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National Minimum Wage Research Initiative

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Abstract

This Research Brief analyses whether neoclassical computable general equilibrium (CGE) models are suitable for assessing the potential impact of a national minimum wage in South Africa. This is important because such models, used most recently by the National Treasury and DPRU, are being used to guide policy. We highlight their systematic bias, demonstrating that, by construction, increased wages will, and can only, lead to predictions of job losses and economic deterioration. In neoclassical CGE models the economy is only able to adjust to higher wages by increasing prices and reducing employment. These adjustments have been shown empirically not to occur, or to occur only modestly, when minimum wages are implemented or increased. The adjustments that occur most often in practice are not accommodated within the models. Crucially, the construction of neoclassical CGE models and the assumptions used in their design lead to an inevitable fall in aggregate demand as a result of increasing wages due to the introduction of a national minimum wage. This occurs because (i) real incomes fall due to higher prices and rising unemployment and (ii) aggregate demand is further depressed by declines in investment and consumption expenditure. The models and assumptions made cannot, by design, accommodate non-negative consequences from an increase in wages. Given that the direction of the results, if not their magnitude, are determined before the model is run we question the usefulness of these projections to actual policy making.

Project information

This Research Brief forms part of the National Minimum Wage Research Initiative (NMW-RI) undertaken by CSID in the School of Economics and Business Science at the University of the Witwatersrand. The NMW-RI presents theoretical and case-study evidence, statistical modelling and policy analysis relevant to the potential implementation of a national minimum wage in South Africa.

For more information contact Gilad Isaacs, the project coordinator, at gilad.isaacs@wits.ac.za or visit www.nationalminimumwage.co.za.

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Executive Summary

This Research Brief analyses whether neoclassical computable general equilibrium (CGE) models are suitable for assessing the potential impact of a national minimum wage in South Africa. This is important because such models are being used to guide policy. We demonstrate that such neoclassical CGE models, due to the manner in which the models are constructed and assumptions made prior to their use, necessarily produce a prediction that rising wages will lead to unemployment and economic deterioration. This helps to explain the implausibly large job losses predicted in recent CGE modelling exercises by the National Treasury (MacLeod 2015) and UCT's Development Policy and Research Unit (DPRU 2016), where very low minimum wages – as low as R1 258 and R1 619 respectively – result in up to 450 000 job losses. The paper highlights four central shortcomings of the CGE modelling studies reviewed.

First, as acknowledged by scholars using the South African models, the model economy is only able to adjust to higher wages by increasing prices, shedding jobs, or a combination of the two. The empirical evidence in the minimum wage literature – analysing the effect of minimum wage increases after they have been implemented – show that job losses and rising prices occur only very modestly, if at all, in practice. Instead, economies and firms have been shown to adjust to higher wages through: productivity increases due to changing production techniques; 'efficiency wage' effects through which higher wages improve performance and reduce job turnover irrespective of management intervention; redistribution from high earners to low earners within firms; reduced profit margins; and (less often) small changes to the number of hours worked or non-wage benefits. Such adjustments are excluded or heavily constrained in neoclassical CGE models. In addition, rising minimum wages have been shown to positively stimulate aggregate demand; in the CGE models studied, instituting a national minimum wages always leads to a fall in aggregate demand.

Second, neoclassical CGE models set up the model economy – through the variables selected and equations used – to function as predicted by neoclassical economic theory irrespective of the observed dynamics of the specific economy being studied. Most important is that (relative) prices play the dominant role in the model. This informs the manner in which the model economy responds to higher wages. Job losses arise in the models from two interrelated processes: firms employing relatively more machines and less workers (a 'substitution effect'), and price rises eroding real incomes and reducing demand (a 'scale effect'). Demand falls because: (a) employment falls (through capital-labour substitution) leading to a loss of consumer income; (b) a higher price level makes production inputs and the final product more expensive and so reduces demand for both; (c) higher output prices mean the real wage increase is less than the nominal wage increase, thereby eroding the buying power of consumers; (d) price-sensitive net exports potentially decline depending on the assumptions made regarding the trade balance; and (e) a necessary depreciation in the exchange rate occurs in order to maintain a constant trade balance (if the assumption of a constant trade balance is imposed). Thus these models find that negative effects on demand outweigh positive effects that may have occurred

due to increased incomes from higher wages. All of this results in falling aggregate demand, depressed output and growth, lower firm profits and rising unemployment.

Third, the models assume (based on neoclassical theory) that savings determine investment and, given the specifics of the assumptions made regarding this relationship (the 'macroeconomic closure'), aggregate demand can only be depressed further when firm profits and firm savings fall. When investment as a percentage of domestic demand is assumed to be fixed (as in the majority of the studies reviewed) this fall in demand occurs because overall investment falls to keep investment as a percentage of domestic demand constant (in the context of declining domestic demand) and because household savings must rise to compensate for a fall in firm savings (as acknowledged by the modellers). The former results in reduced investment expenditure and the latter results in a decline in household disposable income and consumption demand. The cumulative effect is a fall in aggregate demand, job losses, and a negative impact on output and growth. The imposition of a rise in the household savings rate is neither mentioned nor justified and there is no credible explanation for why low-wage households might save more with the institution of a national minimum wage. When an alternative assumption is made (as in one of the studies reviewed) and investment is simply set equal to savings, a fall in firm savings results in a fall in investment, thus reducing demand and employment.

Fourth, it is possible that different assumptions, for instance a Keynesian closure where investment drives savings (rather than the reverse assumed by neoclassical theory), may result in a different outcome. This highlights how many of the studies do not interrogate the assumptions made in the course of the modelling, despite how heavily these modelling assumptions determine the direction of the results. The sensitivity of the results to alternative closures is also not tested.

The results reported in the studies reviewed reflect the design and assumptions made and not the actual workings of the South African economy. Other modelling approaches are not necessarily subject to the shortcomings listed. By construction the neoclassical CGE models find that higher wages reduce aggregate demand and cause economic deterioration, irrespective of the magnitude of the (negative) price, wage, and substitution elasticities used. Given this, we question the suitability of these models for forecasting what may occur in practice as a result of the introduction of a national minimum wage in South Africa. We raise doubts over whether policy should be guided by modelling for which the direction of the outcomes is predetermined with the only open question being how bad the employment effects will be and whether these can be justified in light of some degree of poverty alleviation.

1 Introduction

As part of an on-going debate over the possible implementation of a national minimum wage (NMW) in South Africa, a number of statistical modelling exercises have been undertaken attempting to estimate the possible effect that a national minimum wage might have on the South African economy (MacLeod 2015, Adelzadeh and Alvillar 2016, DPRU 2016, Strauss and Isaacs 2016). Two of these, by the National Treasury (MacLeod 2015) and the Development Policy Research Unit at the University of Cape Town (DPRU 2016), use computable general equilibrium (CGE) models. The results of these models carry considerable analytical weight and seem to have been influential in shaping government's position. This Research Brief analyses the construction of these models in order to assess whether they are appropriate for this task.

We demonstrate here that such neoclassical CGE models, *due to the manner in which the models are constructed* and *assumptions made* prior to their use, *necessarily* produce a prediction that rising wages will lead to unemployment and economic deterioration. This helps to explain the highly implausible results generated.

We do not consider in depth possible alternative econometric models as details of these can be found in Strauss and Isaacs (2016) and Adelzadeh and Alvillar (2016) although these are referred to where relevant. There is a specific focus here on the relationship between wage increases and employment. The methods for estimating welfare effects are not directly considered, although these are substantially driven by the impact on employment. Unfortunately the National Treasury (MacLeod 2015) and DPRU (2016) provide very limited information on their modelling assumptions, while the DPRU shows results for just a few variables. This is problematic for a critical debate. Accordingly, in discussing CGE models we also draw on forerunners of their models, as well as DPRU (2008), Pauw (2009), and Pauw and Leibrandt (2012).

