

A fair price for economic modelling? Transparency required

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Summary

- The principle of transparency is the only way that policy makers can understand the limitations of a model and use its outputs effectively to inform policy.
- In absence of this transparency, there is no accountability and claims cannot be tested. An example of this is the recent report by Applied Development Research Solutions (ADRS).
- The report ignores standard modelling practices and generates questionable results.
- The ADRS model authors claim that the model is very big. Large and complex models are difficult to understand. They generate “black box” results, as neither the modeller nor the user of the outputs can understand how the results are generated.
- The model appears to ignore supply constraints, economic trade-offs, financial market dynamics and key monetary and fiscal policy relationships.

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Introduction²

Models are important tools in policy analysis and design and vary greatly in their construction and applicability. Often several different models are used to answer the same question. Using multiple models is important because all good models are simplified versions of reality – no one model can capture all the important relationships of complex systems, like an economy.³ This is not a limitation of economic modelling but rather a strength. Diversity supports robust debate and better policy making. But to fully reap the benefits, the models (and their authors) need to be transparent about the model structure and assumptions underlying their analysis. This is one of many things academia is essential for: to create opportunities for publication of models and their analyses and to allow them to be tested through replication. Underlying all this is the principle of transparency, which in this context is achieved when we can see the structure of a model, how variables interact with one another, and the data used for each variable. This is the only way anyone can value the assertions made about what a model is telling us.

It is also the only way that policy makers can understand the limitations of the model and use its outputs effectively to inform policy. In absence of this transparency, well, pretty much anything goes. There is no accountability and claims cannot be tested. An example of this is the recent report by Applied Development Research Solutions (ADRS)⁴, which sets out a range of policy measures that are supposed to boost economic growth.⁵

Unfortunately, the report ignores standard modelling practices and generates questionable results. In this paper we explain why this is the case.

Publish the model⁶

A detailed description of the model is critical and a bare minimum standard. The ADRS report says it is a ‘technical report,’ but this does not constitute model description. It presents one equation and tests its statistical properties, and asserts that thousands of other equations exist in the model. The report does discuss estimation techniques, and criticises other methodologies and provides diagrams, but this is not the same as detailing the model structure, theoretical relationships, its estimated parameters and model diagnostics. With this level of transparency, other users can interpret the results in the context of the model limitations, interrogate the assumptions, test different assumptions and form an opinion about the results.

Importantly, replicating models also helps to improve them. This is often done through peer reviewed academic articles, published in good journals. If this has not been done, model developers need to share their model code. Models need to be published and reviewed to be taken seriously, not least where governments look to take policy advice from them. A useful comparator is the South African Reserve Bank Core model description (which uses a similar estimation technique).^{7,8}

² We would like to thank Johan Fedderke, Nicola Viegi, Michael Sachs and Neva Makgetla for useful suggestions.

³ Economic models are a set of equations, which aim to capture the characteristics of an economy. The model results must always be considered in the context of the model and data limitations. For more detailed description of what is an economic model see Rodrik (2015).

⁴ The chief economist and director of Applied Development Research Solutions is Dr Asghar Adelzadeh.

⁵ The report is available on the ADRS website

(https://live.adrsglobal.com/resources/static/downloads/18973169_ADRS_Report_on_Growth_and_Development_Strategy_for_South_Africa_2019_to_2030.pdf)

⁶ We have no detailed description of the model. Our comments are based on the model section in the original report as well as a report titled “Review attempts to silence a voice for inclusive economic path ADRS full response”.

⁷ Available here (<https://ideas.repec.org/p/rbz/wpaper/3195.html>). We provide several other examples in the annexure.

In the next few sections we raise several glaring problems with the ADRS model and approach to modelling. This discussion cannot be exhaustive because so little is known about the analysis behind the ADRS report.

Is the financial sector important?

The big complaint about pre-global financial crisis conventional macro models is that they often had limited financial sector behaviour and few feedback loops from finance to the real economy. These relationships were seen to be important, not just for understanding how financial imbalances impact on real variables, but also to get a better model of how economic activity is actually financed. What is the source of financing and where does it go? In the post financial crisis period, the world of economic modelling has focused on improving the representation of financial sector dynamics.

South African macro models, have also been developed to include the behaviour of the financial sector. One important example of such development is the specification of the “risk-taking” channel of monetary policy that account for how banks change their lending spreads in response to changes in their operational environment (like new regulations) and shocks to their capital.⁹ South African models using the same estimation methodology as the ADRS model have tried to account for some part of this mechanism.¹⁰ The National Treasury CGE model does not have this mechanism and hence the model is not used for business cycle or monetary policy analysis.¹¹

Some of the heterodox models in the Post Keynesian tradition have very detailed financial sector representation. These models build on the work of Godley and Lavoie (2006).¹² The ADRS claims the model is heterodox, and yet it has no financial dynamics or detailed model description as in good stock and flow-consistent heterodox models.¹³

The authors point to data limitations (only household financial wealth is available), which prevents them from incorporating financial dynamics. But the data complaint is not valid. The Quarterly Bulletin published by the South African Reserve Bank shows a wide range of financial sector data, including flow of funds data. This data (showing how money moves between economic agents and financial instruments) is commonly used by heterodox modellers to develop the financial dynamics in their stock and flow consistent models. It is also used by other economists as illustrated by the modifications to the Bureau of Economic Research model, presented in Grobler and Smit (2015) The Global Financial Crisis taught us that models without financial dynamics are not as suited for

⁸ The ADRS claims that their technical report has received positive review from Professor Rob Wilson who is based at the University of Warwick. In our correspondence with him, he made it clear that he has not reviewed the performance of the model and cannot assess its suitability for the type of analysis undertaken by the ADRS.

