

**The wrong track also leads someplace**  
**Milton Friedman's presidential address at 50**

Storm, Servaas

**DOI**

[10.4337/roke.2018.04.09](https://doi.org/10.4337/roke.2018.04.09)

**Publication date**

2018

**Document Version**

Accepted author manuscript

**Published in**

Review of Keynesian Economics

**Citation (APA)**

Storm, S. (2018). The wrong track also leads someplace: Milton Friedman's presidential address at 50. *Review of Keynesian Economics*, 6(4), 517-532. <https://doi.org/10.4337/roke.2018.04.09>

**Important note**

To cite this publication, please use the final published version (if applicable).  
Please check the document version above.

**Copyright**

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

**Takedown policy**

Please contact us and provide details if you believe this document breaches copyrights.  
We will remove access to the work immediately and investigate your claim.

# The wrong track also leads someplace: Milton Friedman's presidential address at 50

Servaas Storm\*

Delft University of Technology, the Netherlands

*Milton Friedman's presidential address to the American Economic Association holds a mythical status as the harbinger of the supply-side counter-revolution in macroeconomics – centred on the rejection of the long-run Phillips-curve inflation–unemployment trade-off. Friedman (seconded by Edmund Phelps) argued that the long run is determined by 'structural' forces, not demand, and his view swept the profession and dominated academic economics and macro policymaking for four decades. Friedman, tragically, put macroeconomics on the wrong track which led to disaster: secular stagnation, rising inequality, mounting indebtedness, financial fragility, a banking catastrophe and recession – and no free lunches. This is Friedman's legacy. We have to unlearn the wrong lessons and return macroeconomics to the right track. To do so, this paper shows that Friedman's (and Phelps's) conclusions break down in a general model of the long run in which productivity growth is endogenous – aggregate demand is driving everything again, short and long.*

**Keywords:** natural rate of unemployment, endogenous technological progress, monetary policy, generalized NAIRU model

**JEL codes:** E02, E12, E31, F02, F15

## 1 THE GOVERNING MYTH OF ECONOMIC POLICY

Presidential addresses to the American Economic Association are not generally known for generating discernible, let alone lasting, impacts on the evolution of economic thinking – as a matter of fact, most have been quite forgettable. One exception has been Milton Friedman's 17-page presidential address on 'The role of monetary policy', delivered in December 1967 and published 50 years ago in the March 1968 issue of the *American Economic Review*. Today, Friedman's address holds an almost mythical status as the harbinger of a budding revolution in macroeconomic thinking: the supply-side revolution centered on the rejection of a Phillips-curve inflation–unemployment trade-off in the long run that swept the profession at the end of the 1970s (Mankiw and Reis 2018). Erik Lundberg (1976), in the presentation for Friedman's Nobel Memorial Prize, summarizes Friedman's contribution:

Friedman was the first to show that the prevalent assumption of a simple 'trade-off' between unemployment and the rate of inflation only held temporarily as a transient phenomenon .... According to Friedman's theory, a level of unemployment which is held below a structural

\* The author is grateful to the Institute for New Economic Thinking for financial support (under individual grant #INO 1600007). The paper was written in the spirit of George Bernard Shaw's apology: 'I am sorry this letter is so long, I didn't have time to make it shorter'.

equilibrium level leads to a cumulative rate of price and wage change, primarily because of the destabilizing role that expectations play.

Friedman himself went out of his way to paint and forefront the groundbreaking role played by his presidential address in upending the ‘Keynesian’ consensus built around the Phillips curve – but in truth, Friedman enjoyed considerable serendipity, which allowed a rather run-of-the-mill presidential address to play such an outsized role in contemporary macroeconomic thinking. The attraction of Friedman’s presidential address, which was both complex and vague enough to lend a flavour of scientific achievement to his ideas (Galbraith 2008b), was that supply-side economists could use it as a tale of origin and ethno-genesis, explaining the origins of the New Classical revolution which upended the Keynesian establishment of the 1960s, stuck as it was on a stable Phillips curve (Eatwell and Milgate 2011; Storm and Naastepad 2012).

Friedman’s address was in many ways a muddle. He argued, for instance, that the growth of money supply could be used as an instrument of inflation control – an idea now given up, because of its infeasibility, by central banks which have allowed money growth to do whatever it wants. Friedman administered his own *coup de grace* when he told the *Financial Times* (7 June 2003): ‘The use of quantity of money as a target has not been a success. I’m not sure I would as of today push it as hard as I once did’. However, the lynchpin of Friedman’s (1968) critique was the Phillips curve – the supposedly precise and (until then rather) stable trade-off between unemployment and inflation, which served to complete the ‘Keynesian consensus’ model and offered (monetary) policymakers the analytical apparatus to explore the impacts on output, unemployment and inflation. Friedman argued that the trade-off could only exist in the short run, for as long as actors in the economy were wrong about (actual and expected) inflation. In the longer run, once actors had learned from experience and correctly started to anticipate the rate of inflation, Friedman claimed, drawing on the work of fellow economist Edmund Phelps (1967; 1968), that the Phillips curve would be vertical at a given rate of unemployment – the ‘natural’ rate of unemployment, also known as the non-accelerating inflation rate of unemployment (NAIRU). Accordingly, monetary policy could only affect the unemployment–inflation trade-off in the short run, but not in the long run when the NAIRU is

ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availability, the costs of mobility, and so on. (Friedman 1968, p. 8)

Likewise, fiscal policy could have no permanent, long-run, impacts: while fiscal stimulus might lead to a reduction in actual unemployment in the short run, the expansion would result in a higher interest rate, crowding out private-sector investment – and hence unemployment would converge back to the NAIRU in the long run. The status of Friedman (1968) was propped up in the late 1970s by the failure of the 1960s Phillips curve (Bator 1987). Stagflation was used to solidify the myth-making: Mankiw and Reis (2018, p. 12) are only impersonating Robert Lucas (1981) when they praise Friedman for predicting the stagflation, writing that this ‘is one of the greatest successes of out-of-sample forecasting by a macroeconomist’. That the stagflation somehow ‘proved’ Friedman’s NAIRU model right is part of macro folklore, but does not mean it is true – Francis Bator (1987, p. 33) explained 30 years ago why Greg Mankiw and Ricardo Reis are wrong:

The new-classical assertion that the 1970s proved wrong the modern Keynesian model is ... untenable. They are criticizing the wrong model. ... I do not think that the failure of the

1960s price and wage equations to reckon with large raw material price shocks and with the sensitivity of wages to prices should one cause to doubt the modern, augmented version of those equations. It certainly is not a good reason for believing that wages and prices instantaneously clear every market.

