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SA's structural budget balance – some fiscal restraint
March 2017

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Abstract

Cyclically-adjusted, or structural budget balances are frequently-used tools to calibrate a country's fiscal stance; however, there have been few estimates for South Africa so far. This note tries to decompose the SA budget deficit between a cyclical and a structural component, and finds that most of the changes in the budget balance over the past 25 years or so have been of a structural nature. Following a marked deterioration in the structural balance during and in the immediate aftermath of the 2008-09 recession, fiscal policy appears to have been tightened at a pace of about 0.4% of GDP per year since 2012/13, a stance which looks roughly set to continue in the next two years. However, this restraint falls short of the tightening implemented in the late 1990s, and mostly relies on tax hikes, whereas expenditure remains close to record highs relative to both actual and potential GDP.

Introduction

The structural, or cyclically-adjusted budget balance, is a widely used concept among economists and policymakers as it helps to: (1) better measure the degree of fiscal restraint or loosening in the economy (the "fiscal stance"); (1) make a better assessment of the medium-term sustainability of specific fiscal policies. In turn, knowledge of the fiscal stance improves economic forecasting and facilitates monetary policy-making, under the (rough) assumption that a restrictive fiscal stance allows for a looser monetary stance (and vice versa) in order to achieve a specific inflation goal.

While estimates of structural budget balances have existed for many years in advanced economies (calculated, among others, by the OECD), such estimates – a fortiori reliable ones – are harder to come by in emerging countries. To some extent, this reflects the greater difficulty in measuring potential growth, and therefore the output gap, in economies which experience more frequent and sizable structural shifts. South Africa fits into that category: As of now, the IMF Fiscal Monitor is the only publication with an estimate of the structural budget balance.[1] In this note, the level and drivers of the SA's structural budget balance is investigated. Findings suggest that the bulk of changes in the actual budget balance, including the marked deterioration in the wake of the Global Financial Crisis, were structural. They also confirm that some gradual fiscal policy tightening is taking place at present, though mostly through tax hikes rather than expenditure restraint.

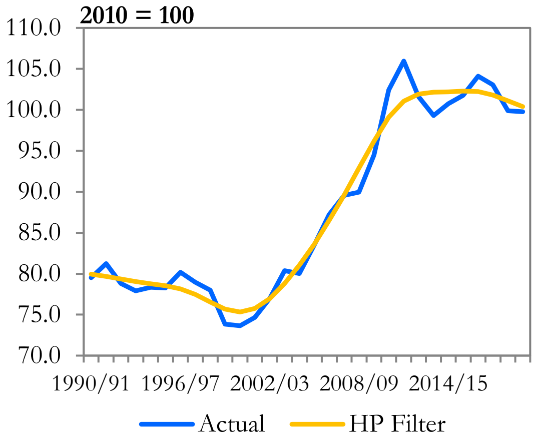
Methodology – augmenting the traditional OECD approach

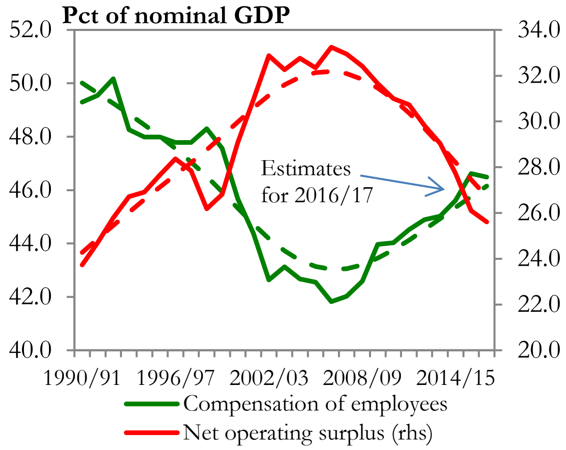
This note's calculations are based on the OECD's traditional approach, as explained in Giorno et al. (1995), which links potential tax revenues and government expenditure to a ratio of potential to actual output, adjusted for the elasticity of that specific revenue (or expenditure) to GDP. In the South African case, however, we assume that both non-tax revenues and government expenditure do not have a meaningful cyclical component (the latter is in contrast to OECD countries, where cyclically-influenced unemployment benefits generally represent a more important component of public spending).[2] Hence,

[1] At some stage, National Treasury published a chart of the structural budget balance in its annual Budget Review; however, that exercise was later discontinued.
[2] In South Africa, the main budget does not incorporate unemployment benefits. Social security payments (including jobless benefits) are part of the consolidated government budget; however, adjusting these payments for the real income gap only has a marginal impact on the estimated structural budget balance.

our approach focuses on extracting the cyclical component from the different tax revenues (see Annexure for details).

Figures 1 and 2: SA terms of trade (left) and proxy tax bases for personal and corporate income taxes (right) versus HP filter trends





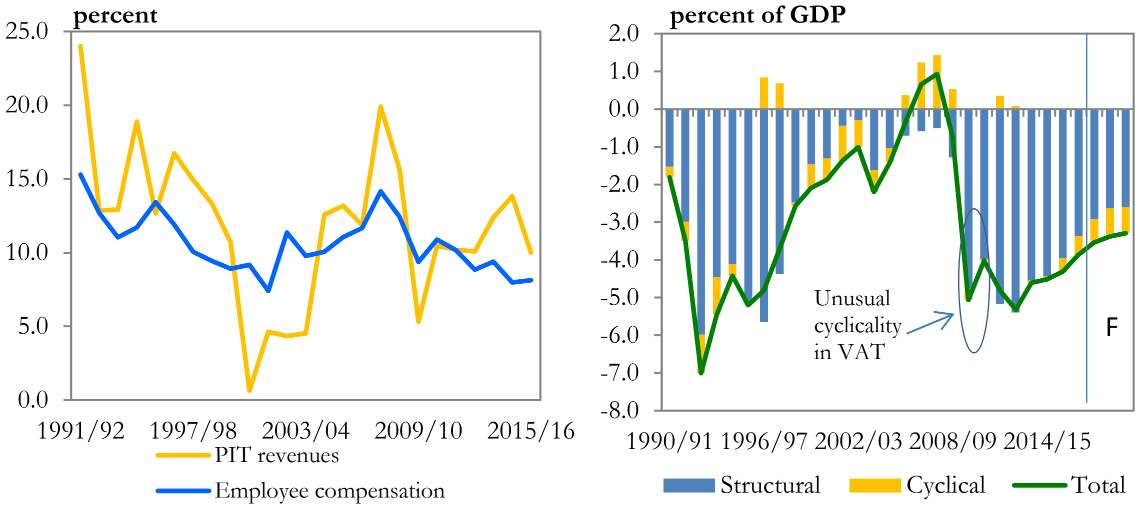
However, because of some specific characteristics of the South African economy, we feel that a simple approach as described above fails to accurately reflect all the cyclical fluctuations that have affected the economy over the past two decades. In particular, we feel that:

- A real income gap (the output gap adjusted for a terms-of-trade gap) is a better measure of the influence of the business cycle on the budget balance than a simple output gap measure. This follows the recommendations of Turner (2006) for commodity-exporting countries.[3] Indeed, South Africa has experienced large terms-of-trade fluctuations over time (see Figure 1);
- The structural balance should be adjusted for a composition effect; that reflects the shifts in the different tax bases over the years relative to trend, following the approach of Braconier and Forsfält (2004) in the case of Sweden. Historical experience suggests such tax bases have indeed not been stable over time (see Figure 2).

In both cases, however, we only consider as cyclical the deviation of the terms of trade (and of the different tax bases) from their trends, proxied here by standard Hodrick-Prescott (HP) filter values. This approach assumes that cycles are short-term in nature, which may be a sound enough assumption for the business cycle but less valid if one discusses, for instance, the financial or commodity cycle. For example, as Figure 1 shows, the use of the HP filter implies that the trend rise in the SA terms of trade from 2002 onwards is mostly structural, and hence affects the structural budget balance. Detractors may argue this was instead a commodity "super-cycle" that will eventually reverse. Yet equally, especially in light of the key role of Chinese growth in reshaping commodity markets in past decades, one can also claim that SA terms of trade have experienced a structural upward shift in the last fifteen years.

[3] Admittedly, because commodity prices influence real South African GDP, the output gap already incorporates some of the effects of the commodity cycle. However, they probably do not capture all of the effects, in particular the contribution to nominal profit variations. An alternative approach is to augment the real output gap with deviations from trend of the GDP deflator; however, it yields roughly similar results to using a real income gap.

Figures 3 and 4: Annual growth in PIT receipts and compensation of employees (left) and split of national government budget balance (right)



Another difficulty relates to tax elasticities. The initial approach of Giorno et al. (1995) recommended using long-term elasticities of tax revenues to GDP. However, in the South African case, these long-term elasticities do not differ significantly from 1.0,[4] yet shorter-term elasticities (also referred to as tax buoyancy) can significantly vary (see Figure 3). Ignoring these shorter-term variations could result in mistaking an amplifying effect of the cycle on some tax revenues as a structural one – like, for instance, when corporate income tax (CIT) receipts were unusually strong in the pre-crisis years. To account for these shifts, we use a rolling short-term elasticity in our calculation of potential tax revenues, as explained in the Annexure. In the pre-crisis years in particular, it has some impact on our structural balance calculations.

The results – four distinct phases in SA fiscal policy

Our calculations – based on the national budget balance, for which data are available over a long period – suggest that while the cyclical component of the deficit has been at times non-negligible, in particular in periods of wide output gaps or terms-of-trade gaps, the majority of medium-term shifts in the fiscal balance are of a structural nature (see Figure 4). Specifically, we see four different phases in South Africa's fiscal stance since the mid-1990s:

- A significant fiscal tightening (equivalent to 5½% of GDP over six years) from 1996/97 onwards, which followed the government's implementation of the GEAR (Growth, Employment and Redistribution) strategy. Expenditure restraint and improvement in the tax collection were key to that achievement;
- A period – lasting up to the eve of the Global Financial Crisis – of relative stability in the structural budget balance, while the emergence of a positive output gap was enough to shift the actual budget into surplus;
- A sharp deterioration in the structural balance in 2009/10 – at the worst of the recession – as public expenditure surged as a share of GDP, followed by a more muted deterioration (on average) in the following three fiscal years;[5]

[4] We calculate long-run elasticities to GDP of 1,2 for personal income tax and VAT, 1,1 for corporate income tax, and 0,7 for other taxes

[5] The surprising pattern in our results – which show a net tightening in 2010/11 followed by renewed easing in 2011/12 – is largely explained by developments in VAT revenues, which rebounded strongly (from very low levels)

- A renewed period of fiscal consolidation – mostly via tax increases – since a 2012/13 peak in the structural deficit. Based on National Treasury's estimates for the fiscal year ending this month and on projections from the 2017 Budget, we estimate that fiscal consolidation averaged 0.5% of GDP per year in the last four years, and should average 0.3%-0.4% of GDP in the next two years, before flattening out in 2019/20.

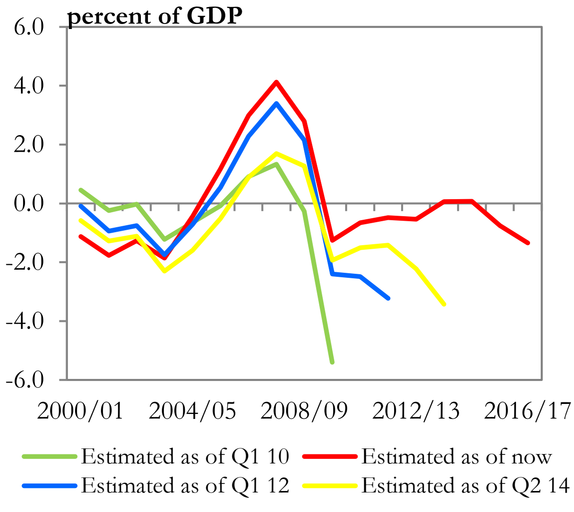
So far, we have based our calculations on national budget data. However, extending our analysis to consolidated government data – including provincial government and social security agencies, and going back to 2000 – does not fundamentally change our conclusions. In particular, we find that the consolidated structural government deficit falls by a moderate 0.3% of GDP per year, on average, from 2012/13 to 2019/20. By the end of the budget projection period in 2019/20, the consolidated structural budget deficit would be about 2.0% of GDP, the lowest since 2008/09 but still not matching the near-zero deficit of the immediate pre-recession years.

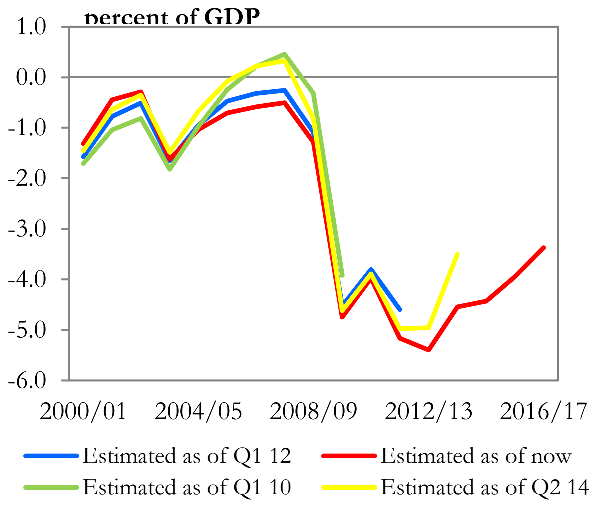
Did the wrong estimates of the output gap confuse policy?

Our calculations are based on the Reserve Bank's present estimates of the historical and projected output gap. However, "real time" estimates of the output gap have changed significantly over the years; because the Bank has regularly revised lower its estimates of potential GDP growth. In particular, the Bank's view now is that the positive output gap prior to the crisis was larger than thought back in 2010; but that it did not turn as negative afterwards as was thought in 2012 and 2014 (see Figure 5). Hence, it is worth asking the question: Could fiscal policy have avoided the present challenges had it been better informed about the true degree of slack in the economy back in 2010-12?

Our answer is mixed. Because of revisions to the output gap, we now estimate the structural budget balance to have been worse over these years than we would have judged back then based on real-time output gap estimates. However, the magnitude of the deterioration in the structural balance in the post-crisis years remains broadly the same whether we use current or real-time estimates (see Figure 6). In a word, uncertainties about the output gap cannot be blamed for the scale of past fiscal deterioration. Policymakers must have known the degree of structural loosening they allowed, even though they believed they were coming from a stronger starting point and hence had more leeway.

Figures 5 and 6: Present and "real-time" estimates of the history of the SA output gap (left) and of the structural budget balance (right)





in 2010/11 before disappointing again in 2011/12. Overall, though, we estimate that the structural balance worsened by about 4.5 percentage points of GDP within a period of four years.