⁹ See for example Borio and Zhu (2012).

¹⁰ See Grobler and Smit (2015). The paper also provides an example of the standard approach to presenting model modifications. The BER model is used mainly for commercial purposes, yet unlike the ADRS, the BER modellers have chosen to be transparent about the model structure.

¹¹ There are CGE models, which incorporate these dynamics. For example see Makrelov et al. (2019).

¹² The Post Keynesian or structuralist approach, sees economic agents as being adaptively rational. There is no natural tendency for economies to generate full employment and hence government through fiscal, monetary and income policies has an important role to play. Loans, credit, money and inventories are important in smoothing consumption and production. This approach is characterised by imperfect competition, imperfect information, mark-up pricing, fixed technical coefficients, and long-run trends being described as a function of a chain of short-period decisions (Godley and Lavoie 2012).

¹³ The stock and flow consistent (SFC) models are associated with the work of James Tobin and Wynne Godley (Backus et al. 1980; Godley and Cripps 1983). Current SFC models are dynamic, but not stochastic. The framework has been used by both mainstream and heterodox economists, though over the last 20 years stock and flow models have been synonymous with the Post-Keynesian school. These models have strict budget constraints and track the evolution of stocks, including of several financial assets. They model the balance sheets of various agents in the economy and link financial decisions to economic decisions to consume and invest. Stock and flow models remain mainly academic as their data requirements are very large. There is recognition, however, that these models have some important properties, which should be incorporated in models used by policy makers (see for example Bolton et al. (2020))

understanding macroeconomic outcomes as we once thought.¹⁴

How big is your model?

The ADRS model authors also make the claim that the model is very big, with thousands of equations. But again, the literature and practice are clear – the suitability of a model is not determined by the number of equations. Very large and complex models are difficult to understand. They generate “black box” results, as neither the modeller nor the user of the outputs can understand how the results are generated. The aim of models is to *simplify* reality, not to *be* reality.

Models should be constructed to do different things, to see different sides of a complex reality. Olivier Blanchard (2016) made precisely this point, reflecting on the Global Financial Crisis and criticising Dynamic Stochastic General Equilibrium (DSGE) models widely in use by central banks and academics.

The ADRS uses the ARDL co-integration estimator of Pesaran and Shin (1998) to estimate equations in their model. The methodology is widely used, but it is not as modern as claimed by the ADRS. It is used by the National Treasury and the South African Reserve Bank to develop and maintain their macro-econometric models. However as any methodology it has several limitations, which have led to the development of other models.¹⁵

Perhaps the most important distinction in models is whether they are partial or general equilibrium. Partial equilibrium models are just that, they measure the impact of a discrete, or “partial” change on main target variables, while holding all other possible effects unchanged and unaffected (the famous “ceteris paribus” condition). Partial equilibrium models capture specific interactions without worrying about all the effects.

The other approach is to measure as many of the direct and indirect effects as possible, normally in models of the “general” economy with many variables. Such general equilibrium models try to capture the opportunity cost effects of economic change over time and to take into account offsetting effects, so we get a more realistic sense of the *net* effects.

It is critical to know what kind of model is being used. If we want to look at long-term effects, where opportunity costs and trade-offs are taken into account, and budget constraints are priced-in, then we need to use a model with general equilibrium features. As we discuss more below, the ADRS model appears to be constructed from a series of partial models, which do not incorporate trade-offs, supply constraints or opportunity costs.

Are CGE models really that bad?

Oddly, the ADRS makes considerable effort to criticise CGE models, perhaps because the National Treasury developed one and used it for various economic and policy assessments. It presents them as a “neoclassical” and “perfect competition” modelling threat. And yet, this is misleading at best. Some CGE models are based on perfect competition dynamics, but certainly not all.¹⁶ Similarly, not all CGE models are neoclassical (see for example Taylor (1990)). More importantly, CGE models are

¹⁴ The ADRS model is not even in line with heterodox models, which are always very well documented and transparent. See for example Dos Santos and Zezza (2008).

¹⁵ These include statistical issues such as multicollinearity, endogeneity and simultaneity. The methodology assumes a single long-term (co-integrating) relationship between the dependent and explanatory variables. In reality, there are often more than one co-integrating relationships. In this case the estimated relationships in the model do not reflect the true relationships in the economy.

¹⁶ See for example Willenbockel (2004)

transparent and open to criticism.

The useful approach to criticising a model is to identify its limitations and provide an alternative model, clearly illustrating how the limitations have been addressed. If perfect competition is so wrong, then the ADRS model needs to provide a detailed description of how they incorporate imperfect competition to get better modelling outcomes.

Compare like for like

It is common to compare results from different models. Diversity supports robust debate and better policy making. These, however, need to be generated using the same shocks, otherwise the results are not comparable.

