interview protocols that were used for the interviews in the first round in the Netherlands.

Table A-2: Dutch interview protocol first round of interviews.

Introductie

Bedankt voor het accepteren van de uitnodiging. Het doel van dit interview is evaluatie van enkele uitkomsten van mijn proefschrift. In mijn onderzoek gebruik ik design science om het ontwerp van het monetair-financieel systeem in het digitale tijdperk te onderzoeken. Ik onderzoek hoe digitale technologieën als internet en distributed ledger technology gebruikt kunnen worden om op lange termijn de belangrijkste tekortkomingen van het huidige systeem op te lossen en nieuwe vormen van geld te ontwikkelen. De lange termijn staat dus centraal. Het is een nieuw onderwerp met een binnen de economische wetenschap nieuwe methodologie.

Introductie vragen

Ik zou graag ons gesprek opnemen. De opnames worden niet gepubliceerd. Dit gesprek is dus anoniem. Na het interview zal ik binnen een week een transcript maken. Je ontvangt dit transcript met de vraag het binnen twee weken te valideren. Het gevalideerde transcript wordt vervolgens gebruikt voor de kwalitatieve data-analyse.

Ga je akkoord met het opnemen van dit gesprek?

Ja/ Nee

Indien ja: Dank je wel. Laat a.u.b. weten als er een moment komt dat je de opnames wilt stoppen.

Indien nee: Dank je wel. Ik maak enkel aantekeningen van dit gesprek.

Voordat we het interview beginnen, heb je nog vragen?

Kernvragen

Dan starten we met de vragenlijst. De eerste vraag is

IQ1) Ben je bekend met de bank theorieën fractional reserve banking, full reserve banking en free banking? Zo ja, heb je een voorkeur? En waarom?

De volgende vragen betreffen de problemen van het huidige ontwerp van het monetair-financieel systeem. In mijn onderzoek definieer ik twee problemen. Het eerste

probleem is de by design fragiliteit van het monetair systeem. Het systeem is fragiel omdat fragiele vormen van geld, te weten bankdeposito's en geldmarktinstrumenten, domineren.

IQ2) Hoe zie jij het probleem van fragiliteit?

Ik beschrijf vervolgens de opkomst van een vicieuze cirkel van steeds meer en steeds complexere regelgeving. Fragiel vormen van geld kunnen enkel bestaan met vangnetten. De twee bekendste zijn de centrale bank als lender-of-last-resort en het depositogarantiestelsel. Enerzijds werken deze vangnetten goed. Anderzijds veroorzaken ze morele risico's. Om deze morele risico's te beperken is regelgeving nodig. Het probleem is echter dat vrijwel elke regel nieuwe morele risico's met zich meebrengt en dus indirect de noodzaak tot meer regelgeving.

IQ3) Hoe zie jij de toenemende hoeveelheid steeds complexere regelgeving? Is het een probleem? Indien ja, wat zijn de gevolgen?

In mijn onderzoek leg ik uit dat digitale technologieën beide hebben verergerd. De afgelopen decennia zijn we steeds afhankelijker geworden van fragiele vormen van geld. Bankdeposito's en geldmarktinstrumenten zijn gedigitaliseerd en by design stabiel contant geld niet. Hierdoor is steeds meer regelgeving nodig. Daarnaast heeft de toepassing van digitale technologieën in bankieren en finance het grensprobleem van financiële regelgeving in het Nederlands verergerd. De mobiliteit van geld en leningen is door digitale technologieën toegenomen. Dit maakt regulering lastiger.

IQ4) Hoe zie jij de invloed van de toepassing van digitale technologieën in bankieren en finance op monetaire fragiliteit en regelgeving?

In mijn proefschrift maak ik onderscheid tussen drie soorten liquiditeit: marktliquiditeit, inherente liquiditeit en contractuele liquiditeit. Marktliquiditeit is gebaseerd op vraag en aanbod. Inherente liquiditeit is de liquiditeit die contant geld biedt en is gebaseerd op een afspraak. Contractuele liquiditeit wordt gedefinieerd als de verplichting van de uitgever van bankdeposito's en sommige geldmarktinstrumenten, om op verzoek tegen pariteit het ene geld in te wisselen voor een andere geldsoort. Met andere woorden, de wisselkoers is vastgesteld; er is geen marktprijsvorming. Op basis van empirische data en een analyse van getuigenissen van bankiers en toezichhouders na de financiële crisis van 2007-9 concludeer ik dat contractuele liquiditeit de oorzaak is van financiële systeem crises en de vicieuze cirkel van steeds meer en steeds complexere regelgeving?

IQ5) Hoe zie jij dit? Ben je het hiermee eens?