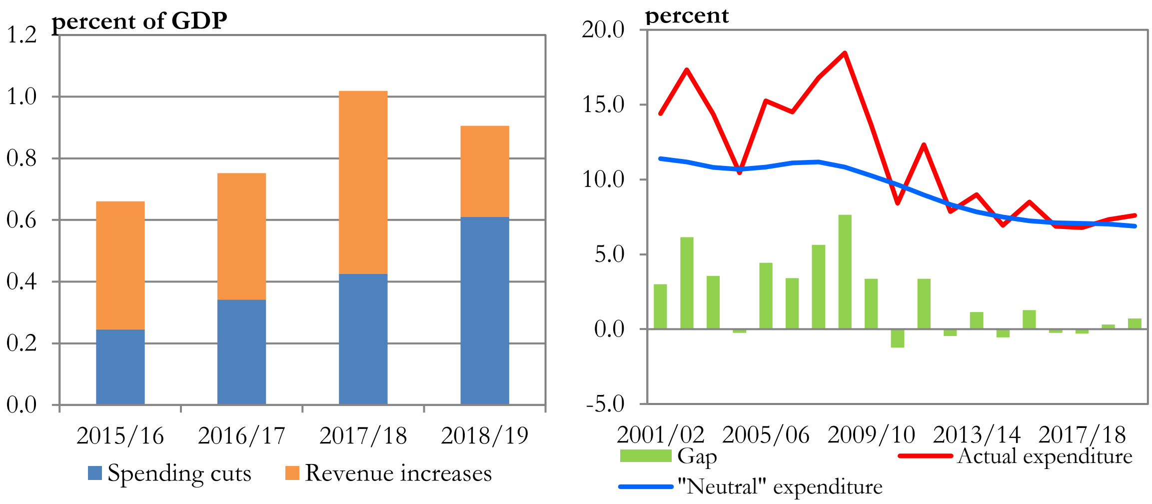
Is there as much expenditure restraint as National Treasury claims?

As mentioned above, there are not many published estimates of South Africa's structural budget balance to which we can compare our calculations. Projections in the IMF's October 2016 Fiscal Monitor show a lesser degree of a restraint (the structural deficit is only expected to fall by 0.3% of GDP between 2016 and 2020, to 2.9% of GDP) but the publication predated the additional consolidation announced in the 2016 MTBPS and confirmed in the 2017 Budget. By contrast, the 2017 Budget review lists the total amount of tax increases and expenditure reductions (relative to National Treasury's self-imposed ceiling) and this "bottom-up" approach would suggest a larger degree of restraint than our calculations – about 0.8% of GDP per year (see Figure 7).

While we do not dispute that higher personal income taxes and excise duties are contributing to fiscal restraint – although any permanent deterioration in tax collection efficiency, which might be a risk in light of the 2016/7 revenue undershoot, would in part negate such structural restraint – public expenditure restraint may not be as strong as National Treasury claims. We calculate that consolidated primary government expenditure (excluding the volatile payments for financial transactions and contributions to the contingency reserve) is only expected to fall by 0.5% of nominal GDP between 2015/16 and 2019/20. Figures are similar if we look at primary expenditure as a share of *potential* GDP[6], meaning that subdued growth cannot be blamed for the relative stickiness of the expenditure/GDP ratio.

One can debate, of course, what "neutral" public spending policy is. We propose, as a rule of thumb, that a growth rate of public expenditure equal to real potential GDP growth plus the trend increase in the GDP deflator is "neutral", in the sense that it is counter-cyclical but does not affect the medium-term "steady-state" of the economy. Using that benchmark, we find that actual growth in primary expenditure – after significantly exceeding the "neutral" rate for most of the 2000s – has been close to it since 2012/13, and that this latter trend is projected to continue in the next three years. Hence, it appears that the government has successfully ended the upward drift in spending relative to GDP, but that it has failed to bring spending growth sustainably *below* its neutral path, hence relying mostly on tax increases to tighten fiscal policy. And consequently, expressed as a share of potential GDP, government expenditure is still close to the highs of the past twenty-five years.

Figures 7 and 8: Fiscal consolidation measures announced by National Treasury (left) and actual versus "neutral" growth in consolidated government primary expenditure (right)



[6] In all our calculations, we assume that potential nominal GDP equals potential real GDP times the actual GDP deflator – in a word, that the price of output has a neutral effect on the business cycle.

Conclusion

Our estimates of the structural budget balance remain fraught with uncertainties (whether the output gap is properly measured, which trends in tax bases or the terms of trade are structural or not, whether elasticities are properly accounted for…) Nevertheless, they concur with the "conventional wisdom" that fiscal policy has being tightened moderately in the past three to four years already, and that budget projections are consistent with a continuation of this moderate tightening. Provided that the output gap eventually closes, and barring a negative terms of trade shock, this should allow the consolidated government deficit to eventually fall to about 2% of GDP, and stabilize the debt/GDP ratio, albeit in excess of 50%.

On balance, recent and prospective fiscal tightening has assisted and should still assist monetary policy in keeping SA inflation under control, as: (1) a tighter fiscal stance curbs household consumption and in turn reduces demand-driven price pressures; and (2) it strengthens the likelihood of eventual debt/GDP stabilization and thus reduces one risk factor of inflationary rand depreciation.[7] Nevertheless, many questions remain unanswered. These comprise: Whether the policy-mix is appropriate, or whether fiscal policy should be tightened more aggressively to "free up" monetary space; whether National Treasury's reliance on tax hikes rather than spending cuts is detrimental to potential GDP growth; and whether the mix of public expenditure growth (between capital and current outlays, and within the latter, between wages and other consumption) is the optimal one. Further analysis will be required to try and answer these questions.

[7] In addition, commitment to fiscal consolidation has been key to avoiding downgrades in SA sovereign debt ratings to sub-investment grade over the past year. Had such downgrades taken place, potentially inflationary rand depreciation could have been a likely consequence.

Annexure – Our methodological approach to calculating the structural budget deficit

From actual to potential revenues and expenditures

The basic approach to calculate the structural budget deficit follows the OECD's pioneering work in the subject, by Giorno et al. (1995), which uses the following equation:

$$B^* = \sum_{i=1}^{n} T^i * \left(\frac{Y^*}{Y}\right)^{\alpha^i} + NT - G * \left(\frac{Y^*}{Y}\right)^{\beta} - K\ spending$$

Where B^* is the structural balance, T^i the different taxes, Y^* and Y potential and actual GDP, G government current spending and NT non-tax revenues, α and β the elasticities of taxes and spending to GDP. However, in the South African situation, we assume (at least for the national budget) that β=0, as no major component of current government expenditure is specifically linked to the cycle (unlike in OECD countries).

We also assume a neutral role of the GDP deflator in influencing the output gap; consequently the ratio of potential to actual *real* GDP is used as a proxy for that of potential to actual *nominal* GDP.

Accounting for deviations from trend of the terms of trade

To account for South Africa's nature as a commodity-exporting economy, and for the influence of the terms of trade on tax revenues (in particular, via CIT payments from the mining and mining-related sectors) we replace the ratio of potential to actual real GDP by a ratio of potential to actual real income.

Potential real income is derived from both actual real income and the real income gap, which is calculated as follows, based on the approach of Turner (2006):

$$\frac{I - I^*}{I^*} = \frac{Y - Y^*}{Y^*} + Xshare * \frac{T - T^*}{T^*}$$

Where *I* is real income, I^* potential real income, *Y* real output, Y^* potential real output, *T* the terms of trade, T^* its trend (calculated by a standard HP filter) and *Xshare* the export share of GDP.

Calculating the composition effect

The tax bases of different revenues change over time as a share of GDP, affecting the different government revenues irrespective of the level of the real income gap. While trend shifts should be construed as influencing the structural budget balance (for instance, the long-term rise in import penetration means that customs duties represent a structurally larger share of revenues than in the past, assuming that tariffs are constant), short-term deviations from these trends can be seen as cyclical. To capture the impact of these deviations, we calculate a "composition effect", which follows the approach of Braconier and Forsfält (2004):

$$CE = \sum_{i=1}^{n}\left(\left(\frac{T^i}{B^i}\right) * \left(\left(\frac{B^i}{Y}\right) - \left(\frac{B^i}{Y}\right)^*\right)\right)$$

Where CE is the composition effect, T and B the respective tax revenues and bases, and $(B/Y)^*$ the trend in each tax base relative to GDP. These trends are calculated using a simple HP filter for the following: Compensation of employees (as a proxy base for PIT), net operating profits (as a base for CIT), a weighted sum of public and private consumption (as a base for VAT), consumption of food, beverage and tobacco (as a base for excise duties on alcohol and tobacco), consumption of oil products (as a base for fuel taxes) and imports (as a base for customs duties).

The treatment of elasticities

As the first equation above suggests, the influence of the ratio of potential to actual output on potential taxes should be powered by the elasticity of taxes to GDP. However, long-term elasticities do not account for short-term changes in tax buoyancy – which in several cases is stronger in an upward phase of the business cycle – and require different approaches, as illustrated for example by Girouard and André (2005).

Our approach is to compute a rolling elasticity equivalent to an eight-quarter average of the annual elasticity of major tax categories (PIT, CIT and VAT) to nominal GDP. In order to correct for the effect of changes in tax rates, we calculate these annual elasticities as a ratio of ex ante tax revenue growth (i.e. tax revenue as it would have been without the tax changes, indicated in the specific Budget Reviews) to nominal GDP growth.

For other tax revenues, as well as for the difference between consolidated and national government revenues, we assume an elasticity of one to calculate their potential levels.

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Animal spirits and the hangover in private sector investment – June 2017

Marea Sing, Rudi Steinbach and Nkhetheni Nesengani

Abstract

Growth in real private sector investment has slowed markedly in recent years, recording negative year-on-year growth rates since 2015Q3. The South African indicators of business confidence show a similarly dismal trend, recording historic lows in recent quarters. This note looks into the influence that business confidence has had on private sector investment, and considers what investment may have been if business confidence had not plummeted. Private sector investment would have been up to 8.5 per cent higher by 2016, in level terms, had business confidence remained at the levels recorded in 2011. Finally, the SACCI business confidence index shows promising results in improving private sector investment forecasts, especially in the near term.

Introduction

> "Most, probably, of our decisions to do something positive ... can only be taken as a result of animal spirits – of a spontaneous urge to action rather than inaction, and not as the outcomes of a weighted average of quantitative benefits multiplied by quantitative probabilities.
> ... if the animal spirits are dimmed and the spontaneous optimism falters ... enterprise will fade and die;— though fears of loss may have a basis no more reasonable than hopes of profit had before."
>
> – *John Maynard Keynes, The General Theory, Chapter 12*

Private sector investment is not only a significant determinant of economic activity but, more importantly, is a crucial driver of potential output and economic development.[1] That is, through expanding the productive capacity of an economy, investment ensures increases in future socio-economic welfare. This is why the National Development Plan (NDP) has set a target for total investment to reach 30 per cent of GDP by 2030. This target seems particularly ambitious given that total investment only represented 19.9 per cent of GDP by the end of 2016. Given this background, the marked decline in South African private sector investment growth since the recession of 2008/9 is especially worrying (see Figure 1). As a percentage of GDP, private sector investment peaked at 15.4 in 2008Q4, and has since declined to 12.2 per cent by the end 2016. This economic note investigates the role that a decline in business confidence has played in private sector investment during recent years. In addition, the note assesses the extent to which the use of business confidence as an explanatory variable could improve forecasts of investment.[2]

Private sector investment in South Africa since 2000

The early 2000s marked the beginning of an international boom in commodity prices, driven largely by strong demand from economies such as China and India. The commodity boom had two distinct effects: (1) it significantly raised the economic growth of commodity exporting economies; and (2) it fueled global risk appetite. South Africa was no exception, and experienced average annual real GDP growth rates of 5.1 per cent over the period 2004Q1 to 2008Q2. Over this period, annual growth in real private sector investment averaged 11.2 per cent.

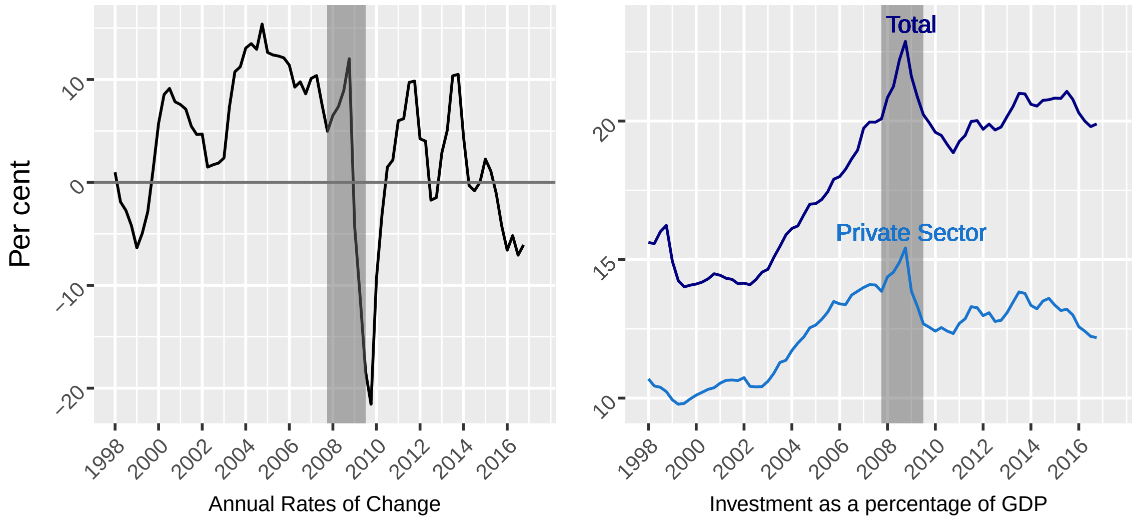
The commodity price boom also fueled global risk appetite, and together with relatively loose global monetary policy, provided further stimulus to the South African economy, as the *risk on* environment encouraged capital flows towards emerging markets.[3] While, domestically, the resultant growth in asset prices and the boom in

[1] Since 2000, private sector investment has been between 10 and 15 per cent of gross domestic product and constitutes between 60 and 75 per cent of total investment.

[2] Currently, there are two surveys of business confidence in SA: (1) the South African Chamber of Commerce and Industry's business confidence index (SACCI BCI), and (2) the RMB/BER business confidence index. Figure 4 in Section shows a comparison between the two surveys. We use the SACCI BCI since preliminary analysis suggests that it is more strongly correlated with movements in private sector investment. In addition, while the SACCI BCI does not survey businesses directly, it is constructed to capture the overall business mood by reflecting the environment in which businesses operate as well as their actual behaviour.