The first scenario tries to test the economic shocks in the National Treasury paper titled *Economic transformation, inclusive growth, and competitiveness*.¹⁷ They claim that their shocks are identical, but their model generates significantly lower positive gains. It is clear however that this is not the case. For example, the National Treasury models a much higher reduction in transport and communications costs, equivalent to 25 per cent within 3 years. The ADRS assumes a reduction of 5 to 10 per cent.

National Treasury reduces mark-ups (charged by firms over economic cost of production) by 50 per cent, while the ADRS reduces the mark ups by 2 percentage points initially and then by one per cent per year – this results in a far smaller gain to the economy from more competition.

Additionally, the National Treasury makes assumptions¹⁸ with regard to growth in skilled workers and inflows of foreign savings, while the ADRS does not. This violates the claim of comparability, but also sidesteps key drivers of economic growth in the Treasury thinking and exercise.

The ADRS report claims very small gains from microeconomic reforms as the shocks are much smaller. The Treasury shows reforms generating 2.3 percentage points increase in growth.

Motivate your shocks and explain the transmission mechanism

Large macroeconomic modelling assessments require micro studies to inform the shocks applied to the model or comparative studies. For example, the National Treasury's paper sets out how reforms and interventions that have been done and measured in other countries might help growth here. It may not be perfect and will certainly be different in practice, but at least we get some kind of magnitude to assess. Then the National Treasury explains the transmission mechanism. Again, it may not be perfect but in the process we understand how the model works and what its limitations and assumptions are.

The ADRS assesses the impact of industrial policy on the economy. They argue that it will generate a large increase in investment. This might as well be the case but the shocks are not well motivated. Industrial policy did not generate large investment increases in the past, what is different now? Some reports have been very critical of industrial policy, why are they wrong and why are the

¹⁷ The paper is available here

http://www.treasury.gov.za/comm_media/press/2019/Towards%20a%20Growth%20Agenda%20for%20SA.pdf

¹⁸ For example, in the very short-run National Treasury assumes that the inflow of foreign savings grows by 0.5 percentage points faster and 1.3 percentage points faster in the medium term. This higher foreign savings reflects higher FDI and portfolio flows associated with the reforms. National Treasury also assumes growth in labour supply of workers with matric rises from 1.7 per cent per year to 1.88 per cent per year between years 4 and 10 and for high skilled workers, labour supply growth rises from 1.7 per cent per year to 1.94 per cent.

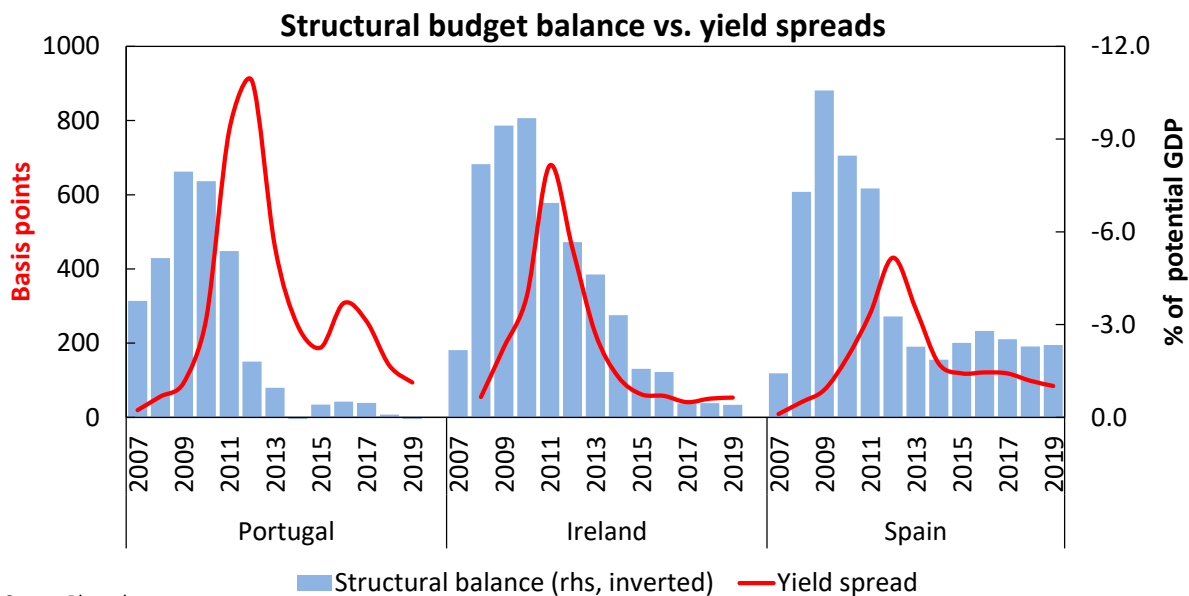
assumed shocks justified?^{19, 20} Investment does not just happen, industrial policy changes relative returns in the different sectors, encouraging investment. How is this mechanism modelled?

Fiscal analysis requires models with debt dynamics

Figure 4 in the report claims to show that an increase in fiscal expenditure, along with nominal GDP targeting, generates larger economic gains than any of the other interventions. Government expenditure is able somehow to grow by 11 per cent per year. While this maybe the impact under certain conditions, the explanation following the simulation suggest that the model is not suite d for this type of analysis.