Op basis van een uitgebreide literatuurstudie formuleer ik vervolgens eisen voor het monetair-financieel systeem. Dit was niet gemakkelijk vanwege het bestaan van verschillende theorieën in de economische wetenschap. Bijvoorbeeld, de theorieën van fractional reserve banking, free bankieren en full reserve banking conflicteren soms. Nu zou ik graag kort uw mening horen over elk van de volgende acht eisen.

Lees requirement op en vraag:

IQ6) Ben je het ermee eens?

Requirements

- R1 The government must ensure at least one public unit of account.
- R2 The government must ensure at least one public currency.
- R3 The government must ensure that the public currency has as low as possible costs.
- R4 Private currencies must be allowed as competitors, discipliners, and backup systems.
- R5 The government must ensure at least/ only the public currency for tax payments.
- R6 The government must ensure that the public currency offers stable settlement power.
- R7 The government must ensure that the Monetary Authority is independent of the government.
- R8 Legal entities must be allowed to issue securities, to establish credit-debt relationships and to trade securities, credits, and debts.

In mijn proefschrift formuleer ik ook ontwerprichtlijnen. Deze richtlijnen moeten richting geven aan het ontwerp van het monetair-financieel systeem in het digitale tijdperk. De eerste richtlijn is: de publieke munt moet geleidelijk worden geupdate naar het digitale tijdperk; dat wil zeggen digitale inherente liquiditeit, digitaal contant geld, dient geleidelijk ontwikkeld en geïntroduceerd te worden.

IQ7) Wat is jouw mening over de ontwikkeling en geleidelijke invoering van digitaal contant geld?

Digitale technologieën maken niet enkel een nieuwe vorm van geld, digitaal contant geld, mogelijk maar hebben de afgelopen decennia ook geleid tot een aanzienlijke toename van marktliquiditeit. Tegenwoordig zijn enkel een mobiel apparaat en internet nodig om effecten en valuta te verhandelen. Deze ontwikkeling is de basis voor een andere ontwerprichtlijn: in het digitale tijdperk zou het financiële systeem meer (of zelfs volledig) gebaseerd moeten zijn op marktliquiditeit en minder (of zelfs niet) op contractuele liquiditeit. De reden is dat des te meer het financiële systeem gebaseerd is

op marktliquiditeit des te stabiel het is, des te beter risico en beloningen op een lijn liggen en des te minder vangnetten, regelgeving en overheidsinterventies nodig zijn.

Een mogelijkheid is contractuele liquiditeit geleidelijk te vervangen door inherente liquiditeit en marktliquiditeit in het digitale tijdperk.

IQ8) Denk je dat dit inderdaad op de lange termijn mogelijk is? Waarom of waarom niet?

Stel indien nodig controle vraag: Contractuele liquiditeit is volgens jou dus niet meer/ nog steeds nodig in het digitale tijdperk?

Het resultaat zou een monetair systeem zijn waarin publieke en private munten met elkaar concurreren en een geliberaliseerd systeem van financiële intermediatie. In zekere zin kan dit ontwerp worden beschouwd als een combinatie van full reserve banking en free banking voorstellen, geupdate naar het digitale tijdperk.

IQ9) Wat is jouw visie op competitie tussen publieke en private munten? Wat zijn de voordelen en nadelen?

Bankiers stellen vaak dat looptijdtransformatie de essentie van bankieren is. Door toegenomen marktliquiditeit, dat wil zeggen verhandelbaarheid van activa en passiva, lijkt dit in het digitale tijdperk steeds minder relevant. Financiële intermediairs kunnen immers altijd verhandelbare leningen, gesecuritiseerd of niet, financieren met altijd verhandelbare effecten, al dan niet getokeniseerd.

IQ10) Hoe zie jij de relevantie van looptijdtransformatie in het digitale tijdperk?

Toegevoegd na 3e interview: Is looptijdtransformatie mogelijk zonder steun van de staat?

Een nog onbeantwoorde vraag is of het mogelijk is om publieke en private aangelegenheden en verantwoordelijkheden in het monetair-financieel systeem in het digitale tijdperk volledig te scheiden. Een dergelijke scheiding werd al geopperd door de econoom van 'Het Chicago Plan' in de jaren 1930. Geregeld wordt bijvoorbeeld gezegd dat overheden falende financiële instellingen in geval van een crisis weer zullen redden omdat de kiezers dit willen.

IQ11) Is het volgens jou mogelijk publieke en private aangelegenheden en verantwoordelijkheden volledig te scheiden in het digitale tijdperk? Waarom of waarom niet? Wat nodig is?