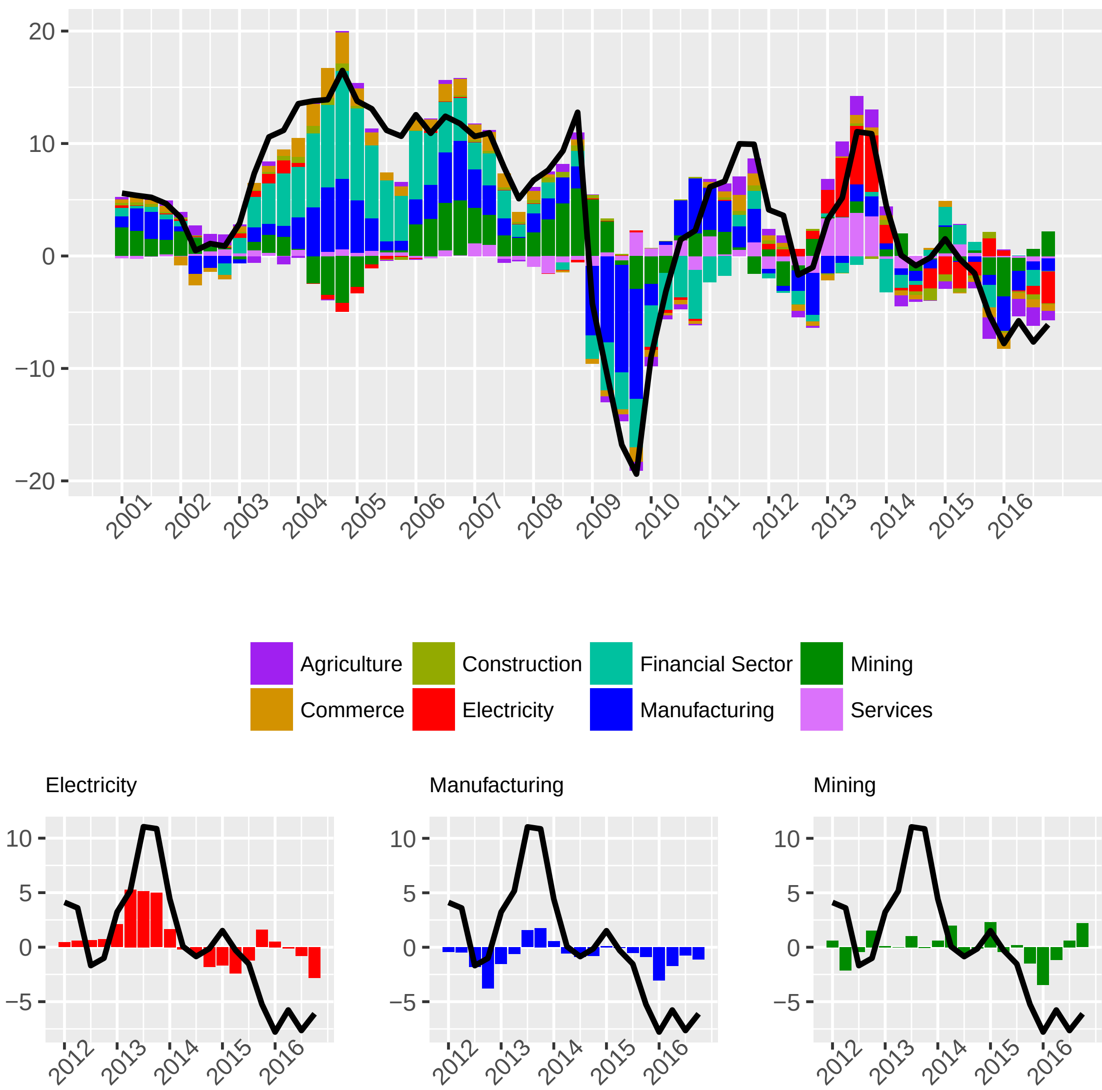
[3] The Chicago Board Options Exchange (CBOE) VIX reached an all time low of 11.19 index points in 2006Q4.

Figure 1. Real Private Sector Investment



Source: StatsSA, Own calculations

Figure 2. Sectoral Contributions to Annual Private Sector Investment Growth



credit extension, saw real consumption of households and investment by the private sector surging. As can be seen in Figure 2, the impact on private sector investment over this period was fairly broad-based. Additionally, growth in private sector investment from around 2008 was further accelerated by preparations for the 2010 Soccer World Cup.

Eventually, the boom culminated with the onset of the global financial crisis (GFC) in 2008/9, and commodity prices subsequently collapsed. While there was a temporary post-crisis recover in commodity prices, they began trending downwards after 2011. This is clearly reflected in private sector investment growth, which only recovers briefly in 2013/14 as a result of the Government's Renewable Energy Independent Power Producer Procurement Programme (REIPPP) in the Electricity sector. Annual growth in private sector investment has been mostly negative since 2014Q2, with the main contributors to this outcome being investment in the manufacturing and mining sectors, as well as the impact of the drought on agricultural sector investment.

Animal spirits and business confidence

> "Thus if the animal spirits are dimmed and the spontaneous optimism falters ... enterprise will fade and die;— though fears of loss may have a basis no more reasonable than hopes of profit had before"
>
> – *John Maynard Keynes*

Business confidence in South Africa similarly reached an all time high of 139.4 index points in 2006Q4, averaging 134 points between the end of 2003 and the start of the GFC in 2008. By 2009Q1, confidence had dropped back to 111.8 points, roughly in line with levels seen before the commodity price boom. Along with commodity prices, business confidence recovered temporarily after the crisis. However, since 2011Q1 it has been in constant decline, recording a current low of 90.1 index points in 2016Q3.

While the initial impetus of the commodity price boom was real demand (mainly from China), it is argued by the authors of this note that a portion of what followed in South Africa can be attributed to Keynes's *animal spirits*. Keynes used the term animal spirits to capture the role that human emotions play in economic decision-making. These emotions – be it feelings of optimism or pessimism – are not linked to the fundamentals of an economy, but often are rather irrational. Therefore, there is an aspect of the business confidence index and its impact on private sector investment that cannot be explained by any observed economic variables. This begs the question, that if "animal spirits" result in self-fulfilling prophecies, what would private sector investment in South Africa have been, had confidence not declined by such a great extent over the last decade?

Modelling investment

In the economic literature there are a number of theories on the drivers of investment[4]. Nevertheless, some overarching determinants of investment can be identified.

Theoretical determinants in the investment equation

Based on the theory underlying the investment equation in the Core model of the SARB, the following five drivers determine private sector investment behaviour:[5,6]

1. GDP after company tax (Net Income, LR):
   This variable proxies the amount of income that is available to firms for investment. Homogeneity is imposed, simply ensuring that in the long-run, investment cannot increase by more than available income. This is in line with standard neoclassical growth theory. However, since it is assumed that there is a lag between when a firm decides to invest and when physical investment occurs, this relationship is only expected to hold in the long-run.

[4] The most well-known of these being: (i) the (Flexible) Accelerator theory (Keynes, see Chenery(1952)), (ii) the Neoclassical theory (user cost of capital) (see Jorgenson and Hall (1967)), and (iv) Tobin's Q theory (see Kaldor (1966)), Tobin and Brainard (1968))

[5] Two dummy variables are also included for 2008Q4-2009Q1, to capture a GFC related outlier, and in 2014Q1, to capture the impact of the protracted platinum mining strike.

[6] LR and SR indicate whether the variable enters the long-run or short-run component of the error-correction mechanism (ECM) for private sector investment.

2. Required real rate of return bonds (Real Bonds + Depreciation, LR):
   This variable (also in line with neoclassical theory) proxies a key component of the user cost of capital. This component implies that investment in the private sector is a function of how much interest the money spent on investment could earn if it was instead used to purchase a safe asset (which does not depreciate over time).

3. The relative price of capital goods (LR):
   This captures an additional key component of the user cost of capital. It is constructed as the ratio of the private sector capital goods deflator to the GDP deflator, and therefore the relationship between this variable and private sector investment is expected to be negative.

4. Openness of the economy (Openness, LR and SR):
   This variable proxies financial and trade liberalisation and has been found to be an empirically important policy determinant of foreign direct investment in South Africa (see Fedderke and Romm (2006)) and Africa more broadly (see Kariuki (2015)).

4. Real broad credit extension (Credit, SR):
   There is a vast literature[7] suggesting that firms, especially small and medium enterprises (SMMEs), face credit constraints when it comes to investment decisions. Thus, the availability of credit introduces procyclicality into investment outcomes. This variable enters the equation with a lag in order to allow for the time it takes for approved credit to be used for investment.

Adding business confidence to the equation

The investment literature has also identified uncertainty as a key determinant of investment.[8] The equation can therefore be respecified to either include the BCI in the short-run only (as the case for broad credit extension), or in both the long-run and short-run. While initial intuition suggests that it be included as only explaining the cyclical nature of investment (the short-run), a recent study has suggested that uncertainty contains both a long and short-run component, and that "investment is significantly more sensitive to long-run uncertainty" (Bloom et al. 2016). Figure 3 below shows the implied residuals of the alternative specifications (i.e., the remaining portion of quarterly private sector investment growth that is not explained by the equation). The observed improvement in the residual by including BCI in both the long and short-run ultimately informed our decision to use this specification of private sector investment.[9,10]

Empirical results

The specification and results of the final estimated equation are presented in Table 1 below.

$$\begin{aligned}\Delta log(\text{Investment}) = &\alpha_0[log(\text{Investment}_{t-1}) - \alpha_1 log(\text{Net Income}_{t-1})\\ &- \alpha_2(\text{Real Bond yields + Depreciation})_{t-1}\\ &- \alpha_3 log(\text{Relative Price of Capital goods}_{t-1}))\\ &- \alpha_4 \text{Openness}_{t-1}\\ &- \alpha_5 log(\text{BCI}_{t-1})]\\ &+ \beta_0 + \beta_1 \Delta(\text{Openness}) + \beta_2 \Delta log(\text{Credit})_{t-2} + \beta_3 \Delta log(\text{BCI})_{t-2}\\ &+ \beta_4 \text{Dummy 2009Q1} + \beta_5 \text{Dummy 2014Q1}\end{aligned} \quad (1)$$

7 For example, see Aghion et al. (2010), and Fielding (2000) for a South African case study.

8 In the South African case, for example, Ajam and Aron 2007) state that "[e]mpirical evidence suggests that investment in South Africa is substantially driven by uncertainty"

9 To obtain these graphs, a standard ECM was estimated based on the theory outlined above. The SACCI BCI was then included in two different equations: one with the BCI (second lag) in only the short-run, and one with the BCI in the long (first lag) and short-run (second lag). The original equation and "short-run only"" specification can thus be seen as versions of the restricted "complete" equation.

10 A standard LM test suggests accepting the complete model at the 5 per cent level of significance.

Figure 3. Residuals from Alternative ECM specifications

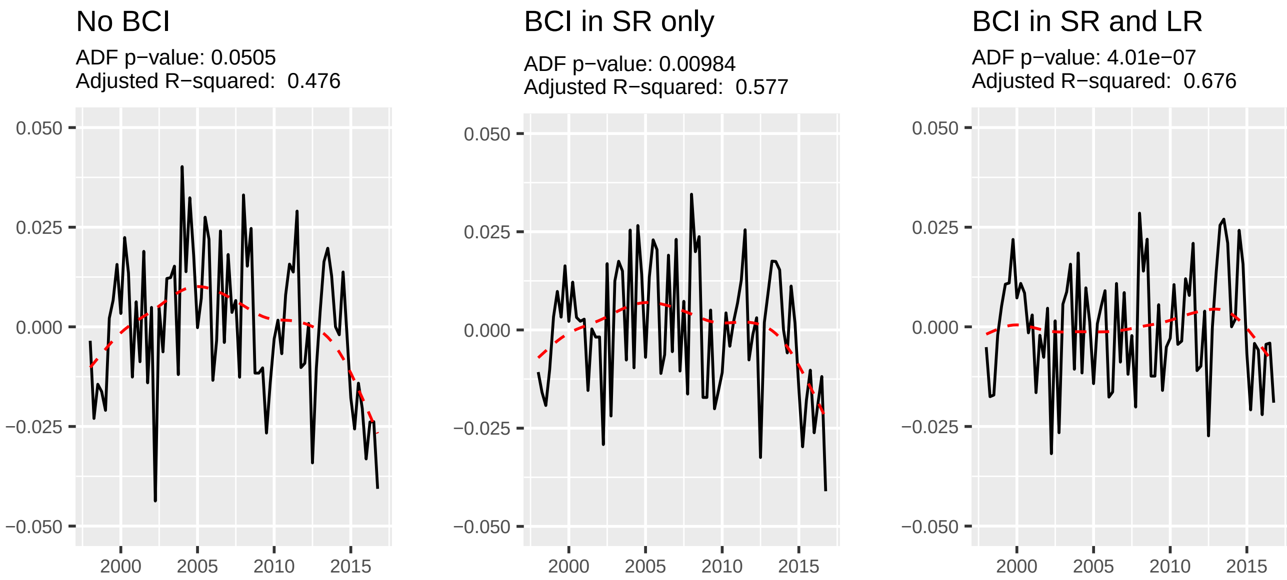


Table 1. Estimation Results (Sample 1998Q1 to 2016Q4)

Dependent variable: Private Sector Investment

long run	α_0	Speed of Adjustment	-0.175^{***}
	α_1	log(Net Income)$_{t-1}$	1.000
	α_2	Real Bond yields$_{t-1}$ + Depreciation $_{t-1}$	-0.017^{**}
	α_3	log(Relative price of Capital goods) $_{t-1}$	-0.926^{***}
	α_4	Openness$_{t-1}$	1.350^{***}
	α_5	log(BCI)$_{t-1}$	0.538^{***}
short run	β_0	Constant	-0.916^{***}
	β_1	Δ(Openness)	0.404^{***}
	β_2	Δlog(Credit)$_{t-2}$	0.133^{*}
	β_3	Δlog(BCI)$_{t-2}$	0.181^{**}
	β_4	Dummy2008Q42009Q1	0.052^{***}
	β_5	Dummy2014Q1	-0.037^{**}
Adjusted R^2		0.676	
F Statistic		16.637^{***}(df=10;65)	
Note:		*p<0.1; **p<0.05; ***p<0.01	

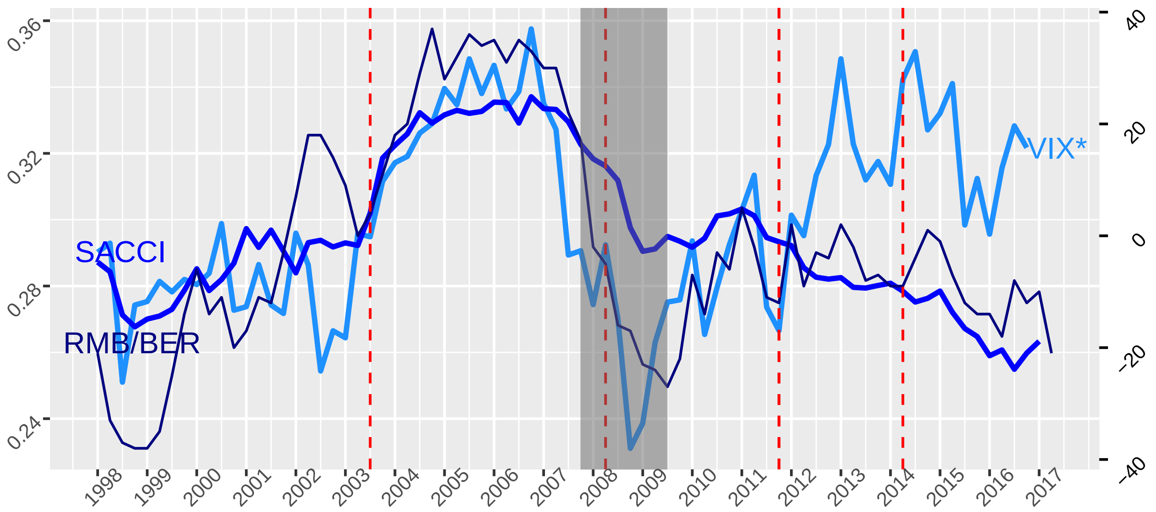
The impact of the business confidence index on private sector investment is positive and significant, meeting our *a priori* expectations. The results suggest that a 1 per cent increase in the BCI leads to a 0.5 per cent increase in investment in the long-run, and a 0.2 per cent increase in the short-run (with a lag of 2 quarters).