Our own work suggests that fiscal multipliers can be very large under certain conditions (Makrelov et al. 2019). The economic literature finds that the size of the fiscal multipliers varies depending on the level of debt, the size of the output gap, government’s choice of expenditure and tax instruments, whether the monetary policy rate is stuck at the so called zero lower bound and other factors.²¹

Figure 1 : Actual structural deficits and lending spreads



Source: Bloomberg

One of the key relationships in fiscal policy analysis is the relationship between fiscal deficits, debt levels and government borrowing costs. Large and sustained fiscal deficits increase government debt. At some point, the market starts to see the debt levels as too high and demands higher return to compensate for higher sovereign debt risk. This translates into higher bond yields but also higher borrowing cost for private firms and consumers. Models without this channel are not suitable for fiscal policy analysis, especially when the debt to GDP ratio is likely to exceed substantially the

¹⁹ For a critical assessment of elements of industrial policy, see for example the incentive review by Department of Performance, Monitoring and Evaluation ([available here: https://www.dpme.gov.za/publications/Reports%20and%20Other%20Information%20Products/Evaluation%20of%20Business%20Incentive%20Draft%20Summary%20Report%20V6%2005112018%20%20STC.pdf](https://www.dpme.gov.za/publications/Reports%20and%20Other%20Information%20Products/Evaluation%20of%20Business%20Incentive%20Draft%20Summary%20Report%20V6%2005112018%20%20STC.pdf)) and a recent paper by Prof Dave Kaplan ([available here https://www.cde.org.za/wp-content/uploads/2019/08/Viewpoints-South-Africas-Industrial-Policy.pdf](https://www.cde.org.za/wp-content/uploads/2019/08/Viewpoints-South-Africas-Industrial-Policy.pdf))

²⁰ For example, if the import-dependency ratio is decreased and production increases, would the economy have enough skilled labour or electricity to support the new level of production? More importantly we are not told how the lower import-dependency ratio is achieved. If this is through developing highly competitive domestic firms that replace importers (a clear failing of current policy), then the impacts will be positive. But if this is achieved through imposing tariffs or other non-tariff barriers on importers, then the costs in the economy will increase, generating negative impacts, particularly in the short-run (as other SA producers or consumers subsidize the firms benefitting from the tariffs).

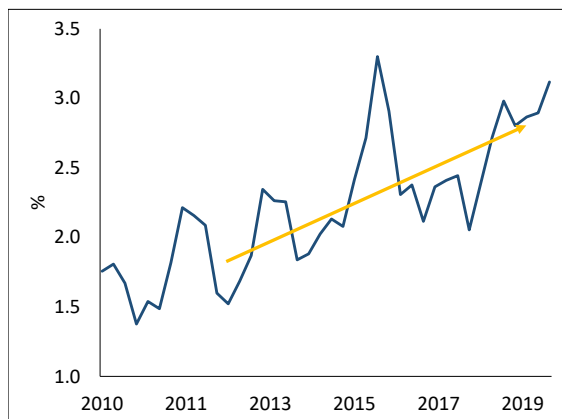
²¹ Huidrom et al. (2019) and Bonam and Lukkezen (2019) show how debt impacts the size of fiscal multipliers. At high debt levels, the multiplier turns negative. Owyang, Ramey, and Zubairy (2013) provides estimates of fiscal multipliers under recessionary and expansionary conditions for Canada. The multipliers are much larger under recessionary conditions. For multipliers under zero lower bound conditions see Christiano, Eichenbaum, and Rebelo (2011).

emerging markets average of 60 per cent.

Figure 1 shows the response of lending spreads to the size of the fiscal deficit across peripheral European economies with unsustainable fiscal positions. Large structural budget deficits led to a large increase in lending spreads. This relationship is real.

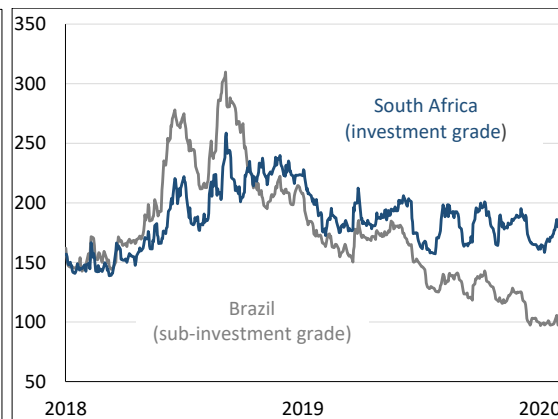
We have seen a sustained increase in South Africa's risk premium and increase in government real bond yields.²² Figure 2 shows the risk premium as measured by the JP Morgan EMBI+ spread. Figure 3 shows South Africa's CDS spread (a measure of insurance against sovereign debt default) against the CDS spread of Brazil. Higher CDS spreads indicate that buyers of government debt see the country as more risky. Brazil's government debt is rated as 'junk' and yet since the beginning of 2019, it is priced as less risky than South Africa's government debt.

Figure 2: SA risk measure (EMBI+ spread)



Source: JP Morgan

Figure 3: CDS spreads (Brazil vs South Africa)



Source: Bloomberg

In figures 4, we show the increase in the government's real long-term bond yield, which has increased by over 200 basis points since 2014.

The ADRS report and model description do not explain how the relationship between debt and borrowing costs is taken into account and why it is not binding given that we are seeing an increase in risk premia and real bond rates. It seems the ADRS model has no fiscal constraints.