Digitale technologieën bieden veel nieuwe kansen. Smart contracts maken bijvoorbeeld real-time belasting innen mogelijk.

IQ12) Welke technologische kansen bieden digitaal contant geld, digitale private munten en digitale getokeniseerde effecten op de lange termijn? Welke kansen en risico's zie je?

In het huidige systeem ligt de focus van financiële regulering op micro- en macroprudentieel toezicht. De vraag is of dit het meest zinvolle toezicht is. Digitale technologieën bieden daarnaast ook andere mogelijkheden.

IQ13) Waar zou de focus van financiële regulering op moeten liggen in het digitale tijdperk?

Vraag als het niet genoemd wordt: Wat denk je van volledig en onmiddellijke openbaarmaking van financiële en niet-financiële gegevens? Moet elke financiële intermediair verplicht worden een prospectus te publiceren? Dient de uitzondering betreffende prospectusplicht van banken te worden opgeheven?

Contractuele liquiditeit is dus de hoofdoorzaak van monetaire fragiliteit en financiële systeem crises.

IQ14) Betekent dit dan ook dat systeemcrises niet meer kunnen voorkomen als contractuele liquiditeit op lange termijn is vervangen? Waarom of waarom niet?

De eisen en ontwerprichtlijnen zijn vrij abstract en een probleem met alle voorstellen voor een meer fundamentele verandering van het monetair-financieel systeem is de praktische implementatie.

IQ15) Welke praktische stap of stappen moeten volgens jou als eerste worden genomen?

Eindvragen

Dank je wel. We hebben vrij veel onderwerpen besproken.

IQ16) Hebben we iets relevant gemist? Heb je nog een slotopmerking?

Eind

Bedankt voor je tijd. Het was waardevol. U ontvangt de transcriptie van ons gesprek binnen een week voor validatie.

Table A-3 present the Dutch interview protocols that were used for the interviews in the second round in the Netherlands.

Table A-3: Dutch interview protocol second round of interviews.

Introductie

Bedankt voor het accepteren van de uitnodiging. Het doel van dit interview is evalueren en aanscherpen de generieke ontwerprichtlijnen die zijn opgesteld in mijn PhD onderzoek. Mijn onderzoek en dit interview gaan over de lange termijn. Zowel het onderwerp van dit onderzoek, het design van het monetair-financieel systeem in het digitale tijdperk, als de methodologie, designwetenschap, zijn relatief nieuw, althans in de economische wetenschap. Vanwege de nieuwheid vindt evaluatie plaats via twee rondes van interviews. In de eerste ronde zijn 21 experts geïnterviewd. In de tweede ronde zullen 7 experts worden geïnterviewd.

Generieke ontwerprichtlijnen wordt vaak geformuleerd om bij te dragen aan oplossingen voor complexe problemen. De richtlijnen zijn bedoeld om richting te geven. Ze bieden dus geen direct beschikbare oplossing voor problemen en zijn ook geen blauwdruk.

Introductievragen

Heb je het document dat ik je stuurde gelezen?

Indien nee: Licht het document toe en bespreek het in ongeveer 15 minuten.

Indien ja: Heb je nog vragen over het document?

Ik zou graag ons gesprek opnemen. De opnames worden niet gepubliceerd. Dit gesprek is dus anoniem. Na het interview zal ik binnen een week een transcript maken. Je ontvangt dit transcript met de vraag het binnen twee weken te valideren. Het gevalideerde transcript wordt vervolgens gebruikt voor de kwalitatieve data-analyse.

Vind je het goed als ik het gesprek opneem?

Indien ja: Dank je wel. Laat a.u.b. weten als er een moment komt dat je de opnames wilt stoppen.

Indien nee: Dank je wel. Ik maak enkel aantekeningen van dit gesprek.

Voor we het interview beginnen, heb je nog vragen?

Hoofdvragen

Dan starten we met de vragenlijst. De eerste generieke ontwerprichtlijn is: de publieke munt dient geleidelijk gemoderniseerd te worden naar het digitale tijdperk; dat wil zeggen, digitale inherente liquiditeit dient geleidelijk ontwikkeld en ingevoerd te worden.

IQ1) Wat is jouw visie op deze richtlijn?

De tweede generieke ontwerprichtlijn is: in het digitale tijdperk dient het financiële systeem meer (of zelfs volledig) gebaseerd te zijn op marktliquiditeit en minder (of zelfs niet) op contractuele liquiditeit; des te meer het systeem is gebaseerd op marktliquiditeit, des te stabielier het systeem is, des te beter risico en de beloningen op een lijn liggen en des te minder vangnetten, regels en overheidsinterventies nodig zijn.

IQ2) Wat is jouw visie op deze richtlijn?