How high would investment have been had business confidence not declined?

In order to determine a point of reference, the SACCI BCI is analysed statistically to identify any clear structural breaks in the series (see Figure 4). In total, five structural breaks are identified.

To aid this search for a reference point, we also compare the BCI to the CBOE's emerging market VIX – a market-based proxy of uncertainty. Up to the end of 2011, the BCI and inverted VIX correlate quite strongly. However, at the start of 2012 – exactly when the last structural break in the BCI occurs – the relationship breaks down completely. As a result, we choose to hold the BCI constant at its 2011Q4 value.

Figure 4. The SACCI BCI with statistically identified break points

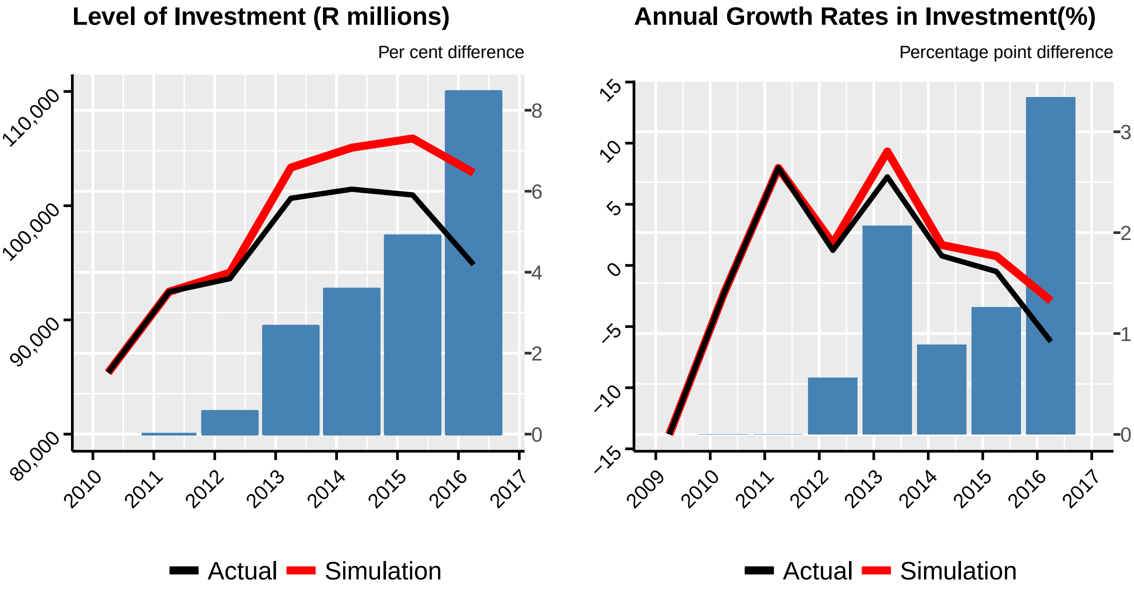


Source: SACCI, BER, CBOE EM VIX (*inverse)
Own Calculations: For comparability, the SACCI BCI is expressed as a deviation from its mean, while the RMB/BER BCI is a deviation from the survey's neutral level of 50 index points.

We are now able to ascertain what investment would have been had the BCI remained at its 2011Q4 value, and not declined by a further 20 index points as it subsequently did.[11]

Figure 5 shows the results of this simulation. They imply that if business confidence had remained elevated (while still far below peak levels), the level of private sector investment would have been roughly 8.5 per cent higher in 2016, relative to the actual outcome, while annual growth rates would have been up to 3.3 percentage points higher by 2016. Given the contribution of private sector investment to overall GDP, these magnitudes imply that the level of real GDP would have been approximately 1.0 per cent higher by the end of 2016, while the GDP growth rate of 2016 would have been 0.4 percentage points higher.

Figure 5. Private sector investment if business confidence had not declined



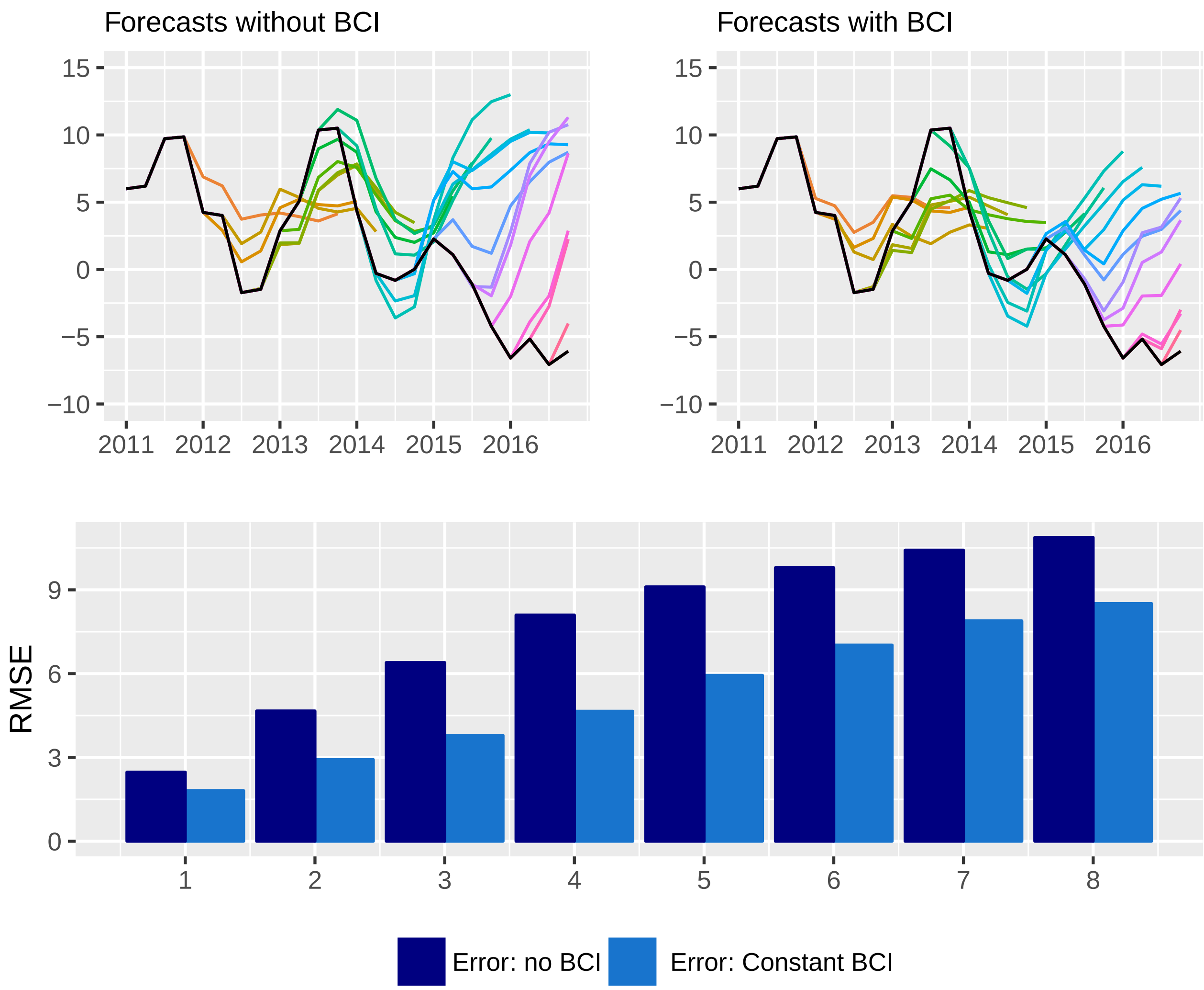
[11] It should be noted that this estimate can be interpreted as the minimum impact from a higher business confidence, as this scenario does not include any positive feedback loops between confidence, and therefore private sector investment, and the rest of the economy. That is, in this scenario all explanatory variables are held constant except for business confidence.

Does business confidence improve the accuracy of investment forecasts?

As a final scenario, and a first-pass assessment of the predictive power of the BCI, we assume that a forecaster has at his disposal two competing models with which to forecast: the current version of the SARB Core Model, and the same model with the private sector investment equation modified to include the SACCI BCI.[12]. Starting in 2012Q1, the forecaster uses these two competing models to forecast growth in private sector investment up to eight quarters ahead. In the model that includes business confidence, the BCI is assumed to remain at its last known value over the entire eight-quarter forecast horizon. The process is then repeated every quarter up to the end of 2016. Using the Core Model for this exercise allows for important feedback loops to and from the rest of the economy. However, it should be noted that this does not result in the reproduction of actual SARB forecasts at the time, as the paths of the variables for which assumptions are normally made are not comparable.

The results are depicted in Figure 6, suggesting that including the BCI, on average, leads to an improved forecast performance over all 8 horizons. The root mean square error (RMSE) of the forecasts is reduced by an average of 20 percent over all quarters, suggesting promising results for improving forecasts of private sector investment.

Figure 6. Private sector investment forecasts (yy) and errors



[12] This equation is represented by equation (1), but the dummy for 2014Q1 is removed as it coincides with the forecast horizon.

Conclusion

While addressing the current form of macroeconomic uncertainty that South Africa faces is generally beyond the remit of the SARB, this note emphasizes the importance of maintaining the SARB's reputation and credibility as a strong macroeconomic institution. Furthermore, given the significance of uncertainty/confidence as both a short- and long-run determinant of private sector investment, this note highlights the relevance of trying to account for "animal spirits" in the analysis and forecasting of the South African economy. That is, while standard macroeconomic variables may capture the rational portion of decision-making, capturing the optimism or pessimism of agents - that may be a result, for example, of political uncertainty - would enable an improved understanding and prediction of economic outcomes.

Future research should therefore include a more thorough analysis of the predictive power of business confidence indices when modelling private sector investment at the Bank. Similarly, an investigation into the role that consumer confidence plays in the final consumption expenditure of households is justified.

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Getting to the core of it – July 2017

Theo Janse van Rensburg and Theresa Alton

Abstract

There has been an unexpectedly large slowdown in core inflation from 5.9% in December 2016 to 4.8% in May 2017. This slowdown is mainly driven by core goods inflation, which has contributed more than twice as much to the decline than services. The cumulative exchange rate pass through (ERPT) to core price levels is estimated at 28%, while the peak inflation rate pass through is 10%. ERPT is strong and fast to core goods, but is much weaker and delayed for services. Unit labour costs take much longer to feed through to core inflation with the largest impact coming through services inflation. Had the rand and output gap remained at 2015q4 levels, core inflation would have respectively been 0.38% lower and 0.07% higher, compared to actual outcomes.

Introduction[1]

Core inflation slowed to 4.8% in April and May this year, from a peak of 5.9% in December 2016. Although a fall in core was widely anticipated, the extent of the decline has been a surprise. For instance, the Bloomberg consensus for March was 5.3%, whereas actual core came in at 4.9%. In January, the SARB expected core inflation of 5.7% for the first quarter, while the actual reading was 5.2%.

In this note we analyse possible reasons for the sharp decline in the core inflation rate. We begin with the recent data, which indicates that most (more than two-thirds) of the decline is attributable to core goods inflation; services inflation has not slowed as markedly. We then proceed to build an econometric model to explain the different drivers of the goods and services components of core inflation.

We find that the slowdown in core inflation primarily relates to high exchange rate pass through – where the strengthening rand has been instrumental in driving core goods inflation down. As these goods are tradeable they are highly sensitive to international competition, and therefore respond quickly to exchange rate developments. Services, on the other hand, are more responsive to changes in unit labour costs (ULC) and the output gap – but the transmission is slower.

We also considered counterfactual scenarios, one with a smaller output gap and the other based on a weaker rand. We found that without the 2016 output gap deterioration, core inflation would probably have been about 0.07% higher than the recorded figure. Had the exchange rate remained at the 2015q4 levels (R14.18/$), core inflation would have been 0.38% lower on average during 2016. This corroborates the importance of the exchange rate as the primary driver of recent core disinflation.

Investigating the slowdown in core inflation

There has been a marked slowdown in core inflation in 2017. After reaching a peak of 5.9% in December 2016, core inflation slowed to 4.8% in May 2017 (Figure 1). The last time core inflation fell as quickly and sharply as over the past five months was in 2009/10, when the appreciation in the exchange rate was similar to the appreciation seen towards the end of 2016 (Figure 2).

[1] The authors are grateful for valuable comments and editorial contributions from David Fowkes and data inputs from Reneilwe Magoane.