But the myth-making continued, as the New Classical 'rational expectations' revolution of the 1970s, led by Lucas (1972) and Sargent and Wallace (1975), reinforced Friedman's (1968) still feeble and embryonic (policy) conclusions – arguing, in what is tantamount to circular reasoning, that fiscal stimulus does not even work in the short run, because actors in the system are endowed with 'perfect foresight' and hence fully anticipate the inflationary impacts and adjust their decisions immediately. It meant the end of 1960s Keynesianism as, in this view, the supply-determined long run would always dominate the demand-determined short run – which would anyway be very short. This view dominates today's textbooks, academic debate and macroeconomic policymaking in the OECD area. Belief in the NAIRU is so strong that Paul Krugman, a self-proclaimed 1960s Keynesian, compared people who challenged NAIRU doctrine to scientists who disputed evidence of damage to the Earth's ozone layer (Storm and Naastepad 2012, p. 10). This, then, is the enduring legacy of Friedman (1968): the governing myth that governments and central banks should not intervene actively to smooth short-run fluctuations or to steer the economy by means of public investment, but, rather, concentrate on creating the structural conditions for deregulated (labour) markets to grind out the 'natural' long-run equilibrium. 'In Friedman's gospels', writes James Galbraith (2008b, p. 2), 'government is the lone serpent in Eden, while the task of policy is to stay out of the way'.

## 2 THE WRONG TRACK

My goal here is to assess Friedman's (1968) contribution, with the benefit of half a century of hindsight. I start by setting the stage and presenting a consistent macro model of the NAIRU, unlike Friedman himself. The introduction of an inflation-expectations-augmented Phillips curve constituted an (in itself sensible) generalization of the 'Keynesian' consensus model of the 1960s, but Friedman's generalization, explicitly framed in terms of the 'long run', is itself only partial – because it ignores the role of (endogenous) technological progress in the macroeconomic system. Building on Storm and Naastepad (2012; 2015a; 2016b), I will next *generalize* Friedman's model by endogenizing productivity growth and will show that Friedman's policy conclusions break down. The 'natural' rate of unemployment, or the NAIRU, does not exist as an anchor for and independent of monetary policy decisions – and the claim that well-timed interest-rate tightening can reduce inflation expectations and pre-empt (runaway) inflation without damaging potential (or structural) economic growth, is plain wrong. Friedman's (and Phelps's) neat dichotomy between a demand-determined short run and a fully 'neoclassical' supply-driven long run is false: it does not exist even when staying close to Friedman's basic model. Friedman (1968) put macroeconomics on the wrong road – and this wrong road did lead somewhere.

The model I use builds on the models developed in Storm and Naastepad (2015a, 2016b). The model describes the long-run state of the economy and abstracts from short-run fluctuations and adjustments. I will not explicitly model the formation of inflation expectations, but will assume that these are forward-looking and based on full information. I will further assume that the (independent) central bank has a strong and credible reputation when it comes to inflation targeting: workers are assumed to

restrain their nominal wage growth demands because they understand that excessive wage claims will be punished by higher interest rates. I will not go into the out-of-equilibrium dynamics and real-time adjustments of actual unemployment, but for the sake of argument will assume that the system, when shocked, moves back to the given equilibrium position instantaneously and without costs. This is clearly absurd, as we know that processes of macroeconomic adjustment take (historical) time and have huge social, economic and political costs. But I want to shift the battleground to Friedman's core claim that inflation targeting makes actual output conform to *given* potential output, or alternatively brings actual unemployment back to the *constant* NAIRU. That is, monetary policy is just stabilizing actual growth and does not harm or hurt potential output growth. 'Thus, and here is the revolutionary point delivered by the modern theoretical consensus', writes Goodfriend (2007), 'even those who care mainly about stabilization of the real economy can support a low-inflation objective for monetary policy ...' This is the 'scientific monetary policy consensus' which rationalizes and legitimizes the central bank's inflation targeting by claiming, in Friedman's footsteps, that the NAIRU is an 'attractor': a fixed point, unaffected by monetary or fiscal policy and determined by the structural conditions prevailing in the labour market, to which the system must evolve, for a wide variety of starting conditions of the system. Empirically, the 'attractor' assumption has been persistently and consistently falsified, because nothing resembling stable NAIRUs could be identified (for example, Stanley 2005; Storm and Naastepad 2012). Time-varying definitions of the NAIRU could not hide the obvious fact that the so-called 'natural' rate was, in reality, mimicking changes in the *actual* rate of unemployment (Storm and Naastepad 2015a; 2015b). 'The way that modern macroeconomics tosses around the notion of a "natural rate of unemployment" is a sort of intellectual scandal', writes Robert Solow (1987, p. 183), adding that the 'coarseness of the definition and the weakness of the empirical results ... suggest that we are in the presence of something that is believed for extra-scientific reasons'. I agree: the NAIRU, exerting a centripetal force on actual unemployment, is part and parcel of Friedman's extra-scientific (that is, ideological) *Weltanschauung* that intrinsically stable free and unfettered markets provide the only legitimate and welfare-enhancing foundation for a stable (capitalist) social order and economic progress. My claim here is that the NAIRU is endogenous, created by (monetary) policy, and does not provide a socially optimal anchor for monetary policy. Findings from recent empirical research for the OECD countries by Karanassou and Snower (2004), Arestis et al. (2007), Karanassou et al. (2009), Cross and Lang (2011), Ball (2014), Blanchard et al. (2015), Lang and Setterfield (2015) and Summers (2015) all support my claim: a temporary recession, caused by higher interest rates to bring down inflation, can and does (often) lead to a permanent decline in *potential* growth and hence an increase in the NAIRU. Hence, monetary policy carries non-negligible social costs (in terms of unnecessary unemployment) and, in addition, Friedman's NAIRU order proved anything but stable and welfare-enhancing (Storm and Naastepad 2012). The NAIRU is a professional embarrassment.

### 3 CHANNELLING THE SPIRIT OF FRIEDMAN (1968)

We start with an aggregate demand relation that explains the level of actual unemployment  $u_A$  as a (positive) function of the target interest rate  $r_T$  and a (negative) function of autonomous demand.  $r_T$  is the interest rate that is consistent with the central bank's

inflation target, which is, say, 2 per cent.  $\gamma$  is  $> 0$  in accordance with received theory.  $\hat{\Theta}$  captures the impact on  $u_A$  of autonomous spending on output and unemployment.