This analysis is critical because if the direction of the outcomes are pre-determined by the model then we cannot seriously consider the models' results for policy-making purposes; this, we show, is the case.

2 Approaching modelling minimum wage increases

All modelling exercises estimating the effect of a national minimum wage *begin* with a few simple steps:

1. Develop 'scenarios' on the level of the national minimum wage to be set and other contextual factors (such as the level of compliance);
2. Calculate the number of workers affected and their sectoral allocation and other features, for example gender, location, and so on;
3. Work out the extent of the wage increase to which they would be entitled;

These three steps are fairly straightforward descriptive statistics exercises and are explained in each paper / presentation. Next, the model must estimate the extent to which the demand for (low-wage) labour is affected by other changes in the economy. Central to all models is the 'wage-employment elasticity': the ratio of the percentage change in employment to the percentage change in the (legislated minimum) wage. For example if the employment elasticity is –0.1 then a 10% increase in the (minimum) wage would reduce the relevant employment by 1%. Also central is the 'elasticity of substitution' between capital and labour: the extent to which an increase in wages cause firms to use more capital and less labour. DPRU (2008) and Pauw (2009) note that the elasticity of substitution is derived from the wage-employment elasticity. In neoclassical CGE models these elasticities, together with rising prices due to wage increases, play a leading role in determining levels of employment. This poses dangers on two levels. First, how these elasticities are arrived at in CGE modelling exercises is often problematic. Second, other factors such as labour productivity, levels of economic activity, and incomes, which also determine employment levels, are ignored or play a secondary role; these issues are discussed here and in Section 4.

No single employment elasticity can capture the relationship between wages and employment in the economy as a whole. This is because the sensitivity of this relationship will vary between sectors. No single elasticity is even applicable to an entire sector, as the effects at different wage levels may vary for the same percentage increase.[1] Neoclassical CGE models, Keynesian CGE models and econometric models may all be vulnerable to these dangers; although the ADRS model used by Adelzadeh and Alvillar (2016) uses elasticities estimated on a sectoral basis.

CGE models face a further challenge in that their elasticities are either 'calibrated' or simply chosen by the modeller. 'Calibration' involves deriving the elasticities based on data from an arbitrarily-chosen single 'benchmark year'. The same is true of other important parameters in the model. Econometric models on the other hand use sophisticated econometric estimations techniques to derive the elasticities based on country-specific time-series or panel data. The ADRS model, for instances, uses 45 years of South Africa data to determine what the sector-specific elasticities in the South African economy are. CGE models also often rely on elasticities that are derived outside of the model and 'dropped into' it. The data used to derive that elasticity may be internally inconsistent – as in Edwards (2004) – or inconsistent with the data in the model. In many instances the elasticity is simply guessed. The National Treasury modelling selects (not calculates) an elasticity of -0.5 for the economy as a whole without any sectoral

[1] This means that the demand curve may have different elasticities at different wage levels. For example, the percentage change to employment induced by a percentage change in wages when moving from R1 000 000 to R1 100 000 may be different than when moving from R1 000 to R1 100 despite both involving a 10% increase. Moreover, demand curves may shift over time as technology changes and labour markets segment in new ways.

differentiation. The DPRU (2016) chooses to model three different elasticities within a range they considered plausible: -0.1, -0.3 and -0,5.[2]

Wage-employment elasticities are almost always negative (in all types of models), that is to say an increase in wages is assumed to lead to a decline in employment. The critical issue is how appropriately the particular model allows the direct wage-employment relationship to be mediated by other dynamic interactions within the economy. These include, for example, ways in which firms and the economy adjust to increases in low-wage labour costs and the possible resulting expansion in domestic demand. The interactions will determine the eventual impact. This is where the design, assumptions and 'closures' of the model are critical. A 'closure' is a decision made over the causality between variables (in determining how equilibrium is achieved in various macroeconomic balances).

There are two key questions. First, do the design, assumptions and closures of the model predetermine the direction (if not the magnitude) of the outcome? We demonstrate that the negative outcome from neoclassical CGE modelling is predetermined (see Section 4). Second, to what extent does the model allow for the adjustment mechanisms that are frequently observed in the actual economy? These adjustment mechanisms include:

1. Firms' ability to mark up prices to cover the increase in their low-wage labour costs (discussed further below).[3]

2. Productivity increases. This includes "greater managerial effort on productivity-enhancing activities, including the reorganization of work, setting higher performance standards, or demanding greater work intensity" (Schmitt 2013, p. 13, for evidence of this see for example Hirsch *et al.* 2011). This may be particularly relevant in South Africa where the apartheid legacy of cheap labour resulted in shop-floor management inefficiency, poor training, and low skills (Joffe *et al.* 1995). Productivity increases also include the 'efficiency wage' effect where higher wages may spur workers to work harder, independently of any actions employers may take (there is strong evidence of this, see for example Dickens *et al.*

[2] DPRU emphasises the wage-employment elasticities used on a number of occasions. However, they then note that: "A general equilibrium approach differs to that of a partial equilibrium approach in that it allows the evaluation of an impact of one factor's wage rate change on not only the employment of that factor, but also the employment of other factors and the knock-on effects of employment of all factors in other sectors. *For this reason, employment changes in general equilibrium models depend on the elasticity of substitution (EOS) and not the wage elasticities, as is the case with partial equilibrium models.*" (DPRU 2016, p. 74 emphasis added). The EOSs – presumably incorporated within CES production functions – determine the substitution between capital and labour as wages change. These elasticities are never given nor, in CGE models, are they usually obtained on the basis of econometric analysis; they are usually assumed to be large (i.e. an increase in wages leads to a large shift towards capital and away from labour). DPRU (2008, pp. 5–6, 87) argues that these are likely to be similar to the employment elasticities used, illustrating this mathematically (see also Pauw 2009, pp. 39, 251–253).

[3] Note that, to the extent this occurs, the South African economy would be adjusting to the minimum wage increase essentially through redistributing income from consumers to low-wage workers, via the price mark-up.

1994, Nickell and Layard 1999, Bassanini and Venn 2007, Peach and Stanley 2009, Dube *et al.* 2010, Mayneris *et al.* 2014, Rizov *et al.* 2016). Efficiency wages increase productivity through:

   a. Reductions in turnover;
   b. Reductions in absenteeism;
   c. Higher morale and a resulting increase in effort;
   d. Attracting higher-productivity workers.

3. Redistribution within the firm: owners having their profit margin shaved, and/or higher-paid workers seeing their wage increases reduced for some time period (see Draca *et al.* 2011, Hirsch *et al.* 2011). This is also relevant to South Africa given that average profit margins for South African firms are well above their emerging market peers, as noted by the IMF (2013).[4]

4. Other reductions, for example in hours worked, non-wage benefits, and training costs, although there is mixed and limited evidence that these actually occur in practice (on hours and training see Neumark and Wascher 2008, Dube *et al.* 2010, Belman and Wolfson 2014, on non-wage benefits see review by Simon and Kaestner 2004).

5. The gains from higher wages and overall economic growth shared disproportionately by low-wage workers for a set period of time (there is strong evidence that this occurs, see Mudronova 2016).

6. Increased domestic demand and hence GDP growth, due to higher wages among the low-paid (with their higher propensity to consume) (see Cahuc and Michel 1996, Askenazy 2001, Herr *et al.* 2009, Rani *et al.* 2013, Alonso 2015). Schmitt notes that this is particularly the case when the "the economy is in a recession or operating below full employment" (2013, p. 20).