Figure 1: Core inflation

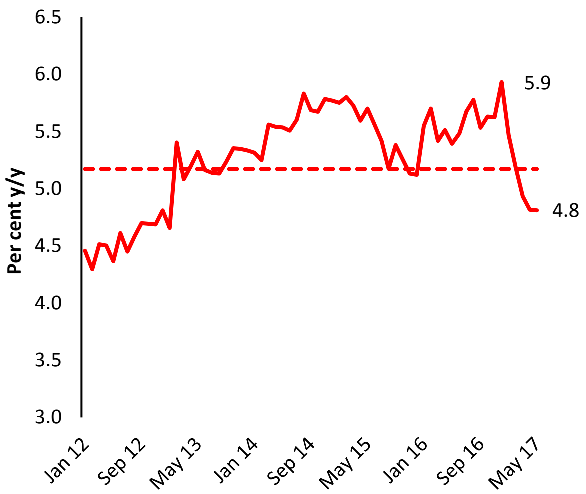
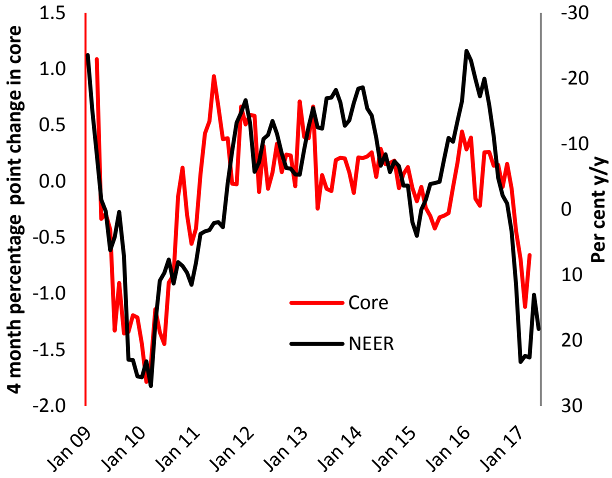


Figure 2: Core inflation and the NEER



Core inflation consists of two main components, core goods and services, which account for 31% and 69% of the core basket respectively. Services inflation has trended slightly lower over the past year, and is now at 5.4%, versus a long-term average fractionally above 6.0%. By contrast, core goods inflation has slowed sharply from 5.9% in December 2016 to 3.4% in May 2017 (Figure 3). This slowdown has in turn been driven mostly by an abrupt downturn in durable and semi-durable goods inflation (Figure 4).

Figure 3: Services and core goods inflation

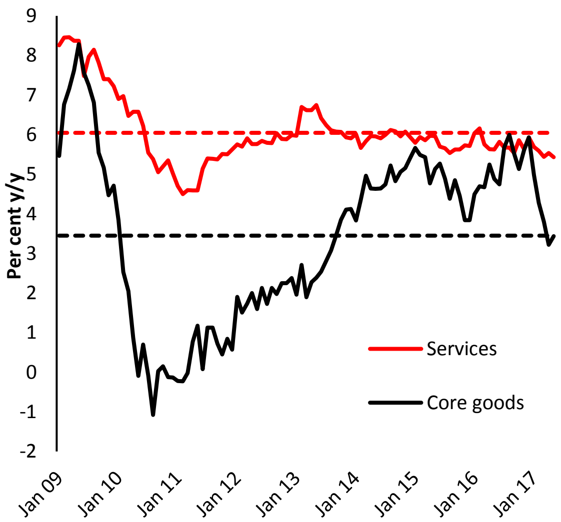
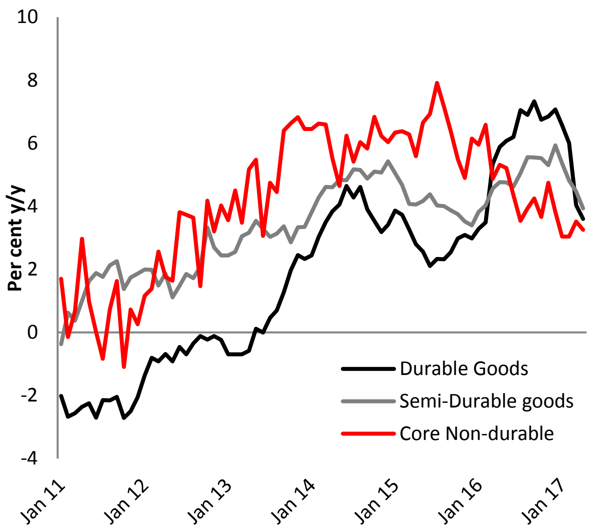


Figure 4: Movements in the components of core goods inflation



Although services inflation has made the largest contribution to core inflation (Figure 5), since the beginning of 2017, core goods inflation has been the main source of change (Figure 6). In fact, the year-to-date decline in core goods inflation has contributed more than twice as much as services did to the overall slowdown in core. This divergence suggests the goods and services components are responding to different drivers. In the next section we econometrically estimate these drivers, and the extent to which they explain the movement in the two components of core inflation.

Figure 5: Percentage point contribution to core inflation

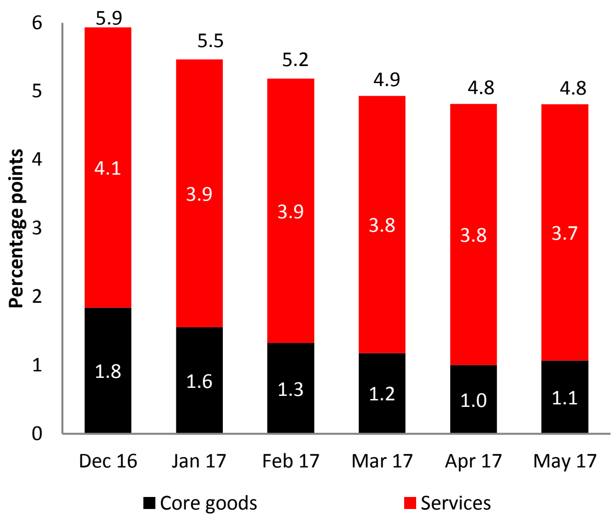
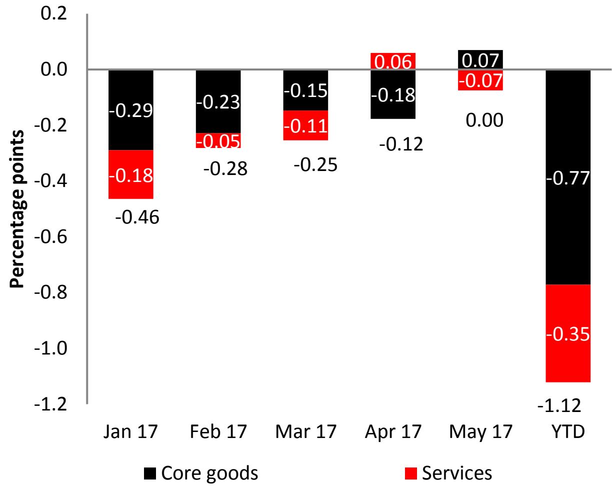


Figure 6: Percentage point contribution to the y/y change in core inflation from the previous month



Modelling core inflation

We econometrically estimate separate equations for the two main components of core inflation, namely services and core goods (See Appendix A, Diagram 1 for a schematic overview of the model and its drivers).

With regard to *services*, we find that over the long run the primary drivers are PPI for final manufactured goods (73.9%), ULCs (26.1%) and the output gap[2], while over the short(er) term changes in electricity prices also play a role. (See Appendices B and C for the mnemonics and equations respectively). From the estimated equation, it follows that when ULCs change by 1%, it will have a direct impact of 0.261% on services; further indirect impacts of 0.41% will come via changes in PPI, bringing the total core services impact to 0.67%. In contrast, a 1% depreciation in the rand will only increase services prices by 0.23%. Put differently, over the long term, a 1% change in ULCs will have almost three times the impact on services of a 1% depreciation of the rand.

With regard to *core goods*, we find that the primary equilibrium drivers are global PPI (36.7%) (in rand terms), PPI for final manufactured goods (8.5%) and openness[3] (54.8%). Over the short(er) term, changes in petrol prices also affect the prices of core goods. In contrast to services, a 1% change in ULCs has an (almost) negligible indirect impact of just 0.05% on core goods. However, the combined direct and indirect impacts of a 1% rand depreciation is 0.39%, which reflects the tradability of core goods. This cumulative 39% exchange rate pass through (ERPT) coefficient for core goods is substantially larger than the 23% ERPT to services – with overall ERPT for core inflation estimated at 28%.[4, 5]

PPI for final manufactured goods is driven by import prices (44.7%) and ULCs (55.3%), while changes in the output gap also play an important role in explaining disequilibria. Over the short(er) term, petrol prices also have some role in price adjustment(s). *Import prices* reflect changes in global PPI (69.0%) and oil prices (31.0%) – both converted to rand. The output gap also has an impact.

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[2] Output gap data is from the Macro Models Unit (as per the May-2017 MPC forecasts).
[3] Openness is defined as: (exports + imports)/GDP; all variables in volumes.
[4] This ERPT is slightly lower than the estimated ERPT of 31.4% for Core Inflation estimated over the 2002-2014 period. However, in the August 2015 version, Core inflation was not split into its two subcomponents. See: Janse van Rensburg and Visser (2015), *"Right for the wrong reasons? How falling unit labour cost inflation masked persistent exchange rate pass-through"*, SARB Economic Note EN/15/20.
[5] The 28% ERPT refers to the *cumulative change in prices*. In the next section, we also report the *peak ERPT inflation rate impacts*.

In the next section we will run impulse responses, where we observe model predictions for core inflation when the primary drivers change.

Impulse responses

Figure 7 depicts the impact of a 10% one-off permanent rand depreciation on the inflation rates for goods, services and core. As discussed previously, core goods price levels will in the long run rise by 3.9% – which is the long run cumulative ERPT of 39% (i.e. 3.9%/10%). However, according to the model, peak pass-through to the inflation rate will be 1.8% for core goods, which occurs some four quarters after the shock. The equivalent numbers for services and total core are 0.8% and 1.0% respectively, and are reached some five to six quarters after the shock. In the case of core goods, 75% of the adjustment to equilibrium levels is completed in around nine quarters, whereas in the case of services only about 60% of the adjustment is completed by that point. To summarise, ERPT is strong and fast to core goods, but much weaker and delayed for services.

Figure 7: Impact of a 10% depreciation in the rand on core inflation

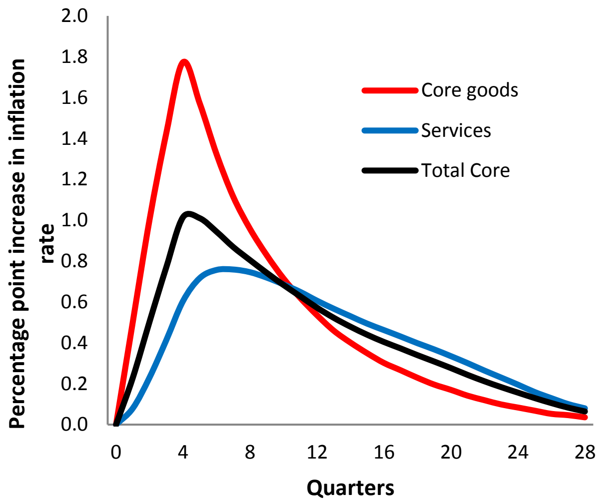
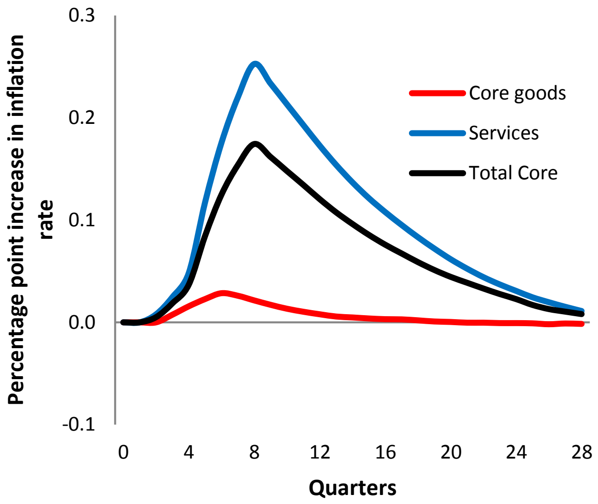


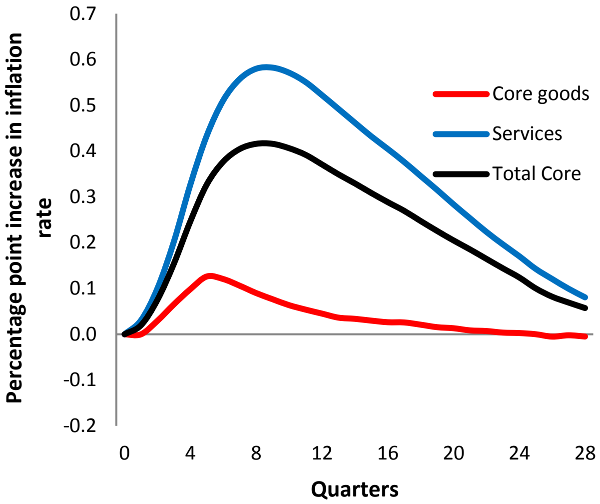
Figure 8: Impact of a 1% increase in unit labour costs on core inflation



ULC shocks transmit more slowly than exchange rate shocks, with the peak core inflation rate impact occurring some seven to ten quarters after the initial shock (Figure 8). The bulk of the shock works through services with just a minor impact on core goods. Overall, goods, services and core prices levels will rise by a cumulative 0.05%, 0.67% and 0.48% respectively over the long run when the level of ULCs permanently increases by 1%. In terms of the peak inflation rate impact, the services inflation rate would rise by 0.3%, and the total core rate by 0.2%, some eight quarters after the initial shock.

The estimated model suggests that demand pressures, as captured by the output gap, will be most visible in services inflation, with a peak inflation rate impact of about 0.6% after nine quarters following a permanent once-off output gap change of 1 percentage point (Figure 9). The peak inflation rate impact on core goods is quicker (after around five quarters), but the impact is very small at 0.13%. The maximum total core inflation rate impact is therefore around 0.42 percentage points – occurring some eight to nine quarters after the shock.

Figure 9: Impact of a 1 percentage point closing of the output gap on core inflation



Output gap and rand contributions to core inflation in 2016

In this section we use our estimated model to calculate what inflation outcomes during 2016 would have been, had the output gap and the exchange rate remained unchanged at 2015q4 levels.

With the rand stable at R14.18/US$ (the average in 2015q4)[6], core inflation would have been on average 0.38% lower in 2016 than the actual outcome (Figure 10). Core goods and services inflation would have been lower than actual outcomes by 0.71% and 0.23%, respectively. These model outcomes are in line with our earlier argument that the bulk of the decline in core inflation was due to falling core goods inflation, in turn driven by exchange rate developments.

When we compare the core inflation outcomes under a scenario where the output gap remained at 2015q4 levels, we find that the deteriorating output gap (vis-à-vis the 2015q4 output gap) has played a very small role (Figure 11). In fact, according to the estimated model, inflation outcomes would have been only 0.07% worse. As per the earlier impulse response discussion, the maximum impact of an output gap shock takes some two years to work through to inflation – and this shock was run only over four quarters.

[6] The R/$ exchange rate averaged R15.86/$; R15.01/$; R14.07/$ and R13.90/$ respectively over the four quarters of 2016. It follows that the rand averaged R14.71/$ in calendar 2016, while in this scenario it averaged R14.18/$.