$$u_A = \gamma r_T - \hat{\Theta} \quad (1)$$

Aggregate supply is described by an inflation-expectations-augmented Phillips curve which we derive – following received theory – from the following wage-setting process (in growth rates):

$$\hat{W} = \alpha_0 - \alpha_1 u_A + \alpha_2 \hat{\lambda} + \alpha_3 z + \hat{p}_e \quad \alpha_0, \alpha_2, \alpha_3 > 0 \quad 0 < \alpha_2 < 1, \quad (2)$$

where  $\hat{W}$  is nominal wage growth,  $\hat{\lambda}$  is labour productivity growth, and  $u_A$  is the actual unemployment rate.  $\hat{p}_e$  is the expected rate of inflation. Unlike Friedman (1968), I include labour productivity growth as a variable in the wage-bargaining process, since (rational) workers will try to claim part of the surplus created by productivity growth; I note that this is a typical specification in microeconomic bargaining models (for example, Mortensen and Pissarides 1994).  $z$  is the workers' 'reservation wage', which depends on the extent and nature of labour market regulation. The reservation wage will be higher, the more jobs are protected by employment legislation, the higher are minimum wages, unemployment benefits, and so on. Hence, the higher is  $z$ , the higher the nominal wage growth claims by workers. We combine (2) with the following simplified price setting (or 'wage growth offer') relation of firms:

$$\hat{W} - \hat{p} = \hat{\lambda}. \quad (3)$$

Firms can afford to pay real wage growth equal to the rate of labour productivity growth, thus keeping their profit share constant. Substituting (2) in (3) gives the Phillips curve, in which  $\hat{p}$  is the inflation rate,

$$\hat{p} = \alpha_0 - \alpha_1 u_A - (1 - \alpha_2) \hat{\lambda} + \alpha_3 z + \hat{p}_e. \quad (4)$$

From (4), imposing Friedman's long-run equilibrium condition that inflation is not accelerating, but stable (that is,  $\hat{p} = \hat{p}_e$ ), the NAIRU can be derived:

$$u_N = \frac{\alpha_0 - (1 - \alpha_2) \hat{\lambda} + \alpha_3 z}{\alpha_1}. \quad (5)$$

Equation (5) satisfies the 'attractor' properties attributed to the 'natural' unemployment rate, as  $u_N$  is affected by neither monetary policy nor fiscal policy. The NAIRU will decline, however, as a result of labour market deregulation (since  $\partial u_N / \partial z > 0$ ). Higher (exogenous) labour productivity growth, on the other hand, reduces the NAIRU (if  $0 < \alpha_2 < 1$ ), because it reduces wage-push inflationary pressure (given nominal wage growth) or, alternatively, creates more space for real wage increases. Friedman ignored  $\hat{\lambda}$ , but would have assumed, in neoclassical fashion, that *exogenous* productivity growth unidirectionally affects wage growth, inflation and the NAIRU, but is itself not affected by anything happening in the economic system.

Now, the monetary policy problem is to fix the target interest rate in such a way as to stabilize inflation at the target of 2 per cent. To do so, the central bank will tinker with the target interest rate in response to 'excess' inflation and the unemployment gap

$(u_N - u_A)$ . Equation (6) gives the central bank reaction function (comparable to the Taylor rule), where  $\hat{p}_T$  is the central bank's target inflation rate.  $\theta_0, \theta_1$  and  $\mu$  are  $> 0$ .

$$r_T = \theta_0 + \theta_1(\hat{p} - \hat{p}_T) + \mu(u_N - u_A) \tag{6}$$

The derivation of this monetary policy rule (MPR) is given in Appendix 1. This simple model works like clockwork: the central bank changes the (real) rate of interest so as to keep actual unemployment at the NAIRU, while at the same time ensuring that actual inflation is equal to the target rate of inflation. Equations (1), (4) and (6) can be depicted graphically as in Figure 1. The upper panel describes the positive relation between the real rate of interest and actual unemployment implied by (1). The horizontal line is the central bank's MPR (6) which is defined by a given  $r_T$  which is set to satisfy the condition that  $u_A = u_N$ . The lower panel of Figure 1 gives the (linear) Phillips curve (4). A shift in aggregate demand (due to fiscal stimulus for instance) will shift the unemployment curve upwards – at the unchanged target interest rate  $r_{T0}$ , actual unemployment will now be lower. The fiscal action has kicked the economy from the knife-edge, and (since  $u_A < u_N$ ) there looms the threat of ever-accelerating wage-push inflation. Hence, the central bank intervenes, raising its target rate to  $r_{T1}$ , creating unemployment until  $(u_A - u_N) = 0$  again and inflation is back at 2 per cent. With the central bank firmly committed to the 2 per cent inflation target, fiscal stimulus would be a no-brainer, as its positive impacts would be crowded out by the higher interest rate.

Table 1 provides a few numerical illustrations using this model. The model is calibrated to produce a long-run equilibrium outcome in which  $u_A = u_N = 6$  per cent,

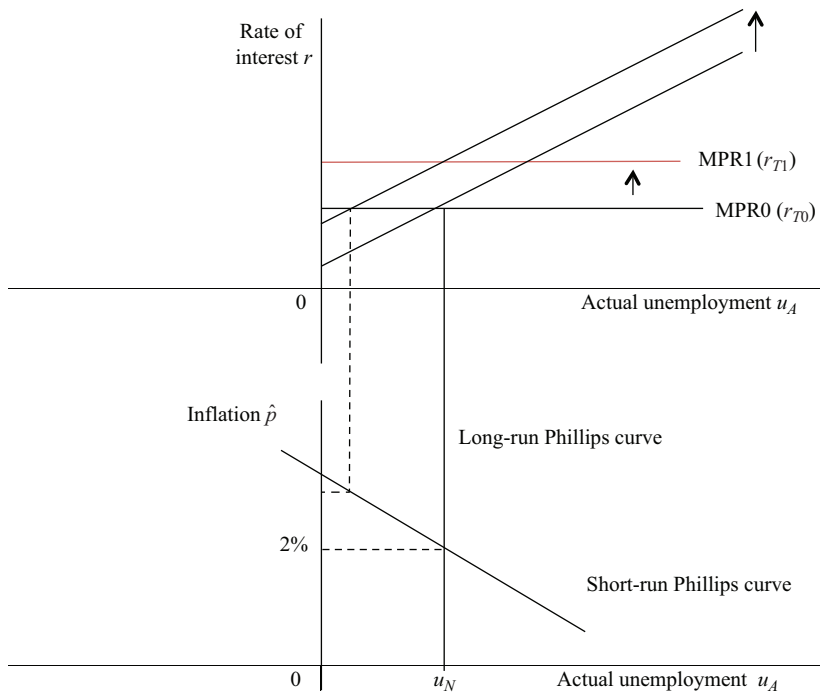


Figure 1 Central-bank inflation targeting: Friedman (1968)

Table 1 Friedman's (1968) model: numerical illustrations

	Base-run	Higher $\hat{\Theta}$	Higher $z$	Higher labour productivity growth
Unemployment $u_N = u_A$	0.0600	0.0600	0.0700	0.0550
Target interest rate $r_T$	0.0450	0.0550	0.0500	0.0425
Nominal wage growth $\hat{W}$	0.0400	0.0400	0.0400	0.0500
Labour productivity growth $\hat{\lambda}$ (exogenous)	0.0200	0.0200	0.0200	0.0300
Inflation rate $\hat{p}$	0.0200	0.0200	0.0200	0.0200
Autonomous demand growth $\Theta$	0.03	0.05	0.03	0.03
Labour market regulation $z$	1.0	1.0	1.1	1.0