Besides for firms raising prices and/or shedding jobs to compensate for increased wages – adjustments that the empirical literature shows do not occur or occur only very modestly – neoclassical CGE models are entirely unable to, or do a very poor job at, capturing these dynamics (this is discussed further in Section 4.2 below).[5]

[4] The use of 'representative households' within CGE models makes it difficult for them to meaningfully to capture distributional shifts. By contrast, the ADRS model uses StatsSA household survey data for 125 830 individuals, making up 61 684 families or 29 800 households (Adelzadeh and Alvillar 2016) and the functional distribution of income plays a central role in the UN GPM (Strauss and Isaacs 2016).

[5] Partial equilibrium simulations – in which the impact on employment is determined solely by the degree of the wage increase and the wage-employment elasticity – do not allow for *any* of these interactions and for this reason are inappropriate (see DPRU 2008, Pauw 2009 for a critique).

3 Existing applications to national minimum wages in South Africa

After the model is set up, different 'scenarios' are run that involve specifying different levels for the national minimum wage and thus producing predictions for how the economy will react. The predictions by DPRU and National Treasury uniformly indicate deterioration in the economy despite some of these involving national minimum wage levels well below the lowest current sectoral minimum wage (for domestic workers in non-major urban centres) of R1 994 per month.

Tables 1, 2, and 3 show the predicted outcomes from the National Treasury (MacLeod 2015) for different possible levels of a national minimum wage (numbers are rounded off in all tables).[6] The first column in each table shows the predicted response of the economy to a national minimum wage of R1 258 per month, under which 16% of workers would benefit from receiving higher wages with the average increase per worker being only R31, or 2.5%.[7] The total wage bill of the country would increase by a mere R52 million. The model predicts that this will result in a fall in real GDP of 0.3% in the short run and 1% in the long run and a loss of 96 000 jobs in the short run (no employment estimates are given for the long run).[8] Progressively higher levels of the minimum wage are predicted to result in greater economic harm. When the national minimum wage is set at R4 303, real GDP, household consumption, gross fixed capital investment, government investment, imports, and exports all fall by between approximately 3% and 4% in the short run – and job losses are predicted to be approximately 1.2 million. At this level, economic deterioration in the long run is even more extreme with the macroeconomic indicators sliding by between 11% and 15%.

Table 1 National Treasury wage increases

	R1 258	**R1 886**	**R3 189**	**R4 303**
Average rand increase	R31	R139	R719	R1 434
Workers affected (%)	16	28	50	60
Workers affected	1 678 000	3 003 000	5 320 000	6 374 000
Average increase (%)	2.5	8	29	50
Total wage bill increase	R51 841 000	R417 670 000	R3 823 640 000	R9 140 774 000

Source: Own calculations using MacLeod (2015)

[6] Unfortunately the National Treasury has declined to make their modelling paper available for public or academic scrutiny, despite requests to do so. The analysis here is based on their Powerpoint and transcripts of their verbal presentations. Workings are available upon request.
[7] These are calculated as weighted averages using slides 16 and 17 of MacLeod (2015).
[8] Strictly speaking, CGE models do not have a time dimension. The model can be run over a set number of iterations but these do not correspond to an actual number of years in the future. The distinction between 'short run' and 'long run' is on the basis of the assumptions made. That is, the economy is assumed to behave in a certain way in the 'short run' and generate particular results, and then different assumptions are made and this is termed the 'long run'.

Table 2 Short-run National Treasury outputs

	R1 258	R1 886	R3 189	R4 303
Real GDP (% change)	-0.3	-0.7	-2.1	-3.7
Household consumption (% change)	-0.2	-0.6	-2.1	-3.7
Gross fixed capital investment (% change)	-0.2	-0.6	-2.0	-3.6
Government consumption (% change)	-0.3	-0.6	-1.7	-2.9
Exports (% change)	-0.2	-0.6	-1.7	-3.1
Imports (% change)	-0.2	-0.5	-1.6	-2.9
Jobs lost (% change)	-0.8	-2.1	-6.2	-10.1
Jobs lost	96 000	244 000	715 000	1 168 000

Source: Own calculations using MacLeod (2015)

Table 3 Long-run National Treasury outputs

	R1 258	R1 886	R3 189	R4 303
Real GDP (% change)	-1.0	-2.5	-7.5	-13.0
Household consumption (% change)	-0.9	-2.3	-7.0	-12.1
Gross fixed capital investment (% change)	-0.9	-2.2	-6.9	-11.9
Government consumption (% change)	-1.2	-2.9	-8.5	-14.6
Exports (% change)	-1.0	-2.4	-7.2	-12.6
Imports (% change)	-0.9	-2.2	-6.7	-11.7

Source: Own calculations using MacLeod (2015)

Similar implausible results appear in DPRU (2016, p. 224 Appendix D), summarised in Table 4, where a national minimum wage of only R1 619 results in between 42 511 and 451 072 job losses. In the DPRU results, as with National Treasury, the higher the national minimum wage, the higher the predicted job losses, with up to 2 million jobs losses predicted (15% of the workforce included!). Note that the DPRU predictions are presented for different values of **ε**, which is the assumed 'wage-employment elasticity', i.e. a measure of how strongly employers react to wage-cost increases. Thus the predictions in the four DPRU scenarios vary hugely – which doesn't much help to understand the likely impact.

Table 4 DPRU outputs

Number of jobs lost

	R1 619	R2 447	R3 400	R6 133
ε = - 0.1	-42 500	-100 000	-205 000	-597 000
ε = - 0.3	-120 000	-281 000	-566 000	-1 595 000
ε = - 0.5	-451 000	-451 000	-897 000	-1 996 000

Percentage decline in employment

	R1 619	R2 447	R3 400	R6 133
ε = - 0.1	-0.3%	-0.8%	-1.6%	-4.5%
ε = - 0.3	-0.9%	-2.1%	-4.3%	-12.1%
ε = - 0.5	-3.4%	-3.4%	-6.8%	-15.2%

Source: DPRU (2016)

Note that the lowest levels modelled by both DPRU and National Treasury are *well below the lowest current sectoral minima* – that of domestic workers which is set at R2 230.70 and R1 993.82 for Areas A and B, respectively – and the affected workers would enjoy only marginal average increases (the exact amount not reported by DPRU). Predicting that such very low national minimum wages would have such large negative consequences casts significant doubts on the realism and credibility of these predictions. As noted by the DPRU itself, international econometric analyses analysing the impact of minimum wages after the fact (rather than predicting the outcome) clearly indicate that: "overall… moderate increases in minimum wages result in little or no decrease in employment" (2016, p. 12). Similarly, in South Africa no negative employment impact was found in five out of six sectors studied (Bhorat, Kanbur, and Mayet 2013, Bhorat, Kanbur, and Stanwix 2013, for a review of the international literature see Isaacs 2016). The DPRU's (2016, p. 33) own conclusion is that:

> "Ultimately then, we would argue that, within some feasible range (dependent on country-specific factors and estimates) a minimum wage will not have significant nor large disemployment effects. Outside of this range however, which indeed time-based factors may alter – negative employment shocks are non-linear in nature, and could occur."

What is striking is that the modelling indicates that this "feasibility range" for South Africa must fall below the R1 619 mark. Given how low this value is, this conclusion is remarkable.