Figure 10: Impact on core inflation if R/US$ was constant at 2015q4 levels

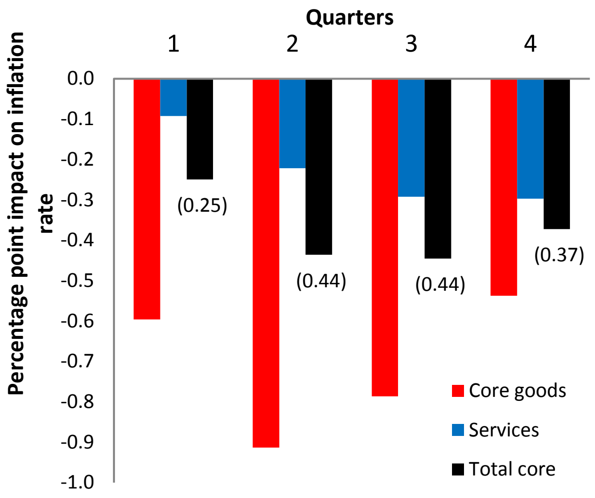
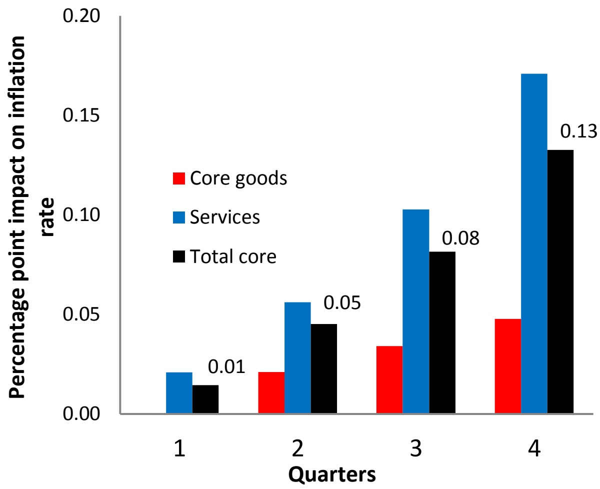


Figure 11: Impact on core inflation if output gap was constant at 2015q4 levels



Implications for monetary policy

The recent decline in core inflation constitutes an opportunity, but not a victory. Had this disinflation been the result of a wider output gap, or softening ULC inflation, then it would have indicated a sustained moderation in core inflation. This may still be coming: as we have shown, these 'weak demand' factors have a slow but meaningful effect on prices. However, the recent disinflation is mostly due to the exchange rate. Unfortunately, it is unlikely that the exchange rate will appreciate further in the current environment, and it could easily begin depreciating again. This suggests inflation is not yet stabilising at permanently lower levels, which limits monetary policy space.

Concluding remarks

Although core goods only has a 31% weighting in core inflation, it contributed more than twice as much as services did to the decline in core inflation since the beginning of 2017. Our econometrically estimated model suggests that the appreciating exchange rate has underpinned the sharp decline in core goods, and by implication core inflation. In contrast, weak domestic demand, as proxied by the output gap, has played a relatively minor role in pushing inflation lower.

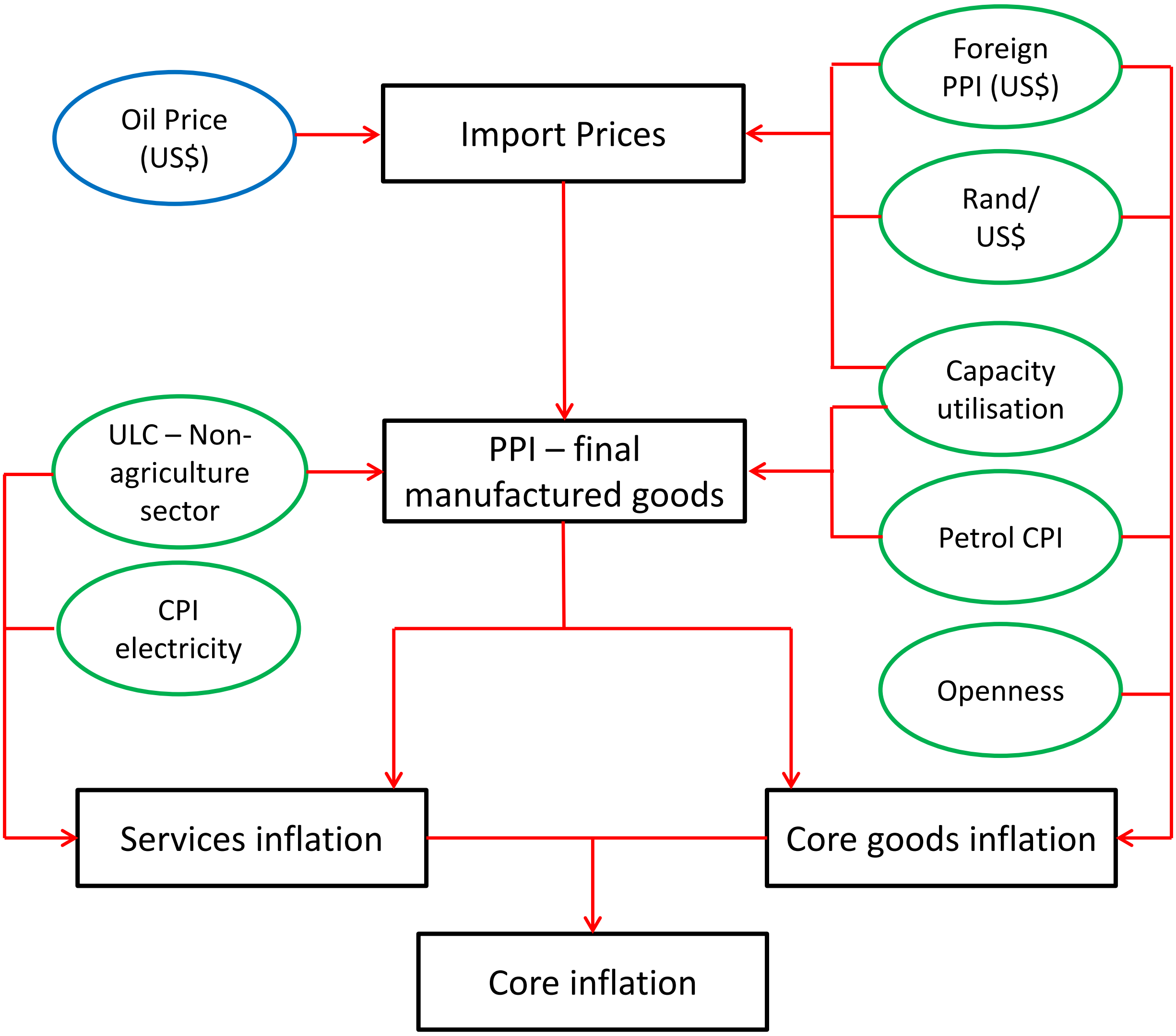
We also found that whereas core goods are largely driven by international prices (in rand terms), services are more responsive to changes in ULCs, albeit with a slow transmission mechanism. In the absence of a quick exchange rate adjustment when monetary policy settings change, the impact on core inflation is likely to be small and slow.

APPENDIX A

Diagrammatic overview of Core inflation model

The small econometric model used to measure the drivers of Core inflation has the following set of endogenous equations (see Diagram 1 and Appendix B for mnemonics and model outline and Appendix C for the equations):

Diagram 1: Model outline



APPENDIX B

Mnemonics

CPI	=	CPI - headline
CPI_CGOOD	=	CPI - core goods
CPI_CSERV	=	CPI - services
CPI_CTOT	=	CPI - core total
CPI_ELEC	=	CPI - electricity
CPI_FNAB	=	CPI - food and non-alcoholic beverages
CPI_PET	=	CPI - petrol
DUM08	=	Dummy = 1 during 2008, 0 otherwise
DUM08Q1	=	Dummy = 1 in 2008q1, 0 otherwise
DUMQ4	=	Dummy = 1 in q4, 0 otherwise
PM	=	Import deflator
POIL	=	Oil price (US$)
PPI_FM	=	PPI for final manufactured goods
REXD	=	R/US$ exchange rate
RPOIL	=	Oil price (rand)
RWLTPPI	=	Global PPI (rand)
ULC_NA	=	Unit labour costs
WLTPPI	=	Global PPI (US$)
YCU	=	Output gap (data from MMU)
YOPEN1	=	Openness defined as total export and import volumes as a ratio of GDP

APPENDIX C

Equation 1: Import prices

Dependent Variable: DLOG(PM)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 26/06/17 Time: 10:45
Sample: 2005Q1 2016Q4
Included observations: 48
Convergence achieved after 9 iterations
Coefficient covariance computed using outer product of gradients
DLOG(PM) = C(1)*(LOG(PM(-1)) -(C(2)*LOG(RWLTPPI(-1)) +(1-C(2))
*LOG(RPOIL(-1)) +C(3)*YCU(-1)/100)) +C(4) +C(5)*DLOG(RWLTPPI)
+C(6)*DLOG(RPOIL) +C(7)*DLOG(RPOIL(-1)) +C(8)*DUM08(-4)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.087975	0.025708	-3.422090	0.0014
C(2)	0.690030	0.081394	8.477677	0.0000
C(3)	2.729406	1.422169	1.919185	0.0621
C(4)	-0.177379	0.051970	-3.413100	0.0015
C(5)	0.357162	0.035300	10.11778	0.0000
C(6)	0.130491	0.014846	8.789579	0.0000
C(7)	0.131373	0.017647	7.444656	0.0000
C(8)	0.057067	0.016581	3.441680	0.0014

R-squared	0.877361	Mean dependent var	0.014534
Adjusted R-squared	0.855900	S.D. dependent var	0.034461
S.E. of regression	0.013082	Akaike info criterion	-5.684216
Sum squared resid	0.006845	Schwarz criterion	-5.372349
Log likelihood	144.4212	Hannan-Quinn criter.	-5.566361
F-statistic	40.88018	Durbin-Watson stat	1.763874
Prob(F-statistic)	0.000000		

Equation 2: PPI – PPI for final manufactured goods

Dependent Variable: DLOG(PPI_FM)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 26/06/17 Time: 10:45
Sample: 2005Q1 2016Q4
Included observations: 48
Convergence achieved after 8 iterations
Coefficient covariance computed using outer product of gradients
DLOG(PPI_FM) = C(1)*(LOG(PPI_FM(-1)) -(C(2)*LOG(PM) +(1-C(2))
*LOG(ULC_NA(-1)) +C(3)*YCU/100)) +C(4) +C(5)*DLOG(PPI_FM(-1))
+C(6)*DLOG(PM) +C(7)*DLOG(CPI_PET)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.142213	0.050019	-2.843162	0.0069
C(2)	0.447297	0.148768	3.006671	0.0045
C(3)	2.134437	0.747104	2.856946	0.0067
C(4)	-0.045031	0.018029	-2.497631	0.0166
C(5)	0.268090	0.104264	2.571252	0.0139
C(6)	0.107822	0.053286	2.023453	0.0496
C(7)	0.042549	0.015609	2.725934	0.0094

R-squared	0.746003	Mean dependent var	0.014947
Adjusted R-squared	0.708832	S.D. dependent var	0.014946
S.E. of regression	0.008065	Akaike info criterion	-6.668565
Sum squared resid	0.002667	Schwarz criterion	-6.395682
Log likelihood	167.0456	Hannan-Quinn criter.	-6.565442
F-statistic	20.06984	Durbin-Watson stat	1.968692
Prob(F-statistic)	0.000000		

Equation 3: CPI-Services

Dependent Variable: DLOG(CPI_CSERV)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 26/06/17 Time: 10:45
Sample: 2005Q1 2016Q4
Included observations: 48
Convergence achieved after 9 iterations
Coefficient covariance computed using outer product of gradients
DLOG(CPI_CSERV) = C(1)*(LOG(CPI_CSERV(-1)) -(C(2)*LOG(PPI_FM(-1)) +(1-C(2))*LOG(ULC_NA(-4)))) +C(3) +C(4)*DLOG(PPI_FM) +C(5) *DLOG(CPI_ELEC(-2)) +C(6)*DUMQ4

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.151867	0.034069	-4.457621	0.0001
C(2)	0.739236	0.069748	10.59865	0.0000
C(3)	0.002406	0.004704	0.511444	0.6117
C(4)	0.094835	0.043995	2.155593	0.0369
C(5)	0.022034	0.012341	1.785405	0.0814
C(6)	-0.006614	0.001545	-4.280436	0.0001

R-squared	0.579357	Mean dependent var	0.014297
Adjusted R-squared	0.529281	S.D. dependent var	0.006427
S.E. of regression	0.004409	Akaike info criterion	-7.893644
Sum squared resid	0.000817	Schwarz criterion	-7.659744
Log likelihood	195.4475	Hannan-Quinn criter.	-7.805253
F-statistic	11.56944	Durbin-Watson stat	1.490798
Prob(F-statistic)	0.000000		

Equation 4: CPI-Core goods

Dependent Variable: DLOG(CPI_CGOOD)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 26/06/17 Time: 10:45
Sample: 2005Q1 2016Q4
Included observations: 48
Convergence achieved after 22 iterations
Coefficient covariance computed using outer product of gradients
DLOG(CPI_CGOOD) =C(1)*(LOG(CPI_CGOOD(-1)) -(C(2)*LOG(RWLTPPI) +C(3)*LOG(1/YOPEN1)+(1-(C(2)+C(3)))*LOG(PPI_FM(-1)))) +C(4) +C(5)*DLOG(CPI_PET) +C(6)*DLOG(PPI_FM(-1))+C(7)*DUM08Q1

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.138783	0.020307	-6.834073	0.0000
C(2)	0.367220	0.058147	6.315371	0.0000
C(3)	0.548132	0.032095	17.07851	0.0000
C(4)	0.179729	0.041458	4.335221	0.0001
C(5)	0.018025	0.007277	2.476814	0.0175
C(6)	0.083073	0.043648	1.903256	0.0640
C(7)	0.014358	0.004461	3.218933	0.0025

R-squared	0.743464	Mean dependent var	0.006769
Adjusted R-squared	0.705923	S.D. dependent var	0.007932
S.E. of regression	0.004302	Akaike info criterion	-7.925599
Sum squared resid	0.000759	Schwarz criterion	-7.652715
Log likelihood	197.2144	Hannan-Quinn criter.	-7.822476
F-statistic	19.80364	Durbin-Watson stat	1.933672
Prob(F-statistic)	0.000000		

Decoupling from global growth – Is confidence becoming a scarce commodity? – August 2017

Theo Janse van Rensburg and Erik Visser

Abstract

After outperforming global growth in the 2000s, domestic growth has since fallen well below the world rate. One implication is South Africa is missing out on the ongoing global recovery. We use a small econometric model to explain SA growth. This allows us to quantify the contributions of various factors, including confidence. The model suggests domestic growth has slowed relative to world growth over the past three years due to declining consumer confidence and below-average real commodity prices. Had these variables been at normal levels, growth would have been over 2%.