Note: It is assumed that  $\alpha_0 = -0.030$ ;  $\alpha_1 = 1$ ;  $\alpha_2 = 1/2$ ;  $\alpha_3 = 0.1$ ;  $\gamma = 2$ ; and  $\mu = 1/\gamma = 1/2$ .

inflation is 2 per cent, nominal wage growth is 4 per cent, while exogenous labour productivity grows at 2 per cent. The equilibrium interest needed to keep the economy stable is 4.5 per cent. More regulated and 'rigid' labour markets (captured by a higher  $z$ ) create stronger wage-push inflation and hence a higher equilibrium interest rate ( $r_T = 5$  per cent) is needed to keep inflation (and inflation expectations) down to 2 per cent. Likewise, fiscal stimulus, or higher export growth, which can both be operationalized in terms of an increase in  $\hat{\Theta}$ , is inflationary and hence  $r_T$  must be raised to maintain price stability – keeping  $u_A = u_N$ . This – supposedly long-run – state is a state in which (aggregate) demand does not matter. This way, Friedman's 'understanding of how the economy worked in the long run provided the basis for, and restrictions on, how we tried to understand the behavior of the economy in the short run', as Mankiw and Reis (2018, p. 6) conclude. Indeed, it is here that Friedman enjoyed his greatest intellectual success and largest policy impact: by influencing the way in which macroeconomists and policymakers think about what macro policy can, and cannot, achieve. His take-away message is twofold: first, activist fiscal policy does not have a permanent effect on growth and unemployment, and, in fact, should be seen as a 'disturbance' in the economic system (Mankiw and Reis 2018, p. 8); second, monetary policy alone can keep inflation in check and basically at no cost to potential output (growth). 'The belief that, in the long run, the central bank can do little about real variables is still canon for most macroeconomists', write Mankiw and Reis (2018) – and this is exactly the problem.

#### 4 A GENERALIZATION OF FRIEDMAN (1968)

Friedman's model has not just been empirically falsified (Stanley 2005; Arestis et al. 2007; Storm and Naastepad 2012), but also criticized for the neglect of fundamental uncertainty about future events, the *ad hoc* assumption of a constant mark-up rate and constant returns to scale (Rowthorn 1995; 1999; Arestis et al. 2007), the neglect of hysteresis (Karanassou and Snower 2004; Karanassou et al. 2009; Cross and Lang 2011; Lang and Setterfield 2015), and the general absence of non-linearities and multiple equilibria (Eisner 1995; Galbraith 1997; 2008a; Ball 1999). While these – powerful – structural critiques are mostly ignored, Friedman's 1967 AEA presidential address continues to be celebrated as 'marking a turning point in the history of macroeconomic research' (Mankiw and Reis 2018, p. 2), which reoriented thinking in – arguably – the



right direction. I beg to disagree. Friedman's NAIRU model is not a general model of the long term, because technological progress and labour productivity growth are assumed exogenous. If the long run is the time horizon over which people become better informed, aligning their (inflation) expectations with reality, then surely there is a long enough time for productivity growth to respond to changes in accumulation and in economic growth? The point is that productivity growth is endogenous in Friedman's long run.

This can be explained in various ways (Foley and Michl 1999; Storm and Naastepad 2012; 2016a; Basu and Foley 2013). I will here focus on the Kaldor–Verdoorn relation which states that higher (investment) demand growth is causing higher productivity growth (Verdoorn 1949; Kaldor 1966; 1996). This process of ‘cumulative causation’, which lies at the heart of Adam Smith's interpretation of the British Industrial Revolution (Young 1928; Myrdal 1957; Storm 2015), happens in two ways. Directly, because investment in new equipment embodies the latest state of production technologies and is therefore more productive than older vintages of capital stock. Indirectly, because the increase in aggregate demand leads to an economy-wide deepening of the division of labour (greater specialization) as well as more rapid learning-by-doing (in firms), which both get reflected in faster labour productivity growth. I assume the Kaldor–Verdoorn relation takes the following shape:

$$\hat{\lambda} = \hat{\lambda}_0 + \beta\hat{\Theta}, \quad (7)$$

where  $0 < \beta < 1$  is the Kaldor–Verdoorn coefficient.  $\hat{\Theta}$  has been defined before as the growth of autonomous demand which includes investment. Equation (7) is a structural, long-term relation, because it captures the productivity-growth-enhancing impact of an increase in the trend growth rate of autonomous demand. Substituting (7) into the Phillips curve (4) gives:

$$\hat{p} = \alpha_0 - \alpha_1 u_A - (1 - \alpha_2)(\hat{\lambda}_0 + \beta\hat{\Theta}) + \alpha_3 z + \hat{p}_e. \quad (8)$$

According to the *original* Phillips curve (4), any trend increase in  $\hat{\Theta}$  must raise inflation, because it reduces actual unemployment (via equation (1)). Hence,  $\frac{d\hat{p}}{d\hat{\Theta}} = \frac{d\hat{p}}{du_A} \times \frac{du_A}{d\hat{\Theta}} = \alpha_1 > 0$  in (4). This is different in the endogenous-productivity-growth-augmented Phillips curve (10), where I obtain:  $\frac{d\hat{p}}{d\hat{\Theta}} = \frac{d\hat{p}}{du_A} \times \frac{du_A}{d\hat{\Theta}} + \frac{d\hat{p}}{d\hat{\Theta}} = \alpha_1 - (1 - \alpha_2)\beta$ . That is, the positive impact on inflation of faster  $\hat{\Theta}$  is partially offset by the Kaldor–Verdoorn effect. Demand growth is less inflationary in the long run, because the larger market allows for a greater division of labour, which implies greater specialization and differentiation of production. All this raises productivity directly and indirectly – in the latter case, by promoting learning by doing and leading to process and product innovation (Storm and Naastepad 2012; 2016a; Basu and Foley 2013). The augmented Phillips curve (8) then gives rise to the following definition of the NAIRU:

$$u_N = \frac{\alpha_0 - (1 - \alpha_2)(\hat{\lambda}_0 + \beta\hat{\Theta}) + \alpha_3 z}{\alpha_1}. \quad (9)$$