Such dire predictions match the results of CGE modelling exercises prior to the institution of national minimum wages elsewhere in the world, which reliably prove to be off the mark. CGE studies in Germany, for example, predicted that minimum wages of between €4.50 and €10.00 per hour would result in between 360 000 and 2 million job losses. The most recent study predicted up to 910 000 jobs lost at a national minimum wage of €8.50, the amount that Germany eventually implemented (Schmöller 2014). In reality, since the implementation

of the German national minimum wage in January 2015 there was, by October 2015, a year-on-year increase of 713 000 formal sector jobs (with a 132 000 person decline in 'marginal employment') (Amlinger *et al.* 2016). For similar dire predictions in the UK see Minford (1998). This is not to compare the German, British, and South African contexts, but to illustrate the persistence of the predisposition within CGE models towards wage increases resulting in employment losses.

In South Africa, three previous CGE modelling exercises on the potential impact of a national minimum wage fit this trend. DPRU (2008), Pauw (2009) and Pauw and Leibrandt (2012) predict up to half a million job losses. These studies are summarised in Table 5 and discussed below. Also of interest is Pauw and Edwards (2006) which assesses the potential impact of a youth wage subsidy, currently implemented as the 'employment tax incentive'. This paper is instructive because it seeks to assess how a reduction in the effective price of the labour input to firms would affect employment – essentially a mirror image of the modelling of minimum wages. As expected from such modelling, demand for labour increases as its price is reduced, resulting in employment increasing by 2-10% across sectors. Wage subsidies are also considered in Pauw (2009) where just over 1 million job gains are predicted. In fact the youth wage subsidy, implemented at the start of 2014, has had no positive impact on employment levels (Ranchhod and Finn 2014, 2015).

These papers use similar CGE models based on neoclassical economic theory. The basis of the SAGE model used by both National Treasury and DPRU is the Standard Computable General Equilibrium Model developed by Löfgren et al. (2002) in the early 2000s for the International Food Policy Research Institute. This serves as a 'template' which other modellers adjust, customise or extend. It was adapted for South Africa by Thurlow and van Seventer (2002) and further 'extended' in Thurlow (2004) and Arndt et al. (2011); it was also used as the basis for Davies and Thurlow (2010), Alton et al. (2012), and Arndt et al. (2014, 2016). Similar to the SAGE model is the STAGE model, which is not open source and was used in DPRU (2008), Pauw (2009), and Pauw and Leibrandt (2012).[9] Considering that National Treasury refuses to make their paper public and that the DPRU offers very few technical specifications we also draw on these other sources in explaining the modelling. Frustratingly, there are significant gaps in the data provided by both National Treasury and DPRU. For example, it is critical to know what happens to the various components of savings in the economy. Using the models' equations and assumptions we illustrate the likely processes that occur despite being unable to quantify these changes. We call on National Treasury and DPRU to make their full output and model specifications available.

In sum, it is clear that these neoclassical CGE models systematically predict job losses and economic deterioration resulting from wage increases. The

[9] The model used in DPRU (2016) is not mentioned in their paper, but the use of SAGE was confirmed by one of the researchers (Tara Caetano) via email. Rob Davies also offered useful clarification on the history of the models via email. The National Treasury has refused to make their paper or model specifications available. However, they have noted that their model is "very similar" to that of Thurlow.

substantial negative effect of such low national minimum wages raises questions over whether CGE models are intrinsically predisposed towards generating a prediction of high job destruction and economic deterioration as a result of rising wages. We now turn to this issue.

Table 5 Summary of results from select South African studies using CGE models

	Aim	**Short-run employment impact (ε = 0.7)**	**Long-run employment impact (ε = 0.7)**	**CGE Model type**
DPRU (2008)	Estimate impact of a NMW (increase in real wages) on employment and output.	Unskilled employment declines by 455 915. A 4.8% decline in low-skilled (and total) employment.	Unskilled employment declines by 514 923. A 5,4% decline in low-skilled (and total) employment.	Standard General Equilibrium (STAGE) model.
Pauw (2009)	Estimate impact of a NMW (increase in real wages) on poverty and employment.	Low-skilled employment declines by 488 991 (and by higher and lower amounts when the elasticity is higher or lower)	Low-skilled employment declines by 502 130 (and by higher and lower amounts when the elasticity is higher or lower)	Standard General Equilibrium (STAGE) model.
Pauw and Leibrandt (2012)	Estimate impact of a NMW (increase in real wages) on poverty and employment.	5.2% of low-skilled workers loose their jobs or 448 991 workers.	Results are assumed to be short-run but this is not specified in the paper.	Standard General Equilibrium (STAGE) model.
Pauw and Edwards (2006)	Estimate impact of a youth wage tax incentive (i.e. a reduction in real wages).	Employment increases between 2-10% across sectors.	Short-run only.	SAGE: International Food Policy Research Institute model (IFPRI) adapted for South Africa by Thurlow and Seventer (2002).

Source: Adapted from Strauss and Isaacs (2016)

4 Critiquing the use of CGE models to model wage increases

Macroeconomic models allow for the dynamic interactions that are important in determining the economy-wide impacts of increased wages. Importantly, a model's output can be shaped by the manner in which it is constructed. CGE models are one kind of macroeconomic model, comprising a large number of mathematical equations. In an attempt to mimic how changes in one part of the economy are transmitted to other parts of the economy, these equations link different sectors (like agriculture or manufacturing) and different variables (like GDP growth or inflation) to each other, thereby specifying supply and demand

for many economic activities. Sectoral supply is influenced by relative prices, the size of the market, and technology, whereas demand depends on incomes (effective purchasing power), relative prices, and consumer preferences (on CGE models see Burfisher 2011, Hosoe *et al.* 2015, for a critique Taylor and von Arnim 2007, Taylor 2016).

The equations of the model will determine which variables are assumed to affect one another. In addition, the direction of causality (i.e. which variable determines the other) must be assumed. In neoclassical CGE models, these equations and assumptions are based on neoclassical economic theory: it is assumed that the economy behaves as neoclassical theory predicts, rather than consciously relating the model to empirical reality (which may contradict the neoclassical assumptions). Typically these assumptions include that markets are perfectly competitive and that all markets clear (i.e. they are able to reach a state of 'general equilibrium'). Critically, it is rapidly-adjusting prices play the dominant role in attaining equilibrium, as Thurlow (2004, p. 9) notes: 'Equilibrium is attained through the endogenous interaction of domestic and foreign prices, and the effect that shifts in relative prices have on sectoral production and employment, and hence institutional incomes and demand.' The magnitude of the response coefficient that is attached to each variable determines the extent to which a change in one variable impacts another. As noted already, in other types of models these are estimated using past statistical data, but in the case of CGE models they are, in the main, assumed (decided) by the model builder or 'calibrated' on the basis of an arbitrarily chosen benchmark year. At the start of the simulation one variable is 'shocked' (altered) which sets off a chain reaction throughout the model. The simulation is complete when the economy reaches equilibrium again.

We show in this section that the construction of neoclassical CGE models and the assumptions made lead to an *inevitable* fall in demand as a result of increasing wages via a national minimum wage. This occurs because (i) real incomes fall due to higher prices and rising unemployment (Sections 4.2 and 4.3) and (ii) demand is further depressed by declines in investment and consumption expenditure (Section 4.4). Such results cannot be avoided.

4.1 The response of employers to wage increases

It is logical to assume that firms will face higher input costs if wages rise and hence firms will need to adjust. The difficulty for neoclassical CGE models is that the manner in which firms and the economy are able to adjust to higher wages is heavily circumscribed.[10] Pauw (2009, pp. 141–142 emphasis added) highlights the narrowness of these models when he notes:

> '[I]t is useful to consider how, in a general equilibrium context, firms might respond to minimum wages under certain conditions. ... When faced with minimum wages, firms incur production cost increases. They essentially

[10] We emphasise *neoclassical* CGE models because the assumptions made in these exercises, as illustrated below, reflect neoclassical theory and other assumptions based on alternate theoretical paradigms, with potentially very different outcomes, are possible.

have two options available to them to mitigate these cost increases, i.e. *they can either reduce the employment of minimum wage workers by substituting them for other factors of production, or they can absorb the cost increases and pass these on to consumers in the form of higher prices*… In practice firms will opt for a combination of the two cost mitigation options, with wage elasticity of labour demand determining the optimal choice.'