The role of assumptions in modelling is clearly articulated by Rodrik (2015):

"The answer to each question depends on some critical feature of the real-world context. Models highlight those features and show how they influence the outcome. In each case there is a standard model that produces a conventional answer: minimum wages reduce employment, capital flow increases growth, and fiscal cutbacks hamper economic activity. But these conclusions are true only to the extent that their critical assumptions—the features of the real world identified above—approximate reality. When they don't, we need to rely on models with different assumptions."

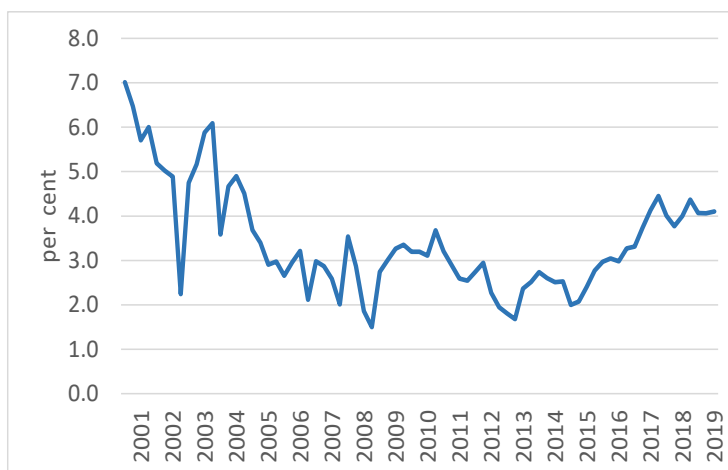
In addition, the ADRS report calculates incorrectly the size of the fiscal multiplier and it assumes that it is constant.²³ In the ADRS approach, an increase in government expenditure increases the

²² The ADRS seems to suggest that South Africa's is experiencing austerity similar to some countries in the Euro area. These countries recorded real and in some cases nominal declines in expenditure. In South Africa, however, real government spending has been consistently positive and the primary balance always in deficit. See for example National Treasury's 2019 Medium Term Budget Policy Statement, available here <http://www.treasury.gov.za/documents/mtbps/2019/mtbps/Chapter%203.pdf> and the recent Article 4 assessment (Box 1) available here <https://www.imf.org/en/Publications/CR/Issues/2020/01/29/South-Africa-2019-Article-IV-Consultation-Press-Release-and-Staff-Report-and-Statement-by-49003>.

²³ The literature on fiscal multipliers is vast. Many papers provide empirical estimates and many models generate multiplier analysis. These are never only based on input-output tables, especially in the case of projection. See for example, Auerbach and Gorodnichenko (2012) and Owyang, Ramey, and Zubairy (2013). Mineshima, Poplawski-Ribeiro, and Weber (2014) provide a comprehensive review of the recent literature on fiscal multipliers for advanced countries, and Batini, Eyraud, and Weber (2014) for emerging economies.

demand for goods and services based on a historical input-output table. But this is not the fiscal multiplier.²⁴ Calculating the fiscal multiplier requires the calculation of opportunity costs – the money spent has to come from somewhere, like more debt – and other factors such as the output gap, global conditions, health of the financial sector, expectations of households and firms and composition of government expenditure and taxation. If government expenditure is increased but the domestic factories cannot produce more cars or pens, the increase will translate into higher inflation and imports. Similarly, if government needs to fund the spending through higher VAT or other tax rates or financial markets require much higher returns on government debt, the net impact of an expenditure increase can become negative. How are these relationships captured in the ADRS model?

Figure 4: Real 10 year and over bond yield



Source: South African Reserve Bank

Another important relationship is between fiscal and current account deficits. In the past, high growth in government expenditure has been accompanied by higher current account deficits. The current account balance shows the income and trade balances with the rest of the world. A deficit must be funded by foreigners buying domestic assets. For example, a big part of the fiscal and current account deficits have been funded by foreigners who have purchased government bonds. Non-residents hold close to 40 per cent of government debt.²⁵ The current account deficit is a constraint on economic growth because it requires constant funding by foreigners but also because it indicates that the economy does not export and generate sufficient foreign currency income to pay for its imports and borrowing from abroad.

The ADRS report again tells us nothing about how these relationships are captured in the model; the impact of the fiscal proposal on the current account; and how the current account deficit is funded. If the relationship between the government expenditure and the current account deficit is different to what we have observed in the past, why is this the case?

Higher inflation expectations imply higher nominal and real rates

The fiscal expansion envisaged in the ADRS report is backed up by easier monetary policy, shifting from inflation targeting to nominal GDP targeting so as to accommodate a higher inflation rate. The proposal presumably seeks to exploit a supposed short-term Phillips curve trade-off that trades higher inflation for more growth, but which is not much in evidence in a wide array of econometric