The NAIRU now depends (negatively) on  $\hat{\Theta}$ . A structural increase in  $\hat{\Theta}$  (say, due to faster world trade growth) reduces  $u_N$ . The reason is that the higher export growth raises labour productivity growth (via equation (7)), and as a result, the structural conditions (assumed to be exogenous by Friedman and Phelps) have changed in a way as

to reduce the wage-push inflationary potential of the system. Workers’ demand for higher nominal wages, in other words, can be partially satisfied while keeping inflation constant at the 2 per cent target. As a result, the NAIRU can come down – which is something beyond the pale in Friedman’s thinking. The exact scenario is illustrated in Figure 2. The economy is in long-run steady-inflation equilibrium at the NAIRU  $u_{N0}$ , and a corresponding ‘natural’ rate of interest  $r_{T0}$  (which is derived from the MPR in equation (6)). Now let us suppose that a structural increase in export growth pushes up the activity curve in the upper panel: at the unchanged interest rate  $r_{T0}$ , actual unemployment  $u_A$  will be lower than  $u_{N0}$  – and inflationary pressures start to build up; we move up along the original Phillips curve. But we know that a structurally higher  $r_{T0}$  leads to higher productivity growth (in equation (7)) and this, in turn, shifts the Phillips curve down for reasons already explained. Let me assume that  $\alpha_1 - (1 - \alpha_2)\beta = 0$ , which implies that the net impact on inflation of the increase in  $\Theta$  is zero. In that case, the (omniscient) central bank has no reason to change the target interest rate and keeps it at  $r_{T0}$ . The economy settles down in a new long-run equilibrium state in which inflation is constant (at 2 per cent), the interest rate has not changed, but trend economic growth is higher and the NAIRU has come down from  $u_{N0}$  to  $u_{N1}$  (in Figure 2).

Blinded by their special (exogenous-productivity) model, Friedman and Phelps fail to see this possibility and their failure is socially costly. I use Figure 2 to illustrate the economic damage inflicted on our economies and societies by their myopia. Suppose the central bank is not omniscient, which is not an unreasonable assumption to make in light of the rather consistent monetary policy mistakes made by central bankers in the USA and the eurozone (Storm and Naastepad 2012; 2015a; 2016b). Specifically, let

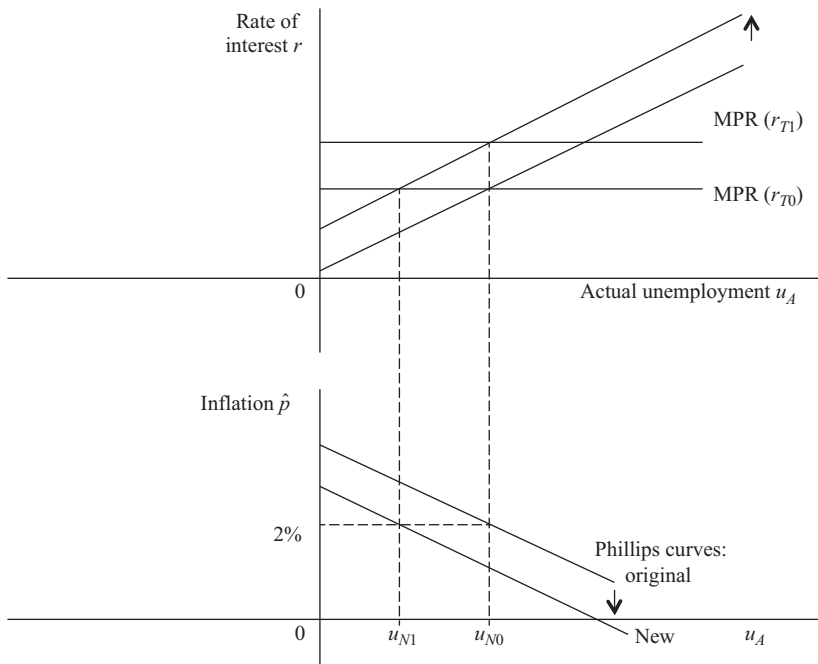


Figure 2 The generalized NAIRU model

me assume that the central bank believes that the NAIRU is fixed at  $u_{N0}$  and acts on this belief: following its MPR and fearing accelerating inflation, it raises the interest rate to  $r_{T1}$ . This, in turn, depresses investment and autonomous demand growth – until  $u_A$  is raised up to  $u_{N0}$ . What has happened is that the deliberate hike in the interest rate has crowded out the external demand stimulus by depressing domestic (investment) demand. The economy never settles in the better long-run equilibrium outcome defined by  $u_{N1}$ , because monetary policy does not allow it to happen. What is worse, it will appear as if inflation targeting is indeed just making actual unemployment conform to the given NAIRU ( $u_{N0}$ ), because the interest rate increase has also aborted the (Kaldor–Verdoorn) acceleration of productivity growth by crowding out the demand stimulus. This is a strong case of reflexivity: when central bankers believe the economy works as in the NAIRU model, they behave in line with what the model predicts, and thus create a reality that comes to resemble their model. The model becomes a self-fulfilling prophecy and since the historical data do not show that reaching a better long-run equilibrium outcome defined by  $u_{N1}$  was a real possibility, we can never prove the central bank has done us a public disservice (for example, Galbraith 1997, p. 99). TINA, but not because there is no alternative, but because macro-economists ‘who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist’ (Keynes 1936, p. 383). There’s no need for second-guessing who the defunct economists are ....

Table 2 compares the effects of higher  $\hat{\Theta}$  in Friedman’s (1968) model and in my generalized model. It can be seen that equilibrium unemployment, if allowed by an omniscient central bank, would go down by  $\frac{1}{2}$  a percentage point from 6 per cent to 5.5 per cent as a result of a structural rise in autonomous demand growth by two percentage points. This is possible because labour productivity growth accelerates – from 2 per cent to 3 per cent. This creates space for higher nominal wage growth, and a reduction in the interest rate. While a central bank following the advice of ‘defunct’ economists will lock the economy into the original equilibrium situation featuring a NAIRU of 6 per cent, a more enlightened central bank, acknowledging that strong (demand) growth may lead to higher potential growth, would allow trend (output and productivity) growth to rise and the NAIRU to decline – and not raise the interest rate, indeed perhaps even lower it. In this context, Mario Draghi, President of the European Central Bank, may be more ‘Keynesian’ than Paul Krugman, when stating: ‘Strong growth may be leading to *higher potential output*, as crisis-induced hysteresis may be reversed in conditions of stronger demand’ (Draghi 2018, emphasis added).

Table 2 Friedman’s (1968) model versus a more general model

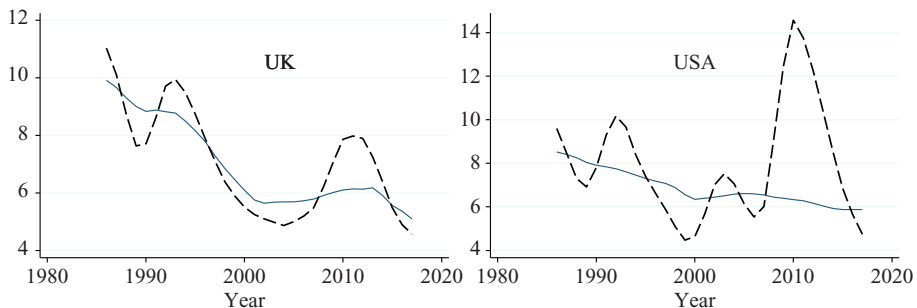
	Friedman (1968)		Generalized model
	Base-run	Increase in $\hat{\Theta}$	Increase in $\hat{\Theta}$
Unemployment $u_N = u_A$	0.0600	0.0600	0.0550
Target interest rate $r_T$	0.0450	0.0550	0.0525
Nominal wage growth $\hat{W}$	0.0400	0.0400	0.0500
Labour productivity growth $\hat{\lambda}$ (exogenous)	0.0200	0.0200	0.0300
Inflation rate $\hat{p}$	0.0200	0.0200	0.0200
Autonomous demand growth $\Theta$	0.03	0.05	0.05
Labour market regulation $z$	1.0	1.0	1.0

Note: It is assumed that  $\alpha_0 = -0.030$ ;  $\alpha_1 = 1$ ;  $\alpha_2 = \frac{1}{2}$ ;  $\alpha_3 = 0.1$ ;  $\gamma = 2$ ;  $\mu = 1/\gamma = \frac{1}{2}$ ;  $\hat{\lambda}0 = 0.005$ ; and  $\beta = \frac{1}{2}$ .