The fact that CGE models only allow for price increases and job losses in response to rising wages is deeply troubling given the robust evidence of other adjustment mechanisms outlined in Section 2. Moreover, these two consequences – rising unemployment and rising prices – have been specifically shown not to occur, or to occur very modestly, when minimum wages are raised or implemented. On unemployment, Schmidtt (2013, p. 2) notes that the "weight of that evidence points to little or no employment response to modest increases in the minimum wage" (all meta-analyses of minimum wage employment effects support this, see: Doucouliagos and Stanley (2009), Boockmann (2010), Belman and Wolfson (2014), Leonard et al. (2014), Cheletsos and Giotis (2015) and Broecke et al. (2015), summarised in Isaacs (2016)). Regarding rising prices, Lemos, in a comprehensive review of 30 academic papers on the price effects of minimum wages, finds only a 0.4% increase to overall prices from a 10% increase in minimum wages, illustrating that minimum wages can be increased "without destroying jobs or causing too much inflation" (Lemos 2008, p. 208) (Aaronson, French and MacDonald (2008) find the increase to be roughly 0.7%). Even conservative minimum-wage scholars like Neumark and Wascher (2008, p. 248) find that "the effect of a minimum wage increase on the overall price level is likely to be small".

Account can be taken (in neoclassical CGE models) of the impact of higher wages on productivity, but only by *exogenously* imposing various productivity increases. Pauw (2009) does this (as does DPRU 2008) and notes that: "Clearly labour productivity gains are important in countering some of the employment losses associated with minimum wages." (Pauw 2009, p. 150) Neither the National Treasury (MacLeod 2015) nor DPRU (2016) include productivity gains in their modelling. Pauw goes on to show that employment losses are significantly lower if various levels of productivity increases are included. Increased productivity among low-skilled workers also has various positive knock-on effects. By contrast, the relationship between wages and productivity plays an important role in both the UN GPM (Strauss and Isaacs 2016) and ADRS (Adelzadeh and Alvillar 2016) models with feedback effects between output, productivity growth, and aggregate demand – the so-called 'Kaldor-Verdoorn' effect.[11]

Other models, depending on the behavioural equations deployed, may also be limited in the real-world adjustments they can accommodate. Relevant also, therefore, is that by construction, and irrespective of the magnitude of the (negative) price, wage and substitution elasticities used, higher wages lower

[11] A number of studies try to estimate this relationship. See, for example, Storm and Naastepad (2007), Pianta and Crespi (2008), Millemaci and Ofria (2012) and Magacho (2016).

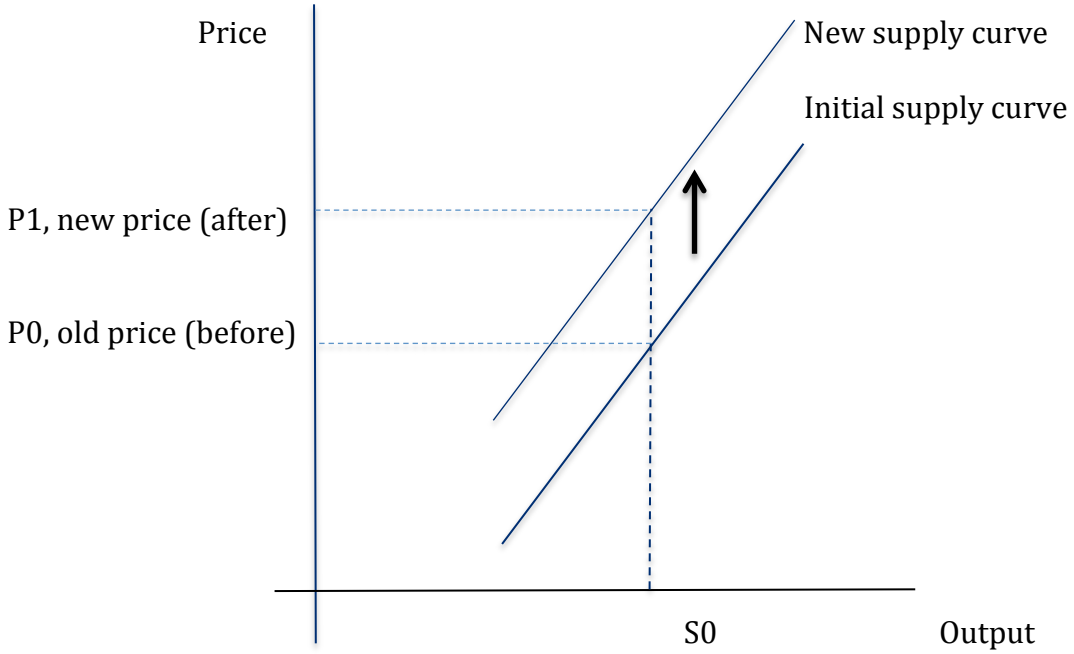
aggregate demand in neoclassical CGE models leading to economic deterioration. The next section shows why this is the case.

4.2 Setting the scene: aggregate supply and demand dynamics

Our claim is that the neoclassical CGE models under review are predisposed to predict that higher wages lead to a slowdown of growth and rising unemployment in the South African economy. The primary reason is that, in these models, higher wages will depress aggregate demand: this occurs (as we explain below) because aggregate supply falls and aggregate demand is made to adjust to equal this lower aggregate supply (through changes in relative prices). (For the reader unfamiliar with economic theory we suggest not to get bogged down by the graphical representations here. The key points are expressed in the text and the arguments outlined in Sections 4.3 and 4.4 on why aggregate demand must fall in neoclassical CGE models are clear irrespective.)

Let us first consider the effect of higher wages on aggregate supply. Wages are a component of production costs and hence higher wages raise the production costs of South African firms (assuming that the elasticity of capital-labour substitution is less than 1). This means that at a given level of output, South African firms now need a higher price to cover their costs (plus a profit margin), and this gets reflected in an upward shift of the supply curve in Figure 1. P0 is the old price desired by firms to cover production costs at a given level of output S0 (which in Figure 1 is held constant), while P1 is the new and higher price needed to cover the increased production costs after the introduction of the national minimum wage. The shift in the upward-sloping (aggregate) supply curve corresponds to the upward shift in the (upward-sloping) marginal cost curve of profit-maximising firms, caused by higher wages.