De derde generieke ontwerprichtlijn is: In het digitale tijdperk dient financiële regelgeving zich meer of veel zelfs meer te richten op het verbeteren van transparantie en het beschermen van consumenten en beleggers en minder of zelfs veel minder op microprudentiële eisen.

IQ3) Wat is jouw visie op deze richtlijn?

Op de lange termijn zou het (theoretische) resultaat van de generieke ontwerprichtlijnen een monetair systeem zijn waarin publieke en private munten met elkaar concurreren en een geliberaliseerd systeem van financiële intermediatie. In zekere zin kan dit ontwerp worden beschouwd als een combinatie van de voorstellen voor full reserve banking en free banking bijgewerkt naar het digitale tijdperk.

IQ 4) Wat is jouw visie op competitie tussen publieke en private munten?

IQ 5) Wat is jouw visie op de waarschijnlijkheid van financiële systeemcrises in een dergelijk systeem?

De experts in de eerste interviewronde noemden drie nieuwe risico's. Het eerste risico is dat een private munt of effect erg groot wordt. Het tweede risico zijn technologische problemen zoals bugs en hacks van de publieke digitale munt. Het derde risico is mismanagement van de publieke digitale munt.

IQ 6) Wat is jouw visie op deze risico's? En zie je andere risico's?

Een open vraag is of het mogelijk is om publiek en privaat volledig te scheiden in het digitale tijdperk. In de eerste ronde van interviews noemden experts vier voorwaarden

om een volledige scheiding te realiseren:

1. De beschikbaarheid van voldoende reserves van run-proof digitale inherente liquiditeit in de samenleving en een veilig digitaal en fysiek betalingssysteem. Dit is in overeenstemming met generieke ontwerprichtlijn 1.
2. Toezicht gericht op transparantie van risico's en bescherming van consumenten en beleggers. Dit is in overeenstemming met generieke ontwerprichtlijn 3.
3. De implementatie van stabiele tijdconsistente regels. Een optie is een wet die overheden en centrale banken verbiedt om financiële intermediairs te redden.
4. De implementatie van aanvullende regels om een volledige scheiding tot stand te brengen. Bijvoorbeeld een belasting op contractuele liquiditeit of een verbod.

IQ 7) Wat is jouw visie op een volledige splitsing en deze condities? En zie je andere voorwaarden?

Slotvragen

Dank je wel.

IQ 8) Hebben we iets relevants gemist? Heb je nog een slotopmerking?

Slot

Bedankt voor je tijd. Het was waardevol. Je ontvangt het transcript van het interview binnen een week voor validatie.

Appendix III: Background document for interviews in second round

Second round of interviews with experts

PhD thesis ‘Eliciting generic design guidelines for the monetary and financial system in the digital age’

M.J. van der Linden (Delft University of Technology)

About this research

This PhD research applies design science to explore the possibilities of digital technologies in the long run for the design of the monetary and financial system. The topic of this research, the design of the monetary and financial system in the digital age, as well as the methodology, design science, are (relatively) novel, at least in economic science. Because of the novelty and the immaturity of the outcomes of this thesis, evaluation takes place via informed argument and two rounds of interviews with experts.

Generic design guidelines

The elicitation of generic design guidelines is often used to contribute to solutions to complex problems. This research on the one hand assumes that the monetary and financial system is designable but on the other hand admits that the system is highly complex and therefore difficult to design. The elicited guidelines in this thesis are meant to give direction.

About the researcher

Martijn van der Linden is a PhD candidate at Delft University of Technology. His research supervisors are prof. dr. Cees van Beers (professor of Innovation Management at Delft University of Technology) and prof. dr. ir. Marijn Janssen (professor ICT & Governance at Delft University of Technology).

About the interviews

The purpose of the second-round interviews is evaluation and refinement of the generic design guidelines (chapter 9). The interview consists of semi-structured questions. If you give permission, the interview will be recorded and transcribed. The transcription will be sent to you within a week. You will be asked to validate the transcripts within two weeks. After validation, the transcriptions will be used only for qualitative data analysis. The transcriptions will be anonymized and will not be published.

About this document

This document summarizes the thesis. To increase the effectiveness of the interview, the researcher recommends the interviewees to read the document in preparation to the interview.

Note: after the interviews the structure of part II has been changed.