Figure 3 uses official OECD statistics on the NAIRU for the UK and the USA (1986–2017) and compares these to the three-year moving average of the *actual* unemployment rate in these two economies. What is remarkable is the very strong correlation between  $u_A$  and  $u_N$  ( $R^2$  is about 1 in both graphs). We can see strong comovement except for the years 2008–2014, when  $u_A$  shot up relative to the NAIRU in the aftermath of the financial crisis. What also strikes us is the rather continuous decline in both actual and equilibrium unemployment rates: the NAIRU is anything but constant. The graphs are not telling us whether the NAIRU is 'leading' actual unemployment, or whether it is the other way round. I cannot offer decisive proof that the NAIRU is mimicking the actual unemployment rate, as equation (9) implies, but I think it is plausible – and more so than the other story. The strong correlation is also signalling this, because if the *demand-determined actual* unemployment rate, measured as a *three-year* moving average, is almost indistinguishable from what is supposed to be a *structural, long-term*, equilibrium or even 'natural' unemployment rate, then one cannot avoid asking: is three years the long run? Is three years 'structural' in any meaningful way? The answer is clear: if the official NAIRU moves up and down with (non-structural, fluctuating) actual unemployment, it cannot be structural or long-term. Equation (9) holds.

Theoretically, the upshot is this. First, Friedman's and Phelps's neat dichotomy between a demand-determined short run and a ('structural') supply-determined long run is a charade. It doesn't exist. Demand matters for long-run (potential) growth through its impact on accumulation and production capacity, and through a deepening of the division of labour, specialization and increasing returns to scale. This implies that there is a significant and avoidable cost to inflation targeting in terms of growth lost forever and additional unemployment suffered – which should not have surprised Friedman who, after all, is famous for popularizing the idea that 'there is no such thing as a free lunch' (Friedman 1975).

Second, the NAIRU is not an anchor, as it has no 'homing tendency' (as Phelps 2017 puts it), but rather is a moving target, as it moves up and down with trend growth of (autonomous) demand. There is nothing 'natural' about the NAIRU.



*Notes:* The dashed line is the actual unemployment rate (measured as a three-year moving average); the solid line is the NAIRU. The average NAIRU during 1985–2017 is 7.1 per cent for the UK and 5.5 per cent for the USA. The actual unemployment rate and the NAIRU are closely and highly significantly correlated:  $R^2 = 0.99$  for the UK and 0.95 for the USA. The biggest discrepancy between  $u_A$  and  $u_N$  occurred in the wake of the financial crisis of 2008.

*Source:* OECD *Economic Outlook Dataset* No 102 (November 2017).

*Figure 3* The NAIRU closely tracks the actual unemployment rate: UK and USA (1986–2017)

Friedman (1968, p. 9) appears to recognize this when he writes: ‘to avoid misunderstanding, let me emphasize that by using the term “natural” rate of unemployment, I do not mean to suggest that it is immutable and unchangeable, on the contrary, many of the market characteristics that determine its level are manmade and policy-made’. But Friedman simply means labour market ‘rigidities’ and unions here. Phelps (2017) writes that the ‘natural rate’ is ‘not a constant of nature, like the speed of light. Certainly, it could be moved by structural forces, whether technological or demographic’. But Phelps falls short of acknowledging the possibility that demand is driving technological progress *in a structural sense*, as I argue here and elsewhere (Storm and Naastepad 2012). The point is that any structural, or secular, decline in demand growth, due to consistently rising inequality, a permanent state of fiscal austerity and/or depressed global export growth, must show up in a rising NAIRU. Conversely, as argued in Storm and Naastepad (2012; 2015a; 2015b; 2016a; 2016b), a successful restoration of a higher trend for demand growth sets in motion a virtuous cycle of faster productivity growth, higher nominal wage growth, higher job growth and lower equilibrium unemployment.

## 5 WHERE DID THE WRONG ROAD LEAD TO?

John Kenneth Galbraith once remarked that ‘Milton Friedman’s misfortune is that his economic policies have been tried’. Galbraith was, of course, referring to the failed practice of using money supply as the instrument of inflation control.<sup>1</sup> But Friedman, who died in 2006, did not live long enough to witness the true scale and scope of the catastrophe, brought on by his extremist ideas: the shambles of a Not So Great Moderation, the global financial crisis of 2008 and the long recession which followed it (Galbraith 2008a; Storm and Naastepad 2012). In a sense, he did enjoy a free lunch. Friedman’s presidential address led us on the road to this disaster, as it legitimized and ‘rationalized’ monetary, fiscal and labour market policies that over a period of three decades created structurally low-inflation economies in the US, the UK and the eurozone, which suffer from artificially depressed productivity growth and higher structural unemployment than would have been possible and desirable (to stabilize inflation). Friedman legitimized the prioritization of fighting inflation over fighting unemployment, and justified the deregulation of labour markets, thus paving the road to Alan Greenspan’s ‘traumatized worker’, ‘someone who felt job insecurity in the changing economy and so was resigned to accepting smaller wage increases’ (Woodward 2000, p. 163), and to stagnant wages, the polarization of jobs, and sharp rises in inequality (Storm 2017; Temin 2017). The economic and social costs of taking the wrong road, on Friedman’s and Phelps’s advice, have been huge and, sadly, wholly avoidable: Friedman’s policy prescriptions slowed down aggregate demand growth, demolished social overhead structures and retarded technological progress. Unfortunately, there is more. The secular stagnation of growth and the traumatization of workers made it possible to transition to a low interest rate regime, but the cheap credit did not persuade firms and consumers to spend more (for lack of demand); instead, as is well known, it led to massive issuing of (mortgage) credit, speculative securitization and corporate (banking) fraud, as well as massive asset-price bubbles which collapsed in the financial crisis of 2007–2008. Paul Samuelson (2009a) provides a fair summary of Friedman’s legacy:

Today we see how utterly mistaken was the Milton Friedman notion that a market system can regulate itself . . . . Everyone understands now, on the contrary, that there can be no solution

without government. The Keynesian idea is once again accepted that fiscal policy and deficit spending has a major role to play in guiding a market economy. I wish Friedman were still alive so he could witness how his extremism led to the defeat of his own ideas.