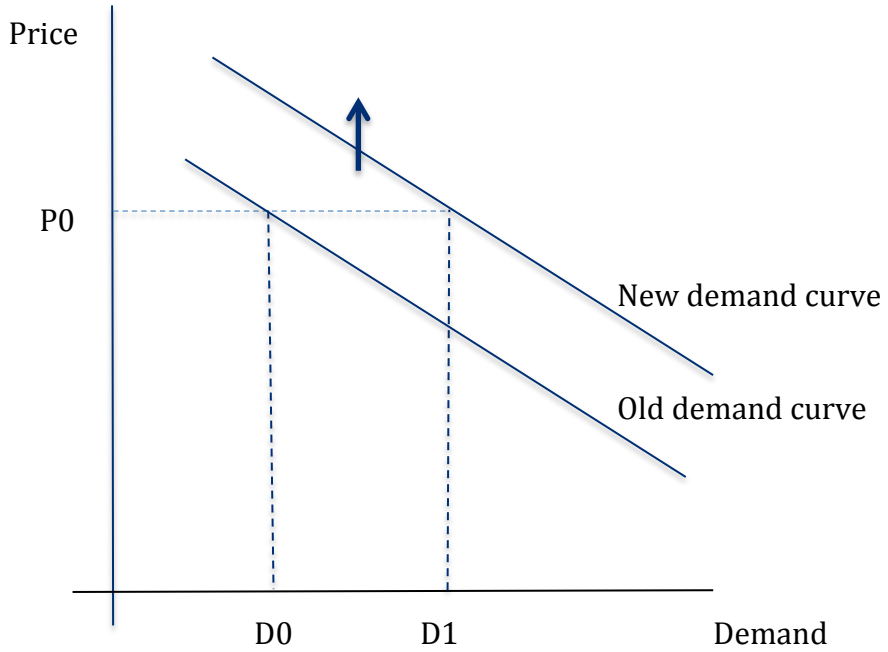
Figure 1 The impact of higher nominal wages on supply



We must however also consider the effect of higher wages on (aggregate) demand. To do so, we have drawn the (aggregate) demand curve in Figure 2. The downward slope of this curve shows how a higher price is associated with lower demand (demand is a downward-sloping function of the (aggregate) price). However, demand is not only influenced by price, but also by the level of income (Y) – how much people have in their pockets to spend. Theoretically, any increase in income would increase demand, and hence shift the demand curve up (as in Figure 2): a *positive income effect*. Assuming that prices remain constant, an increase to (nominal) wages would cause demand to shift from D0 to D1 while prices remain at P0. The effect on demand will be even larger when minimum wages are raised, because lower-income groups consume more of their wages than is typically spent by higher-income groups.

The problem with Figure 2 is that prices will not necessarily stay constant; in Figure 1 firms needed a higher price to cover higher production costs. Higher prices would reduce income (Y) in real terms (i.e. Y/P) – people may have more money but may be able to buy less with a given amount as prices rise – and the smaller the real income increase is, the smaller the upward shift of the demand curve in Figure 2 will be, and the smaller the potentially expansionary impact of higher wages. If the price rise is equal to the nominal wage increase, real wages stay the same and the demand curve will not shift. If the price rise exceeds the (nominal) wage increase then real incomes will fall. So one key issue concerning the demand impacts of higher nominal wages is what happens to real wages and real incomes.

Figure 2 The impact of higher nominal wages on demand



We argue that there are a series of rather ad hoc assumptions made in the South African neoclassical CGE models that ensure that higher national minimum

wages do not translate into higher real wages, higher real incomes, and higher demand for goods and services produced in South Africa. Specifically, we show how higher wages must decrease investment demand, decrease consumption demand (through higher household savings), or both, and hence depress aggregate demand. Due to these assumptions the aggregate demand curve in Figure 2 will not shift upwards but downwards – in response to a higher national minimum wage. This result is not just counter-intuitive, but also left unmentioned in the neoclassical CGE reports under review.

4.3 Eroding real wages and fall in aggregate demand

As noted above, neoclassical CGE models only allow the economy to adjust to higher wages by decreasing employment or raising prices. A fall in employment is caused, in the first instance, because profit-maximising firms will substitute capital for labour and reduce their labour input – they will lay off workers and use machines instead – resulting in declining employment (probably particularly for the low-skilled workers first). This *substitution effect* is reflected in typical CGE models by rising unemployment when wages are raised, with the extent of the employment loss depending on the size of the elasticity assumed. As we have noted above, this is not the only possible outcome from raising wages. A *positive income effect*, from higher wages, could potentially raise income and demand for consumption goods. The resulting increase in consumption could translate into *higher* output, *higher* labour demand, and *higher* employment.

However in neoclassical CGE models, rising prices (due to firms having higher wage costs) will dominate and erode real incomes and lead to falling consumption and reduced demand – a *negative scale/income effect*. This will occur because: a) there is higher unemployment and therefore a loss of income; b) higher prices mean the real wage increase is less than the nominal wage increase, therefore eroding the buying power of consumers; c) higher prices will make production inputs and the final products more expensive, reducing demand for them and resulting in a further fall in employment; and d) price-sensitive net exports could decline depending on the assumptions made regarding the trade balance.

Prices would also rise due to a depreciation in the exchange rate (the nominal domestic value of the currency) which makes imports more expensive. This could arise due to the unjustified and ad hoc assumptions made regarding the current account and balance of payments. In Pauw and Leibbrandt (2012) and DPRU (2016), net exports (or the trade balance or the current account balance) is assumed to be fixed with the exchange rate variable so as to keep the trade deficit constant at the pre-specified level. An increase in domestic prices (through higher wage costs) will make imports relatively more attractive and exports less attractive. This will induce an exchange rate depreciation in order to stimulate exports and reduce imports so as to keep the trade balance constant. This depreciation would make imports more expensive and hence raise production costs for firms and lower real incomes of households and hence

reduce domestic demand; in a way, domestic demand is being 'crowded out' by higher import costs.

The net impact on aggregate demand from these various effects is theoretically ambiguous, but as noted by both DPRU (2008, p. 49) and Pauw (2009, p. 146): "the [negative] scale effects dominate". The potential positive income effect of higher wages is therefore more than nullified and a fall in aggregate demand results. Pauw (2009, p. 142) summarises the above: "Higher unemployment AND increased prices both erode wage income gains associated with minimum wages, causing disposable income to drop. Reduced levels of disposable income impact negatively on consumption demand, which causes secondary employment and wage income losses due to a decline in labour demand."[12] What Pauw describes is a downward spiral: the original fall in disposable income (due to falling employment and rising prices) causes a reduction in consumption demand, this leads to a further fall in employment[13] and further loss of income, with any other result precluded. These consequences will occur irrespective of the magnitude of the wage-employment elasticity so long as it is negative. As a result, domestic demand is depressed. Critical to our discussion in the next section is that this process also entails a decline in firm profits and therefore firm savings fall.

The reason for these results is the dominance of prices in the CGE models. This becomes clear when one traces the determinants of demand (for individual factors of production – including labour – and on aggregate) through the equations of the SAGE model in Thurlow (2004) (see in particular equations 50-55, 3-5, 32-38 in Appendix A of Thurlow where composite commodity prices, the value-added price, and the average price of factors are particularly important). Pauw (2009, p. 83) summarises this dynamic: "The important deduction from this brief discussion of the price relationships in the CGE model is that any exogenous increase (say) in the wage of a group of workers will directly lead to an increase in PVA_a [price of value added] and hence PX_a [the activity price or average production cost of a producer]. Ultimately such production cost increases will raise domestic consumer prices (PQD_c)." Income plays a secondary role, itself shaped by shifting (relative) prices as discussed above. Greater room for income/spending to influence demand for particular commodities and factors of production would be more appropriate to the South African context; as Kantor (2012) notes:

> "[S]ometimes the economic problem becomes one of too little spending rather than of dismal constraints on spending. Too little demand is now

[12] In Appendix D, DPRU (2016) gives a very similar description of these dynamics, as they note: "It is possible that this increase in labour income causes demand for outputs to rise, and therefore the income effects to outweigh substitution (disemployment) effects … Whether this happens depends on a number of other assumptions." This is followed by an incomplete summary of the above dynamics. In the real world, it may well be possible (and even likely) that the income effects of higher wages outweigh the substitution (disemployment) effects, but what DPRU (2016) does not mention is that their own prior modelling assumptions exclude this possibility.

[13] Pauw (2009, p. 40) notes: "output levels in a perfectly competitive environment are driven by demand levels, which is why labour demand is also sometimes called 'derived demand' – it is the demand for labour derived from the demand for commodities produced by those workers".