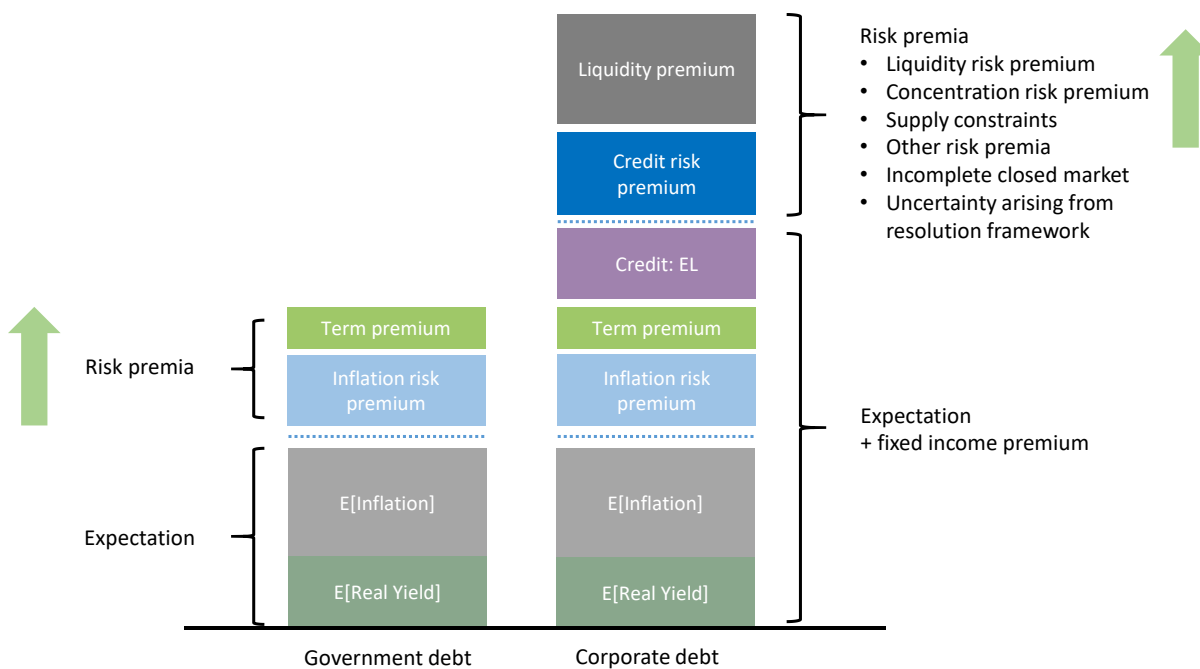
²⁴ The ADRS report acknowledges in one sentence that the multipliers can be negative, but ignores testing how the results change if the multipliers are smaller. Nor do they motivate why the use of a large fiscal multiplier is appropriate.

²⁵ See chapter 7 in the 2020 Budget Review, available here <http://www.treasury.gov.za/documents/national%20budget/2020/review/Chapter%207.pdf>

studies that try to find the beneficial slope of the curve.²⁶ Leaving aside the empirical policy question of whether using money illusion to reduce workers' real income levels to get more growth is actually doable, there are some important economic relationships that need to be present in order for a model to generate useful results.

Assessing the impact of different monetary policy frameworks requires modelling the different components of interest rates and in particular the relationship between inflation expectations, inflation risk premium and nominal and real interest rates. A model should also distinguish between short and long rates.

Figure 5: The structure of interest rates²⁷



Source: RMB

Figure 5 shows a decomposition of the interest rates for government and corporate debt. Lenders are primarily interested in real, not nominal returns. In the real world, permanent and anticipated increases in inflation are instantaneously priced into borrowing rates. Indeed, a reduction in the repo rate can only reduce overall interest rates when inflation expectations are well anchored (do not rise in the event of the policy rate falling).

The ADRS report and technical description do not show how this relationship is taken into account. If the Reserve bank tolerates higher inflation and higher inflation expectations that will push the rates in figure 5 up and not down.

Some of this increase maybe offset by lower policy rates but this is where distinguishing between different rates becomes important. For example a decrease in the policy rate can lead to higher long rates because the market believes that the Reserve Bank is tolerating higher inflation. It can also lead to a shift down of the yield curve depending on the markets view of the sovereign risk premium and only if inflation expectations are well anchored. What we have observed is that the lowering of the policy rates in the post 2008 period has been accompanied by steepening of the yield curve

²⁶ See for example Dadam and Viegi (2015) and Kabundi, Schaling, and Some (2016).

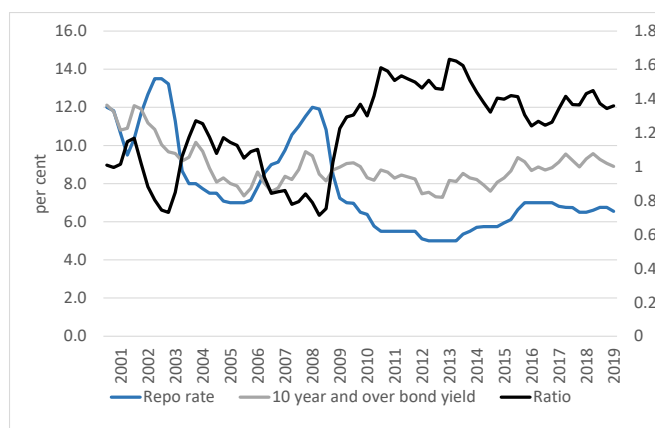
²⁷ E(Inflation) is expected inflation and E(Real Yield) is expected real yield.

(Figure 6). Again how are these relationships modelled? Are they modelled?