Introduction[1]

South African output growth has stagnated despite a favourable turn in the external environment. Domestic growth has fallen to levels well below global growth and among major economies, SA and Venezuela are the only economies currently in recession (as of the first quarter of 2017).[2] This performance contrasts unfavourably with that of the early 2000s, when SA tended to grow above the global rate. Even in the aftermath of the global financial crisis, domestic growth held up reasonably well, remaining on par with global growth. However, since 2014 SA's growth has fallen well below the world average.

In this note, we explain why SA's growth has decoupled from global averages. We build a small econometric model that indicates the chief determinants of SA's growth are four long term factors, namely global growth, real commodity prices, the real effective exchange rate (REER) and (consumer) confidence. The fiscal balance and real repo rate are also significant, albeit over the short(er) term.

According to the model, the bulk of the slowdown in domestic growth relative to global growth has been due to declining confidence. In the first year (2014) of the decoupling, SA still benefitted from above-average real commodity prices, which neutralised the negative impact of declining confidence. But during 2015 and 2016, real commodity prices became a drag on growth, while the continued fall in confidence exerted even more downward pressure on growth. According to the model, real interest rates have played an almost insignificant role in the growth slowdown – in fact, they have been marginally supportive during 2015 and 2016.

1 The authors are grateful for valuable comments and editorial contributions from David Fowkes and Theresa Alton.

2 L de Lange, 'Een krisis ná die ander laat die ekonomie steier'. *Sake-Rapport*, 13 August 2017, p 4.

From relative growth over-performance to underperformance

When SA's growth is compared to global growth in the post-2000 period, three broad trends can be observed:

a) *Pre-crisis boom period* – lasting from 2000 to 2008. During this period SA's GDP grew at a faster pace than the global economy (Figure 1.1), depicted as SA's GDP rising as a share of global output.

b) *Post-crisis consolidation period* – stretching from 2010 to 2013, with SA's growth on par with global growth.

c) *Post-2013 slowdown* – SA growth slows markedly relative to world rates.

This comparison is based on a constant 2010-US$-weighted measure of world growth, taken from the World Bank. When we express SA's GDP as a share of SA export-weighted world GDP, the patterns are similar – except that the boom phase is less pronounced and the post-crisis consolidation period disappears: SA's share of global output declines from the crisis onwards. However, the export-weighted world growth series is only available on an annual basis, because of data shortages for sub-Saharan African countries. We therefore prefer the World Bank measure (Figure 1.2).

The post-2013 slowdown has had significant implications. For example, had domestic growth remained on par with global growth after 2013, domestic output would have been 6.4% larger by the first quarter of 2017. This in turn could have generated additional tax revenues[3] equivalent to 1.7% of GDP, which would have halved the envisaged budget deficit of 3.5% of GDP for 2017/18.

Figure 1.1: SA output as a share of global output

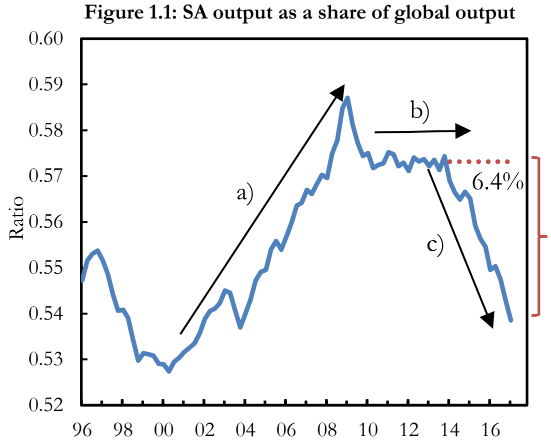
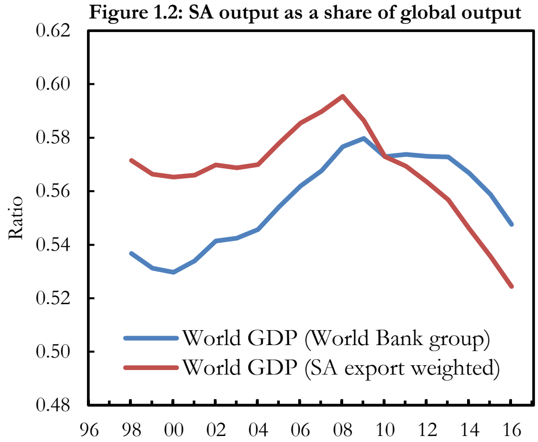


Figure 1.2: SA output as a share of global output



[3] Assuming a main budget revenue-GDP ratio of 26.2% of GDP (as per the 2017 Budget Review).

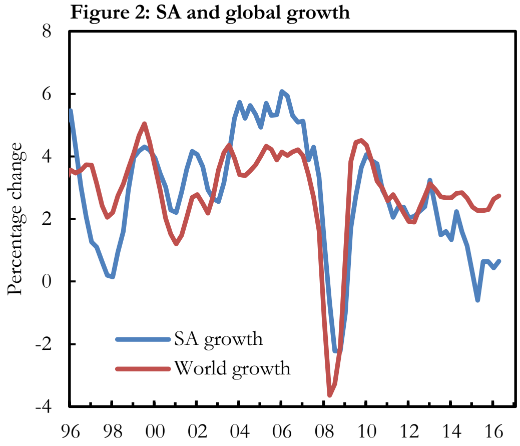
Determinants of SA growth

We identify the following major drivers of SA growth:

i) Global growth

There is a strong correlation (coefficient = 0.69) between SA and global growth (Figure 2). The breakdown in this correlation recently has been unusual; the gap between the two growth rates was last this large during the extreme political uncertainty of the early 1990s.

Figure 2: SA and global growth



ii) Commodity prices

Although export volumes are highly depended on global demand, real commodity prices (particularly mining) is also an important driver of domestic export volumes. Over and above the link between growth and global demand, domestic growth is thus also strongly correlated with real commodity prices – even when there is strong correlation between global GDP and real commodity prices (Figures 3.1 and 3.2).

Based on historical patterns and the level of global growth, one would have expected somewhat higher real commodity prices in the post-2013 period. The slight decoupling of real commodity prices from global growth might partly explain why SA's growth has been decoupling from global growth. Note that both global growth and SA growth have not responded to the most recent surge in real commodity prices, possibly indicating that the impact that commodity prices are having on growth is becoming weaker.

Figure 3.1: Global growth and commodity prices

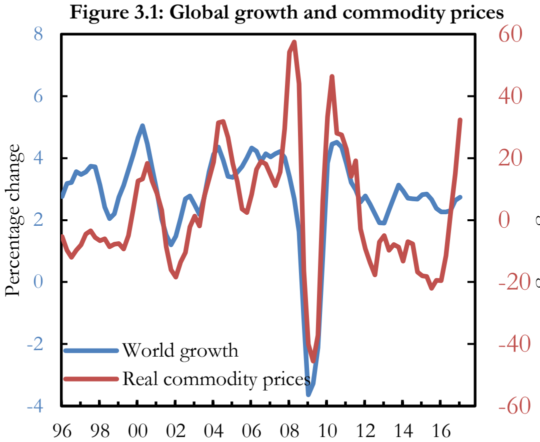
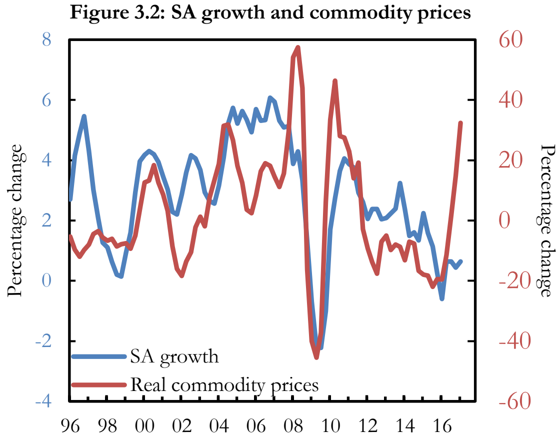


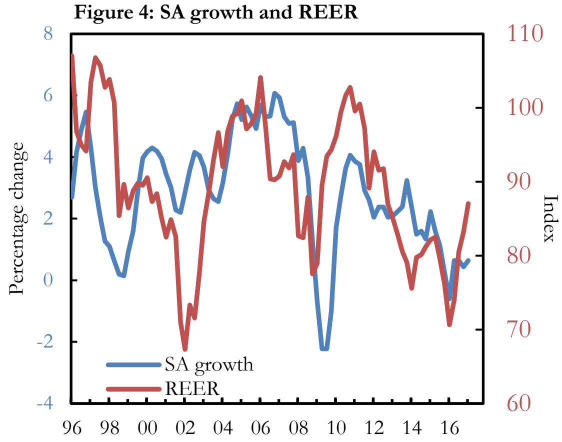
Figure 3.2: SA growth and commodity prices



iii) Real effective exchange rate (REER)

Domestic competitiveness is largely driven by the REER. Accordingly, SA growth should be negatively correlated with the REER. This relationship holds for the 2000s (Figure 4). However, in the post-2010 period, the correlation seems to have become positive, which may have to do with a declining tradeables sector.[4]

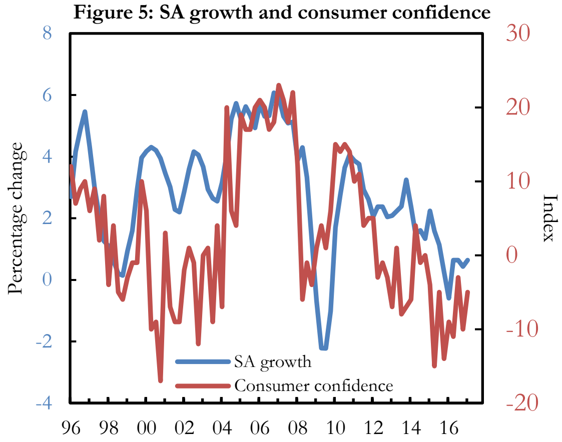
Figure 4: SA growth and REER



iv) Confidence

Confidence has been on a declining trend since 2010 (Figure 5) and is now around its lowest level in almost two decades. Although business confidence displays similar trends to consumer confidence, and was also statistically more significant in the equation specification, we opted to use consumer confidence. The reason for this is that when we used business confidence, the real interest rate variable became statistically insignificant. For theoretical reasons, we felt it was important to keep real interest rates in the specification.

Figure 5: SA growth and consumer confidence



Although confidence is closely correlated with some of the other variables in our model Annexure A), such as global growth and the real exchange rate, it retains its statistical significance even when these variables are included.

[4] T Janse van Rensburg, D Fowkes and C Loewald, 'The shrinking tradeable sector, competitiveness and the post-crisis slump', *South African Reserve Bank Economic Note No. EN/14/19*, September 2014.

v) **Fiscal balance**

The fiscal balance also has an impact on overall economic activity and growth. As depicted in Figure 6, when the fiscal balance becomes more negative, government is adding to aggregate demand, and *vice versa*.

Figure 6: SA growth and the fiscal balance

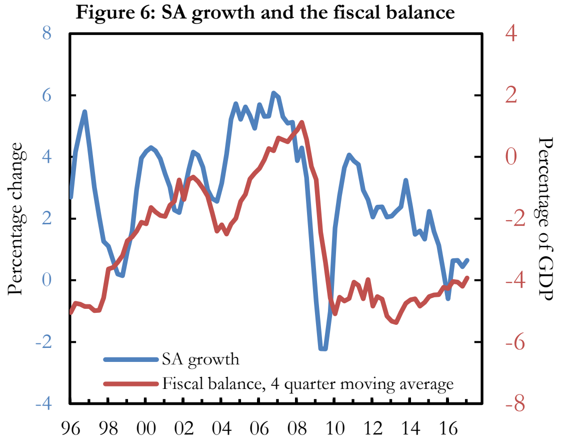
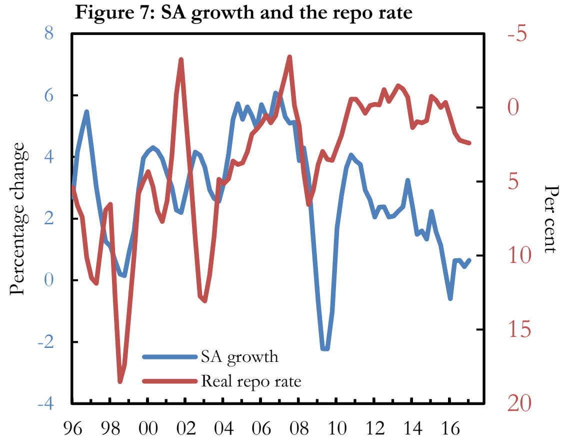


Figure 7: SA growth and the repo rate



vi) **Interest rates**

As expected, there appears to be an inverse relationship between the real repo rate and SA's growth, but the correlation is rather weak (Figure 7). In fact, in recent years growth has slowed despite a persistently low repo rate, relative to the pre-crisis period.

Modeling the slowdown

Using the growth drivers[5] discussed above, we construct a small quarterly econometric model which explains the bulk of SA growth over the 1996–2016 period (Annexure B). The estimated model indicates that:

- A 1% increase in *global growth* raises the level of SA output by 0.94%, with half (three-quarters) of the adjustment completed within one (six) quarters.
- A 1% rise in *real commodity prices* increases domestic output by 0.08%, with 50% (75%) of the adjustment completed within five (ten) quarters.
- A 1% appreciation in the value of the *REER* lower domestic output by 0.15%, with 50% (75%) of the adjustment completed within five (ten) quarters.
- A one index point change in *consumer confidence*, changes domestic output by 0.29%. It takes about six quarters to do half the adjustment to equilibrium and about one year to complete 75% of the adjustment.

It follows that SA growth is quick to adjust to changes in global growth; however, the adjustment is slower for changes in the other growth drivers. The impulse responses depicted in Annexure C provide more detail on the magnitude and duration of these adjustments. It is important to note that unlike the growth drivers discussed above, which permanently alter SA output, the real interest rate and the fiscal balance were not statistically significant in the long run specification. This shows these variables have

[5] With regard to confidence, we also estimated the model using business- instead of consumer confidence. Although the business confidence variable was statistically more significant than consumer confidence, it made the real interest rate variable (even) less significant. We therefor opted to use consumer confidence.

only temporary effects on output.[6] Another option for analysing these growth drivers is to consider the effects of large shocks. For instance, we have seen that a one unit change in consumer confidence results in a 0.29% change in SA growth – which appears small. Yet consumer confidence has a standard deviation of 10.1 points, which means that a one standard deviation shock to consumer confidence will lower SA output by 2.91% (i.e. 10.1*0.29%).