Sadly, Friedman's extremism did not (yet) lead to the defeat of his ideas, as the 'new monetary consensus' continues to mythologize Friedman's address until this day (Mankiw and Reis 2018). Richard Eisner (1995) and James Galbraith (1997) wrote trenchant briefs against the NAIRU which should have closed the case once and for all, but didn't. James Galbraith repeated his argument in 2008:

The idea that low unemployment generates runaway inflation was an absurdity on its face. If it had been true, runaway hyperinflations should have been common in history, whereas in fact they are very rare. Yet the [NAIRU] model served the self-importance of central bankers and the perpetuation of conservative rule in monetary policy. ... Over time, central bankers managed to persuade themselves, and many economists, of their indispensability to the anti-inflation struggle. (Galbraith 2008a, p. 46)

Storm and Naastepad (2007; 2012) followed up and attempted to convince the profession that the NAIRU model is a professional embarrassment. But in economics, 'where there is no agreed procedure for knocking out errors, doctrines have a long life', wrote Joan Robinson (1962, p. 76). This is especially true for Friedman's NAIRU model – because, as I tried to explain above, the NAIRU is endogenous and hence fixed by the central bank at the level at which monetary policymakers have estimated the 'natural unemployment' based on a partial model and a false doctrine. Enslaved by a defunct doctrine, central banks have not allowed structural expansions, which would have reduced the NAIRU and raised potential output growth, to last. Worse still, the hawkish inflation targeting and persistent real wage restraint have raised the NAIRU by curbing the growth of aggregate demand and of productivity. It is in this sense that Friedman's NAIRU doctrine has created a 'self-inflicted wound, a socio-psychological disability, of colossal proportions' (Galbraith 1997, p. 99). Fifty years after Friedman's (1968) presidential address, we have to unlearn his lessons (and those of Phelps as well) – and return to the road we left. One way to do so is by treating Friedman's (1968) model of the long run as just a special case of a more general demand-determined theory of the long run – as I tried to argue here. Keynesians' claim that demand is all-powerful – that it alone increases employment and thus investment and even (productivity) growth – is justified. But let me give the final word to a well-known contemporary of Friedman's, who knew him well:

[Milton Friedman] is as bright a guy as you would ever meet. But I don't think he realizes the tremendous number of mistakes he has made in his life. I don't think anybody has read every item of Milton Friedman's work in the world but me ... Sometimes I say he's got such a high IQ that he's got no protection against himself. He looks at his work and is satisfied with it. However, I think that it is a tragedy when somebody really takes the wrong train in life.

*Dixit* Paul A. Samuelson (2009b, p. 49). The tragedy is ours, however, rather than Friedman's.

## REFERENCES

- Arestis, P., M. Baddeley and M. Sawyer (2007), 'The relationship between capital stock, unemployment and wages in nine EMU countries', *Bulletin of Economic Research*, 59(2), 125–148.
- Ball, L. (1999), 'Aggregate demand and long-run unemployment', *Brookings Papers on Economic Activity*, 1999(2), 189–251.

- Ball, L.M. (2014), 'Long-term damage from the Great Recession in OECD countries', NBER Working Paper No 20185.
- Basu, D. and D. Foley (2013), 'Dynamics of output and employment in the U.S. economy', *Cambridge Journal of Economics*, 37(5), 1077–1106.
- Bator, F.M. (1987), 'The state of macroeconomics', in A. Steinherr and D. Weiserbs (eds), *Employment and Growth: Issues for the 1980s*, Dordrecht: Martinus Nijhoff Publishers, pp. 29–45.
- Blanchard, O., E. Cerutti and L. Summers (2015), 'Inflation and activity: two explorations and their monetary policy implications', NBER Working Paper No 21726.
- Cross, R. and D. Lang (2011), 'The NAIRU: still "not an interesting rate of unemployment"', *European Journal of Economics and Economic Policies: Intervention*, 8(2), 317–340.
- Draghi, M. (2018), 'Monetary policy in the Euro Area', Speech given on 14 March, available at: [https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180314\\_1.en.html](https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180314_1.en.html).
- Eatwell, J. and M. Milgate (2011), *The Fall and Rise of Keynesian Economics*, Oxford: Oxford University Press.
- Eisner, R. (1995), 'On NAIRU limit: the governing myth of economic policy', *The American Prospect*, Spring, 58–63.
- Ericsson, N., D. Hendry and H. Stedman (2017), 'Milton Friedman and data adjustment', VoxEU.org, 4 May, available at: <https://voxeu.org/article/milton-friedman-and-data-adjustment>.
- Foley, D.K. and T.R. Michl (1999), *Growth and Distribution*, Cambridge, MA: Harvard University Press.
- Friedman, M. (1968), 'The role of monetary policy', *American Economic Review*, 58(1), 1–17.
- Friedman, M. (1975), *There's No Such Thing as a Free Lunch*, LaSalle, IL: Open Court Publishing.
- Galbraith, J.K. (1997), 'Time to ditch the NAIRU', *Journal of Economic Perspectives*, 11(1), 93–108.
- Galbraith, J.K. (2008a), *The Predator State: How Conservatives Abandoned the Free Market and Why Liberals Should Too*, New York: Free Press.
- Galbraith, J.K. (2008b), 'The collapse of monetarism and the irrelevance of the new monetary consensus', Policy Note, 1, The Levy Institute of Bard College.
- Goodfriend, M. (2007), 'How the world achieved consensus on monetary policy', *Journal of Economic Perspectives*, 21(4), 47–68.
- Kaldor, N. (1966), *Causes of the Slow Rate of Economic Growth of the United Kingdom: An Inaugural Lecture*, Cambridge, UK: Cambridge University Press.
- Kaldor, N. (1996), *Causes of Growth and Stagnation in the World Economy*, Cambridge, UK: Cambridge University Press.
- Karanassou, M. and D. Snower (2004), 'Unemployment invariance', *German Economic Review*, 5(3), 297–317.
- Karanassou, M., H. Sala and P.F. Salvador (2009), 'Capital accumulation and unemployment: new insights on the Nordic experience', *Cambridge Journal of Economics*, 32(6), 977–1002.
- Keynes, J.M. (1936), *The General Theory of Employment, Interest and Money*, London: Palgrave Macmillan.
- Lang, D. and M. Setterfield (2015), 'Is there scientific progress in macroeconomics? The case of the NAIRU', Working Paper 1509, New School for Social Research, Department of Economics.
- Lucas, R.E. (1972), 'Expectations and the neutrality of money', *Journal of Economic Theory*, 4, 103–124.
- Lucas, R.E. (1981), 'Tobin and monetarism: a review article', *Journal of Economic Literature*, 29(2), 558–585.
- Lundberg, E. (1976), 'The Nobel Prize in Economics 1976 – Presentation Speech', available at: [https://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/1976/presentation-speech.html](https://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1976/presentation-speech.html).
- Mankiw, N.G. and R. Reis (2018), 'Friedman's presidential address in the evolution of macroeconomic thought', *Journal of Economic Perspectives*, 32(1), 81–96.