> the major problem in many of the developed economies and also for us in SA. Given the current availability of labour, plant and equipment in the US, Europe and SA, more goods and services would be produced and more income would be earned in the process of expanded production, if only economic agents would spend more. More spending is thus possible without the usual trade-offs and choices having to be made between one kind of spending or another. There is no opportunity cost to employing more resources when they are standing idle."[14]

By contrast, some econometric models take a more balanced and nuanced approach. The ADRS MEMSA model used by Adelzadeh and Alvillar (2016) determines employment (the demand for labour as a factor or production) based on supply-side factors *and* demand-side factors, including: the wage rate; the capital-labour ratio (the extent to which capital or labour is preferred in that sector); labour productivity; exports and imports; investment; gross domestic expenditure; GDP; the real effective exchange rate; expectations of output in the sector; and the economy-wide price index.[15] The relationship between each of these variables and employment is estimated individually based on South African-specific historic data for every sector.

We return now to discuss other assumptions that impose contractionary outcomes.

4.4 Reduced investment and consumption spending and a further fall in aggregate demand

The assumption made regarding savings and investment – what is known as the macroeconomic closure of the model – is even more important. In the papers reviewed, the assumptions made in this regard directly reduce (aggregate) demand. These assumptions pertain to the direction of causality and the relationship between variables within the equations, the importance of which we noted above. The closure rule relating to investment and savings is particularly crucial, as these variables strongly impact consumption and investment demand in the economy. Fundamentally, there are two macroeconomic closures which can be adopted: a neoclassical savings-driven one and a Keynesian investment-driven one. Within these, different options exist.

Both National Treasury and DPRU adopt savings-driven closures in which savings is the only variable that influences levels of investment. Given how strongly these assumptions determine the outcome, one would expect the CGE modellers to justify their use. Moreover, it is possible to test – through the use of alternative assumptions, for instance a Keynesian (or structuralist) closure –

[14] Thurlow notes how the SAGE model "rules out the possibility of excess capacity" (2004, p. 15), a highly unrealistic restriction in the South African context.

[15] Adelzadeh and Alvillar (2016) give a detailed account of how, in their model, each of these variables impacts employment levels differently, so that wage increases (in 36 of the 40 sectors) has a direct negative impact on employment, but some of the other variables – such as rising GDP or gross domestic expenditure – counterbalance this so that overall employment rises in some sectors but falls in others following economy-wide wage increases.

whether these assumptions are driving their results; neither the DPRU nor the National Treasury do so. The likely net effect of using an alternative Keynesian savings and investment closure is unclear. However with a Keynesian closure it is at least possible that rising consumption demand from higher wages may outweigh the negative effects described above. Gibson and van Seventer test precisely this in the South African context and find, using a structuralist CGE model, that: "if the policy establishment were intent on changing the distribution of income via wage increases, it could do so without loss of employment provided it neutralizes induced policy changes" (2000, p. 513). In the UN GPM (Strauss and Isaacs 2016), investment is modelled in a far more realistic way that in the CGE models discussed here, where it is determined by GDP growth, changes in profits, the real bond rate, external flows, and lending from the domestic financial sector. With the neoclassical closure used by DPRU and National Treasury the option of a non-negative net outcome is precluded by design. This is because the closures necessarily result in a fall in investment expenditure or a fall in consumption expenditure (or both), the latter due (bizarrely) to rising household savings. These assumptions, we show, can *only* further augment the predicted contractionary macroeconomic effect of higher wages, with falls in aggregate demand resulting in further job losses. These assumptions are made on the basis of neoclassical theory rather than being premised on the actual workings of the South African economy.

In a general equilibrium framework (in which aggregate supply is equal to aggregate demand for all goods and services and all markets clear or are in equilibrium), total investment i (as a percentage of domestic demand) must be equal to total savings (as a percentage of domestic demand),[16] or:

$$i = s_{HH} + s_G + s_{FIRMS} + s_F \quad (1)$$

where s_{HH} is the household savings rate, s_G government savings rate, s_{FIRMS} firms savings rate, and s_F foreign savings rate (or current account deficit) all as a percentage of domestic demand. In the CGE models discussed, foreign savings (s_F) typically is assumed to be fixed, assuming a flexible exchange rate,[17] and s_G is either fixed or "largely unaffected by a minimum wage policy" (DPRU 2008, p. 84).[18] The closure selected in the 'short-run' scenario by the National Treasury, DPRU (2008), Pauw (2009), Pauw and Leibbrandt (2012), and presumably DPRU (2016), 'holds constant' the left hand side of the equation, i, that is investment as

[16] Thurlow (2004, p. 9) notes: "Savings by households and enterprises are collected into a savings pool from which investment is financed. This supply of loanable funds is diminished by government borrowing (or dis-saving) and augmented by capital inflows from the rest of the world. There is no explicit modelling of the investment decision or the financial sector within a particular time-period, with savings equalling investment as per the ex post accounting identity."

[17] Foreign savings (s_F) appears not be fixed by the National Treasury but this doesn't materially alter the analysis.

[18] The change in government savings is likely to be small and will rise or fall in line with fluctuations in GDP as the direct tax rate is fixed as a percentage of GDP. Given this, it is possible that a national minimum wage will increase government spending and lead to a fall in government savings.

a share of domestic demand. The contractionary impact of this assumption works in two steps.

First, recall *i* is investment *as a percentage* of domestic demand, so if domestic demand falls (as we've shown above it will) actual aggregate investment must also fall in order to keep the term *i* constant. Investment demand, and hence overall domestic demand, therefore falls when wages are increased. This can be seen in the National Treasury outputs in Table 2, where gross fixed capital formation declines more or less in line with the contraction in real GDP.

Second, we've also shown above that, given how the CGE model is constructed, firm profits – and hence firm savings – will fall if prices increase and aggregate demand declines (due to the previously described dynamics within the model).[19] This means that, in order to keep the equation balanced, the model must predict that household savings will rise. Put differently, if the left hand side of the equation, *i* is constant, then, as firm savings fall, another type of savings must rise (on the right hand side) in order to maintain the accounting identity. As Pauw and Leibbrandt (2012, p. 774) note, when using a neoclassical CGE model, one sees "household savings rates adjusting to ensure equilibrium in the savings market".[20] A rise in household savings implies a fall in household consumption spending and thus in consumption demand, resulting in a further fall in aggregate demand. This is confirmed by Thurlow, one of the architects of these models: "Under the exogenous investment paradigm, maintaining the level of investment would require that savings would have to increase through increases in domestic savings rates. In such a case, the level of disposable income is reduced with 'crowding-out' effects on private consumption." (2004, pp. 10–11) However, there is no good reason to assume households would save more in response to higher wages (or the institution of a national minimum wage). In the modelling by both DPRU and National Treasury this change in household decision-making is left unmentioned and unjustified, which is remarkable given how the subsequent decline in household spending is central to the (contractionary) outcomes.

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[19] Savings is a fixed share of capital income (profits). Thurlow notes: "Enterprises or firms are the sole recipient of capital income, which they transfer to households after having paid corporate taxes (based on fixed tax rates), saved (based on fixed savings rates), and remitted profits to the rest of the world." (2004, p. 7) Because "capital income to enterprises represents gross operating surplus generated during production less activity taxes, and the cost of intermediates and labour remuneration" (2004, p. 67) and "capital-value-added is gross operating surplus" (2004, p. 65), as the quantity of value added (QVA), including capital value added, falls due to higher prices and lower demand, so firm profits and firm savings fall.