The introduction of nominal GDP targeting is widely debated.²⁸ What we are certain is that the ADRS model is not suited to evaluate the impact of nominal GDP targeting on the South African economy.

We are told that the interest rate decreases by 3.1 per cent. Which interest rates? What happens to inflation expectations? Why would inflation expectations remain well anchored? If it is long rates that decline, why have we not seen this over the last 10 years?

Figure 6: Ratio of long rates to the policy rate



Source: Haver

What is the relationship between interest rates and domestic savings in the ADRS report?

Interest rates are a cost to borrowers but a return to savers. In every economy, savings is equal to investment. The interest rate plays an important role in bringing this relationship into equilibrium. A low savings rate is also a constraint to economic growth as higher interest rates are required to incentivise companies and consumers to save while at the same time these higher rates reduce investment and consumption. High growth economies have savings to GDP ratios of above 25 per cent., whereas South Africa's ratio is close to 16 per cent.²⁹

The ADRS report again tells us nothing about this relationship. If all interest rates decline by 3.1 per cent in their macro simulation, and inflation is at 6 per cent, then savers will be receiving negative real returns on their long-term deposits and so will holders of government debt.³⁰ Why would they save and why would they buy government bonds?

Models, which assume that government or the Reserve bank can manage the business cycle perfectly are not useful?

In the report the ADRS states:

"The growth path is supported by policy measures that help gradually shift, in favourable directions, both aggregate demand and aggregate supply accompanied by rising employment, income and expenditure of households and businesses, thus improving the fundamentals of the economy and foundation of sustainable growth"

²⁸ Creamer and Botha (2017) evaluate the suitability of nominal GDP targeting for South Africa. They find that it is not a suitable policy option.

²⁹ The Commission for Growth and Development found that achieving high growth rates required investment to GDP ratio of 25 per cent and a similar savings or higher savings ratio.

³⁰ Long term deposit rates are in the region of 8 per cent per annum. Inflation of 6 per cent reduces the real rate to 2 per cent. A further reduction of 3.1 per cent implies that the real return to savers is negative 1.1 per cent per annum.

Firstly, policy makers can do this on average in the long-run, but not in the short to medium term, and if this kind of optimisation was so easy, then we would never have business cycles or economic crisis, and yet we do. Secondly, the ADRS model cannot generate cyclical dynamics, which are key for monetary policy analysis. This implies that the model cannot tell us much about short-term analysis and the ways in which fiscal and monetary policy impact on cyclical outcomes. In short, the ADRS assumes a long-run market equilibrium, exactly what the authors criticise the CGE models for doing. The difference is that in the National Treasury type CGE models the equilibrium reflects certain constraints in the economy. Also, National Treasury recognises the limitations of its CGE model and is not using it for monetary policy analysis.

More importantly, why do we need to model impacts if we adjust the model outcomes continuously to ensure that we generate positive outcomes and avoid any constraints? The benefit of economic modelling is that we apply shocks to the economic model and we see how the economy depicted in the model structure adjusts to these shocks subject to a set of constraints.

The ADRS seems to be assuming their results rather than generating them, which is against basic economic modelling practices.

It is important to present the impact on variety of variables over time

The ADRS provides no information on key macroeconomic variables such as the exchange rate, capital flows, inflation expectations and the current account. This makes it impossible to understand the transmission mechanism from macroeconomic policy and how the model behaves.

For example,

- What happens to the real exchange rate when inflation and inflation expectations are higher? – If the real exchange rate depreciates, our competitiveness improves but if it appreciates because inflation in South Africa is higher than in its trading partners then our exports become more expensive?
- What happens to capital flows if our inflation is higher and bond yields lower as estimated by the ADRS?
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Again these relationships are important yet it is not clear whether they are taken into account.

Monetary policy analysis requires that the short-term responses of variables are presented. In the ADRS report we are given averages over 10 years for many of the variables. That can work for structural reforms analysis in some cases but it cannot work for monetary policy analysis. We are told that inflation is on average 5.9 per cent. Is this because in the first 5 years inflation is 9 per cent and then 3 per cent over the rest of the period or is it because it is 5.9 per cent throughout the period?

The two paths imply very different economic impacts and policy responses and tell us very different stories about the properties of the model.

Supply constraints and trade offs

The ADRS model appears to have no supply constraints. This implies that any change in aggregate demand is swiftly met by rising production as suggested in the quote above. This is dangerously unrealistic and evinces neglect of any serious empirical work on the South African economy. To take just one, albeit critical, example, South Africa continues to experience major electricity disruptions. The proposed increases in government expenditure and the monetary policy stimulus will certainly

run up against this constraint. And indeed many analysts see this constraint as being one of the primary reasons for our poor growth rate.