Chapter 1: Background

Most of today's (monetary) economic theories, monetary legislations and central bank's mandates have been shaped before the emergence of internet, information, and communication technology (ICT), mobile devices, digitalization, distributed ledger technology and smart contracts. During the last three decades these digital technologies are not only leading to new forms of money and new consumption patterns but are also challenging the current monetary and financial system and its regulations. Moreover, these technologies appear to offer opportunities to improve the design of the monetary and financial system. The current design of the monetary and financial system has, according to scholars, systemic problems as recurrent systemic financial crises, financial exclusion and hindering sustainable development. The overall objective of the thesis is twofold: 1) eliciting generic design guidelines for the monetary and financial system in the digital age; and 2) developing knowledge about the possibilities of digital technologies for the design of the monetary and financial system.

To reach this objective, seven research questions are answered. In part I (chapter 2-5) four questions are explored to overcome four hindrances in current research and discussions about the future of the monetary and financial system and to find terms, notations, and concepts to analyse the systemic problem(s) and to elicit requirements and guidelines. In part II design science is applied as methodology (chapter 6) to answer three other research questions. In this part semi-structured interviews are used to evaluate and refine some of the outcomes: the problem analysis (chapter 7), the generic design requirements (chapter 8) and the generic design principles (chapter 9).

Chapter 2-5: Summary part I

Chapter 2 develops a taxonomy of different kinds of money consisting of four characteristics: 1) *accounting basis* (asset based or asset-liability based); 2) *issuer* (public or private); 3) *form* (material or non-material); and 4) *accessibility* (universal or limited). Moreover, three forms of liquidity are defined: inherent liquidity, contractual liquidity, and market liquidity. In the case of inherent liquidity, the value is determined

by an agreement. This is the liquidity cash offers. In the case of contractual liquidity, the value is fixed by a contract between two economic agents. Bank deposits and several money markets instruments are exchangeable on demand at par into another form of money. In the case of market liquidity, the value is determined by supply and demand. Chapter 3 uses the taxonomy to understand different theories on the origin and nature of money, the emergence of the first monetary accounting systems and the first coins. Chapter 4 explains the historical development of the current bank-based monetary and financial system (fractional reserve banking), the development of two safety nets (central bank as lender-of-last-resort and deposit insurance schemes) and two main alternative systems (full reserve banking and free banking). Chapter 5 explains the functioning of the current monetary and financial system (central banking, commercial banking, and shadow banking) with the help of balance sheets.

Chapter 6: Design science and interviews

Chapter 6 explains the design science methodology and the structure, and the process of the interviews used to evaluate and refine some of the outcomes of this thesis. It is argued that design science is a relevant methodology for three reasons. First, the digitalization of money is hard to grasp with other methodologies (as for example modelling) because no historic data are available for a monetary and financial system in transition. Second, the systemic problems of the current monetary and financial system (and especially the fundamental cause of systemic financial crises) are hard to grasp with other methodologies. Third, design science makes the outcomes accessible for researchers with other (non-economic) backgrounds, policymakers, and the general public. This is important because the design of the monetary and financial system is a multi-disciplinary topic.

There are generally five steps in design science research: (1) explicate the problem; (2) define requirements; (3) design and develop an artifact; (4) demonstrate the artifact; and (5) value the artifact. The latter three activities are in case of the design of the monetary and financial system difficult. It is explained that generic design guidelines are the developed artifact in this thesis. Because of the novelty and the immaturity of this artifact, two rounds of interviews are used for evaluation and refinement of the artifact. Experts in the first round were selected based on three criteria to minimize false positives: a) at least five years study and/ or working experience in a relevant field: central banking and supervision – commercial banking and finance – fintech start-ups – digital technologies – economic science – research NGOs in banking and finance; b) distribution over three variables: age, gender and preferred banking theory; and c) availability to participate in a direct (face-to-face) interview in the Netherlands

Sweden, Switzerland or UK. In the first round 21 experts were interviewed. In the second round 7 experts will be interviewed. The interviews are recorded, transcribed, and validated by the interviewed experts. The validated transcripts of the first round were subsequently analysed, compared, and used to improve the problem analyses (chapter 7), the generic design requirements (chapter 8) and the generic design guidelines (chapter 9). The main objective of the interviews in the second round is evaluation and refinement of the generic design guidelines (chapter 9).

Chapter 7: Systemic problem(s) of the current monetary and financial system

Chapter 7 analyses systemic problems of the current monetary and financial system. The first problem analysed are *systemic* financial crises. It is explained that a feature of these crises is that there is no time to take a well-informed decision. The threat of a collapse of the monetary system ‘forces’ governments and central banks to act on the level of ‘military emergency’. The costs of systemic financial crises are categorized into three groups: direct fiscal costs, indirect fiscal and economic costs, and societal costs. It is concluded that the costs of systemic financial crises are, although hard to calculate exactly and although the diversity of outcomes, significant and therefore that the prevention of these crises is a relevant objective. Subsequently, two theories explaining systemic financial crises – the debt cycle theory and the bank run theory – are discussed. To understand which theory is most accurate, the main events of the financial crisis of 2007-9, testimonies of involved bankers and regulators and the analysis of empirical data of Ricks (2016), Bernanke (2018), Gorton (2012a, 2012b, 2019), Gorton and Metrick (2012) and Gorton *et al.* (2018) are reviewed. It is concluded that although the theories are not (completely) mutually exclusive the bank run theory fits better to the events, testimonies, and empirical data. A key question is if debts are funded with equity and/ or long-term debt or with runnable contractual money. It is concluded that the fragility of the monetary system is a first systemic problem.