- Mortensen, D.T. and C.A. Pissarides (1994), 'Job creation and job destruction in the theory of unemployment', *Review of Economic Studies*, 61(3), 397–415.
- Myrdal, G. (1957), *Economic Theory and Underdeveloped Regions*, London: Methuen.
- Phelps, E.S. (1967), 'Phillips curves, expectations of inflation and optimal unemployment over time', *Economica*, 34(135), 254–281.
- Phelps, E.S. (1968), 'Money-wage dynamics and labor-market equilibrium', *Journal of Political Economy*, 76(2), 678–711.
- Phelps, E.S. (2017), 'Nothing natural about the natural rate of unemployment', 24 November, New York, Institute for New Economic Thinking website, available at: <https://www.inetecconomics.org/perspectives/blog/nothing-natural-about-the-natural-rate-of-unemployment>.
- Robinson, J. (1962), *Economic Philosophy*, London: Penguin Books.
- Rowthorn, R.E. (1995), 'Capital formation and unemployment', *Oxford Review of Economic Policy*, 11(1), 26–39.
- Rowthorn, R.E. (1999), 'Unemployment, wage bargaining and capital–labour substitution', *Cambridge Journal of Economics*, 23(4), 413–425.
- Samuelson, P.A. (2009a), 'Don't expect recovery before 2012', available at: [http://www.digitalnpg.org/articles/economic/331/01-16-2009/paul\\_samuelson](http://www.digitalnpg.org/articles/economic/331/01-16-2009/paul_samuelson).
- Samuelson, P.A. (2009b), 'Interviews: Paul A. Samuelson' in K.I. Horn, *Roads to Wisdom: Conversations with Ten Nobel Laureates in Economics*, Cheltenham, UK and Northampton, MA: Edward Elgar Publishing, pp. 39–57.
- Sargent, T.J. and N. Wallace (1975), 'Rational expectations, the optimal monetary instrument, and the optimal money supply rule', *Journal of Political Economy*, 83(2), 241–254.
- Solow, R.M. (1987), 'The conservative revolution: a roundtable discussion', *Economic Policy*, 5, 182–200.
- Stanley, T.D. (2005), 'Integrating the empirical tests of the natural rate hypothesis: a meta-regression analysis', *Kyklos*, 58, 611–634.
- Storm, S. (2015), 'Structural change', *Development and Change*, 46(4), 666–699.
- Storm, S. (2017), 'The new normal: demand, secular stagnation and the vanishing middle class', *International Journal of Political Economy*, 46(4), 169–210.
- Storm, S. and C.W.M. Naastepad (2007), 'It is high time to ditch the NAIRU', *Journal of Post Keynesian Economics*, 29(4), 531–554.
- Storm, S. and C.W.M. Naastepad (2012), *Macroeconomics beyond the NAIRU*, Cambridge, MA: Harvard University Press.
- Storm, S. and C.W.M. Naastepad (2015a), 'NAIRU economics and the eurozone crisis', *International Review of Applied Economics*, 29(6), 843–877.
- Storm, S. and C.W.M. Naastepad (2015b), 'Europe's hunger games: income distribution, cost competitiveness and crisis', *Cambridge Journal of Economics*, 39(3), 959–986.
- Storm, S. and C.W.M. Naastepad (2016a), 'Bhaduri–Marglin meet Kaldor–Marx: wages, productivity and investment', *Review of Keynesian Economics*, 5(2), 4–24.
- Storm, S. and C.W.M. Naastepad (2016b), 'Myths, mix-ups, and mishandlings: understanding the Eurozone crisis', *International Journal of Political Economy*, 45(1), 46–71.
- Summers, L. (2015), 'Demand side secular stagnation', *American Economic Review: Papers & Proceedings*, 105(5), 60–65.
- Temin, P. (2017), *The Vanishing Middle Class: Prejudice and Power in a Dual Economy*, Cambridge, MA: MIT Press.
- Verdoorn, P.J. (1949), 'Fattori che regolano lo sviluppo della produttività del lavoro', *L'industria*, 1, 3–10.
- Woodward, B. (2000), *Maestro: Greenspan's Fed and the American Boom*, New York: Simon & Schuster.
- Young, A. (1928), 'Increasing returns and economic progress', *Economic Journal*, 38(152), 527–542.



## APPENDIX 1 THE DERIVATION OF THE CENTRAL BANK'S MONETARY POLICY RULE

To stabilize inflation the central bank has to fix its target interest rate so as to equate actual unemployment  $u_A$  and the NAIRU  $u_N$ . This means, from equation (1), that:

$$u_N = \gamma r_T - \hat{\Theta}, \quad (1\#)$$

which yields:

$$r_T = \frac{u_N + \hat{\Theta}}{\gamma} = \mu u_N + \mu \hat{\Theta} = \mu(u_N - u_A) + \mu(\hat{\Theta} - u_A), \quad (10)$$

where  $\mu = (1/\gamma)$ . If the target interest rate is set according to (10), the unemployment gap ( $u_A - u_N$ ) is zero and inflation is stable. But there is no reason why  $r_T$  will stabilize inflation at  $\hat{p}_T = 2$  per cent. Inflation targeting means that  $\hat{p} = \hat{p}_T = 2$  per cent. Imposing this condition on the Phillips curve relation (4), we get:

$$\hat{p}_T = \Xi - \alpha_1 u_A + \hat{p}_e. \quad (4\#)$$

Assuming that inflation expectations turn out to be correct (hence  $\hat{p}_e = \hat{p}$ ), I rewrite (4#) as follows:

$$u_A = \frac{\Xi + (\hat{p} - \hat{p}_T)}{\alpha_1} = \chi \Xi + \chi(\hat{p} - \hat{p}_T). \quad (11)$$

Substituting (11) into (10) and rearranging gives the central bank's MPR given by equation (6):

$$r_T = \mu(u_N - u_A) + \mu \hat{\Theta} + \mu \chi \Xi + \mu \chi(\hat{p} - \hat{p}_T) \quad (6\#)$$

or

$$r_T = \theta_0 + \theta_1(\hat{p} - \hat{p}_T) + \mu(u_N - u_A), \quad (6)$$

where  $\theta_0 = \mu \hat{\Theta} + \mu \chi \Xi$  and  $\theta_1 = \mu \chi$ . Let me remind the reader that although Friedman himself did not propose this particular MPR, he was, for many years, in favour of replacing the Federal Reserve with a computer. The MPR, seen this way, is just Friedman's algorithm.