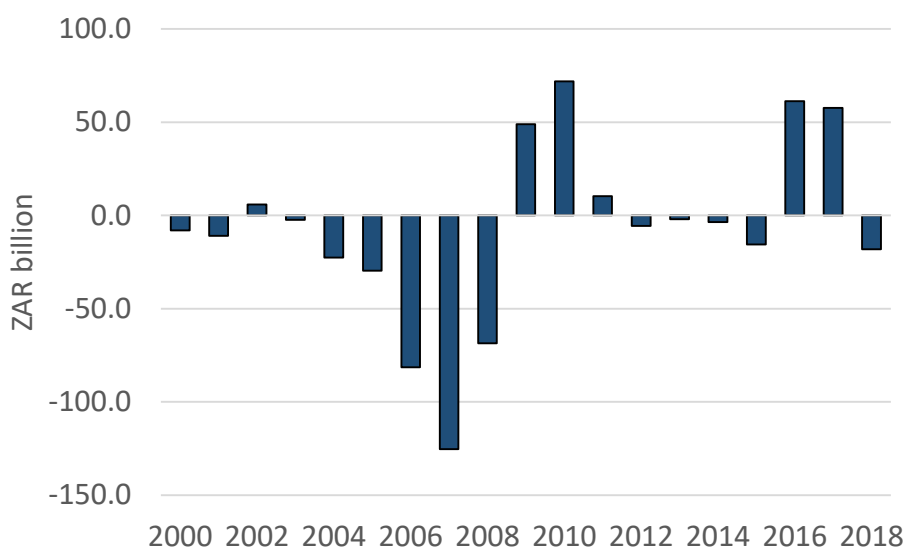
Increasing potential growth over the short term is possible **only** by reducing or keeping unchanged the output of electricity intensive sectors such as mining and manufacturing. This has been the case over the last 10 years. The ADRS model instead suggests strong growth in all sectors. Where can the electricity come from?

Models may be simplified versions of reality but they still need to bear some resemblance to reality. The ADRS does not explain why the electricity constraint is not binding in their analysis?

In the absence of any constraints, there are also no trade-offs. Policy making, however, is about trade-offs in the real world. Spending more on health may require cuts in social spending. Spending more on infrastructure may require higher tax rates or borrowing. There are benefits but there are also costs to policy changes in most cases. Models which aim to help policy makers with the design of their policies need to take into account at least some of these trade offs.

The general case for more public and private investment and better public services delivery in South Africa is clear and strong. However, the ADRS report does a terrible job in explaining their simulations. In particular, it is unclear how the spending proposals in the ADRS report are funded, which would determine the economic outcomes. Instead, the funding just appears. The ADRS seems to suggest that the multiplier effect will be so large that the proposals will pay for themselves. If this the case, the ADRS needs to explain why the rising risk premium and bond yields are not a funding constraint for government?

Figure 7: Savings - Investment Balance for Private Non-Financial Firms



Source: SARB

Investment must also be funded as indicated before. How is this done? The model does not show how the funding takes place. Do interest rates have to increase? If households have to save more, they need to consume less.

The private sector as a whole does not sit on excessive piles of cash. The easiest way to see this is to return to the simple identity that in every economy investment expenditure must equal total savings. Savings is provided by households, government, the private sector and foreigners. Households, government and the private sector also invest. Some institutions invest more than they save and others invest more than they save, but on a country level savings and investment has to be

equal. In figure 7, we show the savings-investment balance for the private, non-financial sector. Saving surpluses were recorded in 2016 and 2017, but investment exceeded savings in 2018. According to the flow of funds data, the surpluses were invested in various financial instruments such as bank deposit and equities. In turn the financial sector, used the funds along with its own savings and other sources of funding to provide loans, buy government bonds and other financial institutions.

Again, the framework is not able to capture the complete transmission mechanism. It focuses on the benefits but it ignores the costs and the sources of funding.

Conclusion

The report by the ADRS is an example of how models should not be used. There is no explicit articulation of the model structure or its properties – it appears to just spew results. The section title, “Analysis of Scenarios,” lists results, rather than *explaining* how they are generated. The reader has to wonder why scenario 2 generates the largest increase in exports to GDP but one of the lowest growth rates and a fairly modest increase in the investment to GDP ratio. Most importantly, the model appears to ignore supply constraints, economic trade-offs, financial market dynamics and key monetary and fiscal policy relationships. The opportunity costs of making choices is perhaps the single defining feature of economic thinking and yet it doesn’t feature in the ADRS report.

Economic models are an important element of the policymakers’ tool box, but they have to be used correctly. This requires transparency in terms of the model structure and assumptions as well as the presence of relationships (transmission mechanism), which are relevant in answering the policy question at hand. This is a universal requirement independent of whether you are a heterodox or main stream economist. The ADRS model does not satisfy these criteria.³¹

Annexure

Here we provide links to several articles that include model descriptions or peer review articles illustrating applications of the NT CGE model. There are no reputable peer reviewed articles of the ADRS model.

- a. <http://www.ifpri.org/publication/standard-computable-general-equilibrium-cge-model-gams-0>
- b. <http://www.tips.org.za/files/707.pdf>
- c. <https://ideas.repec.org/p/rbz/wpaper/3195.html>
- d. <https://www.sciencedirect.com/science/article/pii/S0306261913009288> (peer reviewed application of a version of the NT CGE model)
- e. <https://www.sciencedirect.com/science/article/pii/S1876610214033530> (peer reviewed application of a version of the NT CGE model).

³¹ There are many other issues with the model that we did not discuss but are equally problematic. These include for example: (1) The absence of key relationship for monetary policy analysis such as the Phillips curve and the Taylor rule and their specification. We are told that the model has no Taylor rule dynamics, at least in the baseline. (2) Scenario inconsistencies as the one highlighted below in scenario 2. (3) We have not been able to comment on size of coefficients and the model diagnostics as these are not presented in the ADRS reports or technical model description.

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