Thereafter, chapter 7 explains that the fragility of the monetary system is the starting point of and has caused a second problem during the last decades: a cycle of an increasing amount of increasingly complex regulation. In the aftermath of a systemic crisis governments always implement a new public safety net (e.g., lender-of-last-resort and deposit insurance schemes) and/ or extend existing public safety nets and/ or implement more regulations. These public protection mechanisms and regulations (constraints) contribute on the one hand to stability but cause on the other hand moral hazards. To restrain these moral hazards new regulations (constraints) are required; these cause new moral hazards and thus indirectly the need for more regulations

(constraints). As a result, financial regulation counts today in several countries over 10,000 pages. According to several scholars in the literature the quantity and the complexity of regulation has become a problem in itself. Eighteen experts in the first round of interviews considered current regulations problematic.

The consequences of the cycle are categorized into three groups: 1) a concentrated market structure with high entry barriers; 2) increasing costs of regulation; and 3) increasingly less market discipline and sub-optimal capital allocation. It is concluded that the current situation can be considered a lock-in and an example of path dependency. Path dependency means that institutions and actors are limited in their current choices by previous events and previous institutional design choices. Over time, it becomes increasingly difficult to change path because of the institutionalization of these choices. Therefore, politicians generally choose to implement relatively minor changes. The current path of the monetary and financial system consists of central banks, commercial banks, shadow banks, public safety nets and regulations (protect and constrain). The system in which private banks create contractual money does only still exist because of past government intervention and ongoing public safety nets as the function of lender of last resort and deposit insurance. It is concluded that if the aim is solving the two identified problems – systemic financial crises and the cycle of an increasing amount of increasingly complex regulation –, the path has to be changed and the cause of the two problems has to be understood.

It is subsequently explained that contractual liquidity is the cause of systemic financial crises and thus indirectly also of the cycle of an increasing amount of increasingly complex regulation. A problem is that forms of money based on contractual liquidity fulfil conflicting functions for different economic agents. This leads sometimes to systemic financial crises. In line with several other scholars, it is argued that banks make the fragile promise “to make repayments regardless the circumstances” (Kotlikoff 2018: 22).

In the interviews experts mentioned three other systemic problems of the current monetary and financial systems that are also discussed in the literature: 1) impeding sustainable development/ the realization of a circular economy; 2) impeding financial inclusion; 3) lack of competition between currencies. Four interviewed experts argued that there is no systemic problem. Table 7-6 summarizes the different problem analyses and their key points.

Table 7-6: Overview of problem analyses

Problem analysis of current system	Key points
Fragile by design	• Bank runs/ panics cause systemic financial crises • Safety nets create moral hazards • Welfare losses
Prone to booms and busts	• Too much debt causes systemic financial crises • Misallocation of credit and debt • Welfare losses
Cycle of a growing amount of increasingly complex regulation	• A concentrated market structure • Increasing costs of regulation • Lack of market discipline and suboptimal capital allocation
Impeding sustainable development/ the realization of a circular economy	• Money is debt encourages production • Inflation encourages consumption today above consumption in the future • Non-transparency
Impeding financial inclusion	• Many unbanked and underbanked • Expensive banking services • Focus of monetary policy is wrong
Lack of competition between currencies	• Government involvement leads to mismanagement • Lack of choice for economic agents
No systemic problem	• Current system is decentral and divers • Money creation moves along with economic activity • Regulation can solve problems

The focus of this thesis lies on the grey part of table 7-6. Four conclusions are drawn based on the analysis of chapter 7. First, bank runs – and not high debts or debt cycles per se – cause systemic financial crises. The question how debts are funded is essential. Second, systemic financial crises should be prevented because of their significant fiscal, economic and societal costs. Third, safety nets implemented to avoid bank runs (systemic crises) are the beginning of the cycle of a growing amount of increasingly complex regulation. Fourth, contractual liquidity can be considered a fundamental cause of systemic financial crises and the cycle of a growing amount of increasingly complex regulation. The consequences of these conclusions are far reaching. It means that systemic financial crises are not a kind of ‘natural’ or ‘inevitable’ endogenously phenomena that are evident to (capitalist) market economies. Instead, systemic financial crises are the result of (the dominance of) specific contracts offered

by specific institutions. Moreover, these conclusions mean that a different design can offer an alternative to the cycle of a growing amount of increasingly complex regulation. The insight that contractual liquidity is the root cause of systemic financial crises will be used in chapter 9 to elicit generic design guidelines.