[20] There is another way to show that household savings must rise (and household consumption spending fall) given the assumptions made in the model. The accounting identity will hold that domestic demand (DD) must equal government and household consumption expenditure (C) plus investment (I) plus the trade balance (E - M) or DD = C + I + E – M (Thurlow 2004 also notes this on p. 9). It follows that C/DD + I/DD + (E - M)/DD = 1. The modellers assume *a priori* that I/DD (which is *i* above) is constant, as is the trade balance (E - M). Now if domestic demand falls, as we've shown it must, then (E - M)/DD rises – (E - M) is constant and DD falls. This means that another term must fall to keep the equation balanced, and since I/DD is constant, C/DD must fall. For C/DD to fall then consumption expenditure (either government of household) must fall, as government savings are fixed this implies that household savings must rise and hence household consumption expenditure falls.

The National Treasury chooses a different closure in their 'long-run' calculations in which investment is a residual: it is simply set as equal to savings. This can be shown by this equation:

$$s_{HH} + s_G + s_{FIRMS} + s_F = i \quad (2)$$

The key variable here is s_{FIRMS}, which, as we have established, falls as corporate profits are squeezed. If households do not change their savings behaviour (that is, their savings propensity stays constant) then s_{HH} is constant. Investment i must in this case decline, because aggregate savings go down, because s_{FIRMS} goes down. This drop in investment in turn ensures that aggregate demand will decline, and the national minimum wage will result in contraction and unemployment.

It should also be noted that the basic assumption that investment is a product of savings is not credible. This ignores that investment stimulates demand and output and thereby increases savings. It also ignores – as most CGE models do – the existence of a financial sector (as is expllicitly acknowledged in Thurlow 2004, p. 9). The assumption made above is that firms use their internal savings to finance their investment and hence when s_{FIRMS} goes down, business investment must go down. This does not square with reality in which firms can finance their investments through bank loans – the availability of which means that the link between internal business savings and business investment is much less direct, straightforward, and stable than what these neoclassical CGE models assume (recall that in the UN GPM investment is influenced by the real bond rate, changes in external flows, and domestic lending). As the Bank of England recently noted, "banks do not act simply as intermediaries, lending out deposits that savers place with them," rather "the majority of money in the modern economy is created by commercial banks making loans" (McLeay *et al.* 2014, p. 1). The assumption – made above – that a given level of savings determines investment ignores this and is untenable.

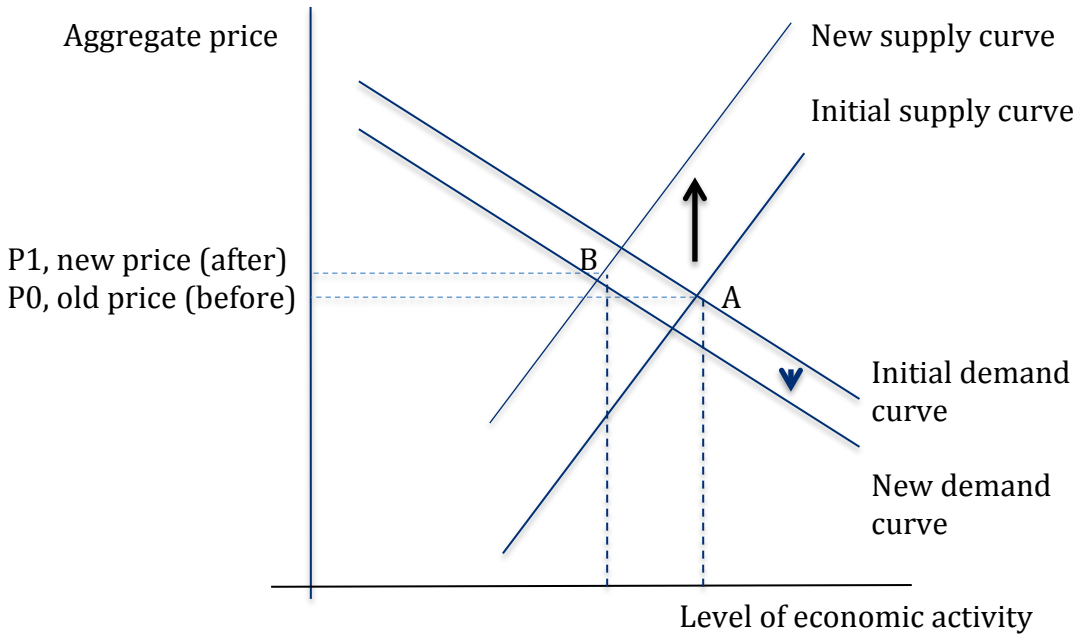
The critical point to appreciate here is that the decision to impose these closures – assumptions about how the variables relate to another – ensures that the model will find that higher wages will lead to lower aggregate demand, irrespective of the magnitude of the (negative) price, wage, and substitution elasticities used in the production functions and Armington (trade) functions. This means that aggregate demand is not shifting up in response to higher nominal wages (as in Figure 2), but rather shifting down (as is illustrated below in Figure 3). All this points to the Achilles' heel of the neoclassical CGE models studied. The numerical outcomes of these CGE models are fundamentally driven by the (investment-savings) closure rules adopted. These macroeconomic closure rules chosen by DPRU (2016) and the National Treasury (MacLeod 2015) have a deflationary bias, in the sense that higher (minimum) wages will lead to either falling actual investment together with higher household savings and lower consumption demand, or falling investment demand; both result in declining aggregate demand. At the heart of this is the inescapable dominance of (rising) prices in neoclassical CGE models: a response that in the real world has

been shown not to occur (or occur very modestly) as a result of minimum wage increases.

4.5 The consequences

The above has clearly described the consequences of the construction of, and assumptions made within, these neoclassical CGE models. Overall, these indicate why the aggregate demand curve will not shift up in response to higher nominal wages (as in Figure 2), but rather shift down as is illustrated in Figure 3. At the same time, higher wages will push the supply curve up (as in Figure 1). From Figure 3 it is clear that this particular interaction between supply and demand leads to real GDP contraction (and additional unemployment) and rising prices (relative to the rest of the world). The economy will move from the original equilibrium A to new equilibrium B, featuring lower output and higher prices.

Figure 3 The aggregate impact of higher nominal wages



Given this, we can clearly demonstrate a predisposition within the model and the assumptions made that make them specifically unsuitable for labour market modelling. We have seen that they ignore the real-world adjustments which have been shown to result from implementing a national minimum wage. In fact, the only adjustments possible are those which have been shown not to occur in reality (or to occur very modestly). Furthermore, we have demonstrated that, by the design of these models, higher wages will lead to investment, demand for output, and employment falling, with any other outcome precluded before the model is run.

5 Conclusions

This Research Brief has argued four interrelated points. First, available neoclassical CGE model analyses of the effect on the South African economy of the introduction of a national minimum wage predict implausibly large losses in jobs and in economic growth – even at an extremely low national minimum wage. This alone should be a serious cause for concern for policymakers and commentators.

Second, the unrealistically large negative effects of a national minimum wage are the result of the model's architecture and *a priori* CGE modelling choices, in particular the savings-investment closure rule. The consequences of this – in particular the adjustments in household savings, corporate and government savings, foreign savings, and investment – are not reported. The particular choice of a closure rule in the DPRU and National Treasury models introduces *a priori* (and undocumented) deflationary bias in the CGE modelling analysis: by design, higher minimum wages can only lead to falling aggregate demand, lower growth, and higher unemployment. Third, it is therefore difficult to see how the results from these models can guide policymaking.

Finally, CGE models are not the only game in town: there are available macroeconometric analyses of the impact of the national minimum wage in South Africa. These analyses avoid the flaws described in this Research Brief.

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