Chapter 8: Generic requirements on the monetary and financial system

Chapter 8 formulates generic design requirement on the monetary and financial system and identifies the consensus and dissensions (disagreements) among scholars in the literature and interviewed experts. The elicited generic design requirements are time independent. Table 8-1 presents the generic design requirements and dissensions.

Table 8-1: Generic design requirements on the monetary and financial system.

The government must ensure at least one general unit of account.
The government must ensure at least one public currency.
<i>Dissension:</i> Should private banks in a public-private arrangement and/or an independent monetary authority issue the public currency?
The government must ensure that the technical design of the public currency is state of the art to make transaction costs as low as possible.
The government should allow private currencies as competitors, discipliners, and backup systems.
The government must accept only the public currency for tax payments.
<i>Dissension (related to R2):</i> Should the government only accept the money issued by the monetary authority or also money issued by private banks in a public-private arrangement?
The government must ensure that the public currency offers stable settlement power.
The government must ensure that the monetary authority is independent of the government.
<i>Dissension:</i> Should the monetary authority have a balance sheet or not? And what is (are) the most effective instrument(s) to use (in the digital age)?
The government must ensure that legal entities have to freedom to issue and to trade securities, credits, and debts.
<i>Dissension (related to open R2 and R5):</i> Should the government guarantee specific credits and debts or treat all financial assets the same?

Chapter 9: Generic design guidelines for the monetary and financial system in the digital age

Chapter 9 finally elicits three generic design guidelines for the monetary and financial in the *digital* age. These guidelines are meant to give direction and do thus not provide readily available solution to problems (and should not be considered a blueprint). Table 9-4 presents the three elicited generic design guidelines on the monetary and financial system in the digital age.

Table 9-4: Generic design guidelines on the monetary and financial system

GDG 1	The public currency should be gradually updated to the digital age; that is, digital inherent liquidity should be gradually developed and introduced.
GDG 2	In the digital age the financial system should be more (or even completely) based on market liquidity and less (or even not) based on contractual liquidity; the more the system is based on market liquidity, the more stable the system is, the better risk and rewards are aligned, and the less safety-nets, regulations and government interventions are required.
GDG 3	In the digital age financial regulation should be (much) more about improving transparency and protecting consumers and investors and (far) less about micro-prudential requirements.

Seventeen experts in the first round of interviews agreed with generic design guideline 1. The interviewed experts mentioned five design variables: 1) the level of anonymity, privacy, and transparency; 2) a limit on the amount of digital inherent money per economic agent; 3) the abolishment or maintenance of material digital inherent money; 4) the monetary instrument; and 5) the underlying technology. Twelve experts agreed with generic design guideline 2. Nine experts had doubts, couldn't oversee all the consequences, emphasized the local circumstances or focussed on public money creation to solve collective problems. No expert completely (fundamentally) disagreed with the direction. Experts mentioned one design variable: the type of funding of financial intermediaries. A design choice is if financial intermediaries should be allowed to fund themselves only with equity securities or also with long-term debt securities and securities that offer conditional (limited) contractual liquidity. Twenty experts agreed to a greater or lesser extent with generic design guideline 3.

In the long-term, the (theoretical) result of the generic design guidelines would be a monetary system in which public and private currencies compete and a liberalized system of financial intermediation. In a way, this design can be considered a combination of full reserve banking and free banking proposals updated to the digital age. Fifteen interviewed experts in the first round were to a greater or lesser extent positive about competition between public and private currencies, four had doubts, one was mostly negative, and one had no clear view.

The experts were also asked if systemic financial crises are still possible in the long run when contractual liquidity has been substituted. Nine experts thought systemic financial crises are no longer possible, eight expected far less crises, three experts did not see a significant change in the likelihood and one expert did not have a clear view. The experts mentioned three new risks. The first risk is that one private currency

or security becomes very large (a cap was suggested as solution). The second risk is technological problems (bugs, hacking) of the public digital currency. The third risk is mismanagement of the public digital currency. The conclusion might be that only if the technology is robust and resilient, and only if the legal-political system is well-established and stable, the complete transition towards (the full implementation of) a system of competition between public currencies and private currencies should be accomplished.

One design tension has been identified. There is a tension between GDR1, GDR2, GDRR3, GDR5, GDR6, GDR7 and GDG1 on the one hand and GDR4 and GDR8 on the other hand. The first elicit tasks for the government, the latter elicit economic freedom for economic agents. An open question is if it is possible to separate public and private affairs and responsibilities entirely in the digital age. Twelve interviewed experts in the first round considered such a separation possible and desirable, five desirable but impossible, one maybe possible but undesirable and three had no clear view. Interviewed experts in the first round mentioned four conditions to realise a complete separation:

- i. The availability of sufficient reserves of (run-proof) digital inherent liquidity in society and a safe digital (and physical) payments system (in line with generic design guideline 1).
- ii. Supervision focussing on transparency (of risks) and protecting consumers and investors (in line with generic design guideline 3).
- iii. The implementation of stable time consistent rules. An option is a law prohibiting governments and central banks bailing out financial intermediaries.
- iv. The implementation of additional rules to accomplish a complete separation – as for example a systemic solvency rule (McMillan 2014), taxes (Cochrane 2014) and a prohibition on the issuance of money-claims (Ricks 2016).

References

- Bernanke, B.S. (2018). The real effects of the financial crises. *Brookings Papers on Economic Activity Conference Draft*, September 13-14. Available at: https://www.brookings.edu/wp-content/uploads/2018/09/BPEA_Fall2018_The-real-effects-of-the-financial-crisis.pdf
- Cochrane, J. (2014). Toward a run-free financial system. *Working Paper*, April 15. Available at: http://faculty.chicagobooth.edu/john.cochrane/research/papers/run_free.pdf
- Gorton, G. (2012a). *Misunderstanding Financial Crisis: Why We Don't See Them Coming*. New York: Oxford University Press.
- Gorton, G. (2012b). Some reflections on the recent financial crisis. *NBER Working Paper* 18397. Available at: <https://www.nber.org/papers/w18397.pdf>
- Gorton, G., and A. Metrick (2012). Securitized banking and the run on repo. *Journal of Financial Economics* 104(2): 343-78. <https://doi.org/10.1016/j.jfineco.2011.03.016>
- Gorton, G., T. Laarits and A. Metrick (2018). The run on repo and the Fed's response. *NBER Working Paper* 24866. Available at: <https://www.nber.org/papers/w24866>
- Gorton, G. (2019). Comments on “Is the financial system sufficiently resilient: a research programme and policy agenda” in Tucker (2019). Is the financial system sufficiently resilient: a research programme and policy agenda. BIS Working Paper 792, June, 25-33. Available at: <https://www.bis.org/publ/work792.pdf>
- Kotlikoff, L. (2018). The big con - reassessing the “great” recession and its “fix”. *NBER Working Paper* 25213. Available at: <https://www.nber.org/papers/w25213>
- McMillan, J. (2014). *The End of Banking. Money, Credit, and the Digital Revolution*. Zurich: Zero/One Economics.
- Ricks, M. (2016). *The Money Problem: Rethinking Financial Regulation*. Chicago/ London: The University of Chicago Press.

Curriculum Vitea

Curriculum Vitae

Martijn J. van der Linden was born in Hoogeveen, the Netherlands, on 28 June 1980. He received a master's degree (Economics, specialisation Strategic Management) from Tilburg University, the Netherlands. For his master thesis, he did research at ING Group and, after graduating, he started there as a management trainee. Between 2004 and 2008, he had different position in the fields of operations, risk and change management in Amsterdam, Brussels, and Frankfurt. Thereafter, he worked for a brief period as a day trader. During the financial crisis of 2007-9, he became interested in systemic financial crises and 'new' economic thinking. This interest eventually resulted in this thesis. In 2010, Martijn left the financial sector and started researching, writing, and giving talks about those topics. From September 2011 until January 2014, he chaired the Dutch Platform for an Economy based on Sustainability and Solidarity.

Martijn joined the faculty of Technology, Policy and Management in February 2014 as a researcher on the EU-funded research project Creating Economic Space for Social Innovation and as a PhD candidate. He explored different methodologies to research the monetary and financial system and, finally, decided to apply design science under the supervision of prof. dr. C.P. van Beers and prof. dr. ir. M.F.W.H.A. Janssen.

In October 2018, Martijn became lector/ professor New Finance at The Hague University of Applied Sciences. He chairs a research group that focusses on the application of digital technologies in finance and the relationship between financial and non-financial (social, ecological) values. He regularly publishes and comments in popular media as *Follow the Money*, *BNR* and *De Nieuwe Wereld*.

For a selection of publications in journals and popular media, book chapters, policy papers, podcasts and talks, see: <https://mjvdl.com/publicaties/>.