Table 1 summarises the impact of one standard deviation shocks to the various long term growth drivers. The model indicates that this kind of shock to global growth and real commodity prices will have about a 1½ per cent SA output impact, whereas the impact of a change in the REER will be slightly larger. It is important to note that domestic growth is most sensitive to changes in (consumer) confidence, with a one standard deviation shock altering domestic growth by nearly 3 percentage points.

Table 1: Domestic growth impact due to a one standard deviation shock to the long-term growth drivers

Variable	Equilibrium (long run) impact of 1 unit shock	1 Standard deviation	Impact of a 1 standard deviation shock
Global growth (% y-o-y)	0.94	1.50	1.40
Real commodity prices (% y-o-y)	0.08	19.68	1.56
REER (% y-o-y)	0.15	10.85	1.67
Consumer confidence (index)	0.29	10.10	2.91
Fiscal Balance (% of GDP)	0	3.05	0
(based on 4-quarter moving average)	0	1.93	0
Real repo rate	0	4.65	0

Explaining and quantifying the contributors to the post-2013 growth slowdown

In this section we employ the estimated model to calculate what growth would have been in the post-2014 period had the identified growth drivers been at their 1996–2013 averages. We see that growth would have been about 1 percentage point higher in 2015, and almost 2 percentage points higher in 2016. The most influential variables are consumer confidence and real commodity prices. Consumer confidence averaged -0.8, -9.5 and -8.3 in 2014, 2015 and 2016 respectively.

[6] We have been surprised by the small (and only statistically significant at the 10% level) coefficient of real interest rates. After experimenting with lags ranging from zero to eight quarters, a six quarter lag on real interest rates was found to be the most significant (albeit with a t-value of only 1.34). Some of the explanatory power of interest rates may be captured by consumer confidence, as the former is correlated to the latter, giving rise to issues of multicollinearity. In fact, as discussed earlier, there are various multicollinearity issues as confidence is strongly correlated with political uncertainty, global growth, (real) commodity prices and the REER. The authors intend doing further work on understanding confidence drivers in a future paper.

Had consumer confidence remained constant at +4.5 over the 2014 to 2016 period, SA growth would have been 0.43, 0.99 and 1.15 percentage points higher over the three years (Table 2). Similarly, real commodity prices subtracted 0.11 and 0.55 percentage points from growth in 2015 and 2016 respectively, relative to where growth would have been with average real commodity prices.[7]

Table 2: Impact on domestic growth over 2014–2016, with drivers at historical averages

Percentage change	2014	2015	2016
GDP at market prices	**1.70**	**1.30**	**0.28**
Growth additions with following variables at 1996–2013 averages:			
Global growth	0.14	0.15	0.37
Real commodity prices	-0.43	0.11	0.55
REER	-0.05	0.13	-0.37
Confidence	0.43	0.99	1.15
Real interest rates	0.00	-0.04	-0.04
Fiscal balance	-0.02	-0.29	0.13
What TOTAL growth could have been (B)	**1.77**	**2.35**	**2.06**

Implications for economic policy

Our model indicates that monetary policy has played virtually no role in SA achieving growth outcomes below those attained globally. Instead, below average real commodity prices and weak consumer confidence are the primary reasons for SA's weakening growth performance over the past three years. Although there is little South Africa can do to influence commodity prices, as SA is a price taker on international markets, policymakers have an important role to play in bolstering consumer confidence – an important catalyst to sustainably accelerate growth.

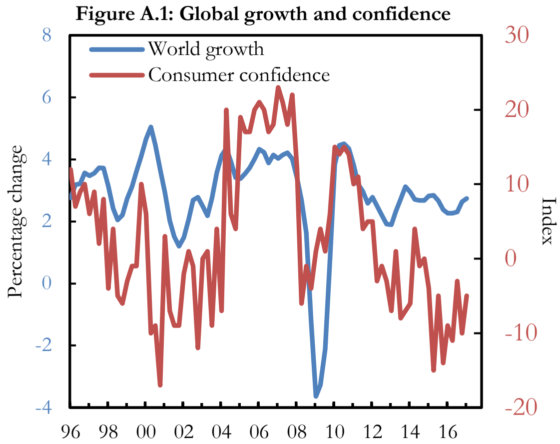
Concluding remarks

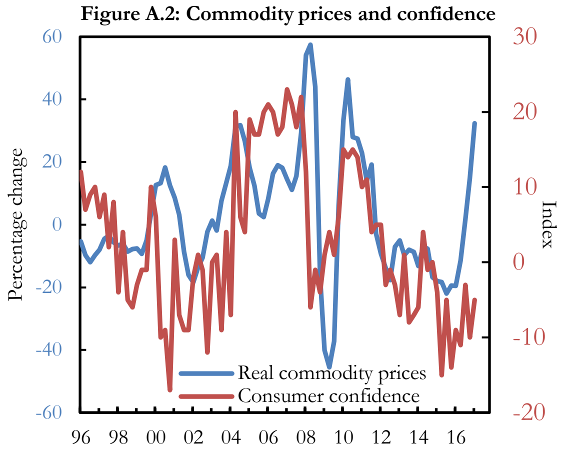
South African growth has historically been closely tied to global growth. Over the past few years, this correlation has broken down. Our analysis indicates the divergence is primarily due to very weak consumer confidence, as well as lower real commodity prices. Reducing political uncertainties appears to be a prerequisite for reversing consumer confidence and thereby renewing growth.

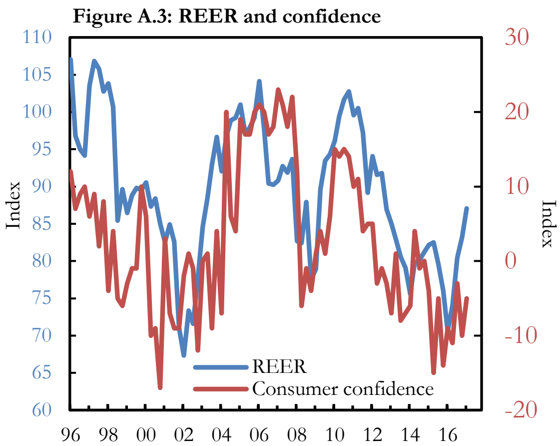
[7] Commodity prices were slightly above long run averages in 2014, contributing 0.43% to growth.

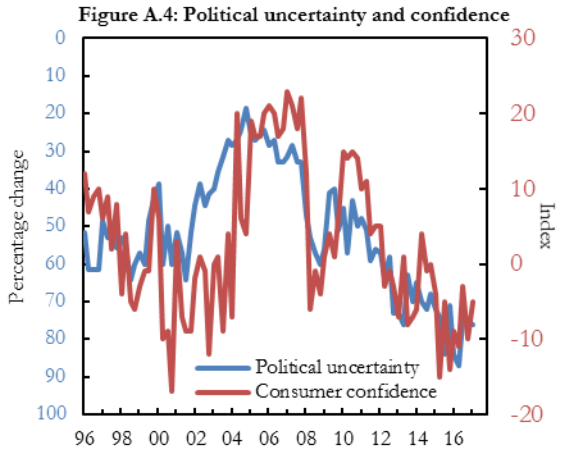
ANNEXURE A

(Consumer) confidence is strongly correlated with various economic indicators









ANNEXURE B

Equation 1: SA GDP at basic prices

Dependent Variable: DLOG(Y1)
Method: Least Squares
Date: 18/08/17 Time: 08:25
Sample (adjusted): 1996Q1 2017Q1
Included observations: 85 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(Y1(-1))	-0.131632	0.031351	-4.198637	0.0001
LOG(WLTY1(-1))	0.123195	0.033015	3.731544	0.0004
LOG(PCOMM1)	0.010412	0.003125	3.331525	0.0013
LOG(REER)	-0.020254	0.006241	-3.245069	0.0018
CCI(-1)/100	0.037904	0.006962	5.444313	0.0000
C	-0.035840	0.121886	-0.294048	0.7695
DLOG(WLTY1)	0.499090	0.107719	4.633260	0.0000
D(CCI)/100	0.023836	0.006659	3.579221	0.0006
D(FREPOR(-6))/100	-0.029479	0.022004	-1.339732	0.1844
D(@MOVAV(GDEFF(-3),4))/10...	-0.208498	0.110758	-1.882464	0.0637

R-squared	0.634779	Mean dependent var	0.006864
Adjusted R-squared	0.590952	S.D. dependent var	0.006072
S.E. of regression	0.003883	Akaike info criterion	-8.154203
Sum squared resid	0.001131	Schwarz criterion	-7.866832
Log likelihood	356.5536	Hannan-Quinn criter.	-8.038614
F-statistic	14.48390	Durbin-Watson stat	1.723239
Prob(F-statistic)	0.000000		

Mnemonics

Y1	=	Real GDP at market prices
CCI	=	BER consumer confidence index
FREPOR	=	Real repo rate (deflated using headline CPI four quarters ahead)
GDEFF	=	Fiscal balance (% of GDP)
PCOMM1	=	Real commodity prices (deflated by US CPI)
REER	=	Real effective exchange rate
WLTY1	=	Real world output

ANNEXURE C

Impulse responses of a permanent 1%/1 unit change on SA GDP (at market prices):

Figure C.1: Impact of a 1% increase in global growth

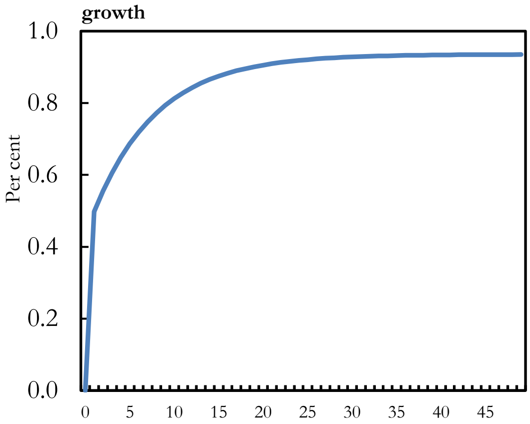


Figure C.2: Impact of a 1% increase in real commodity prices

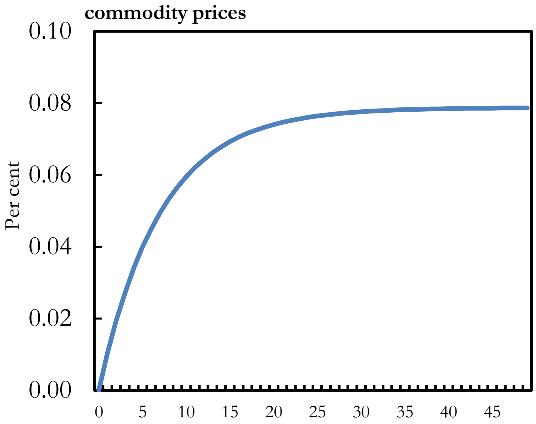


Figure C.3: Impact of a 1% appreciation in the REER

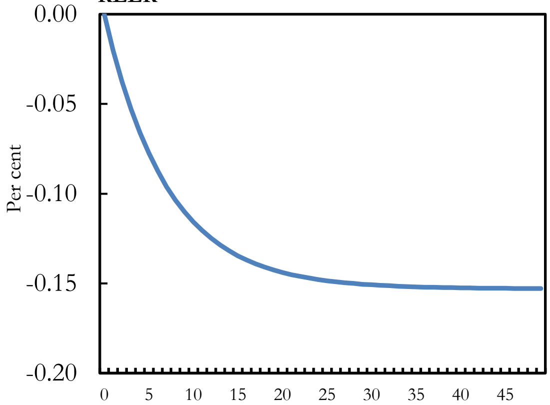


Figure C.4: Impact of a 1 index point change in consumer confidence

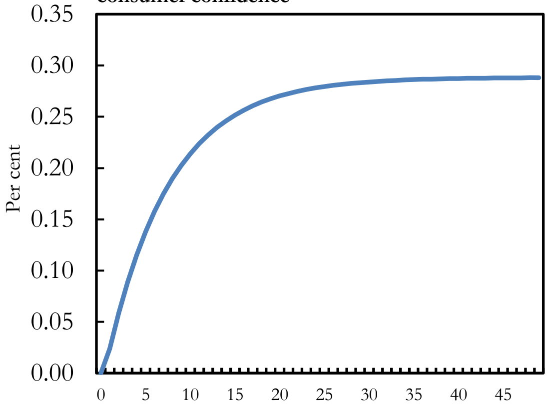


Figure C.5: Impact of a 1 % increase in real interest rates

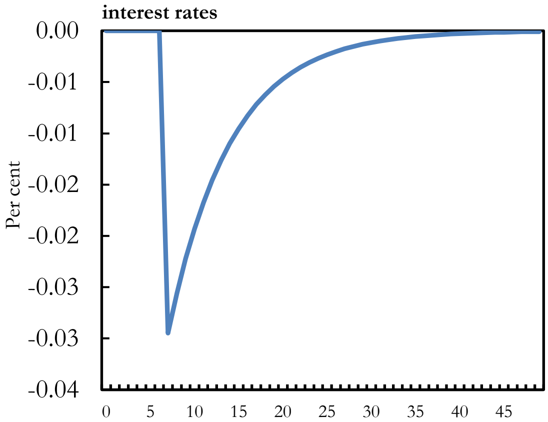
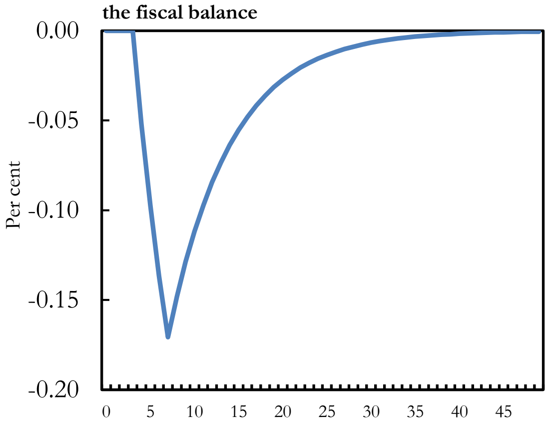


Figure C.6: Impact of a 1 % (of GDP) change in the fiscal balance



Comparing the SARB's Quarterly Projection Model to the "Core" macro-econometric model – September 2017

Macro Models Unit, Policy Development Wing[1]

Abstract

The aim of this note is to highlight the differences between the Bank's "Core" econometric model and the Quarterly Projection Model (QPM). We illustrate some of the benefits of general equilibrium models "GEM's", and focus on the four key "gaps" of the QPM. Models similar to the QPM have been implemented for inflation forecasting in the central banks of New Zealand, Hungary, India, and others. The Core model relies on assumptions for the nominal interest rate and real exchange rate when generating the baseline forecast, while the QPM is a forward-looking model in which the interest rate and exchange rate are endogenously determined in the forecast.

Introduction

Similar to other central banks, the SARB uses several models to assist in the formulation of monetary policy. All models have their specific strengths and weaknesses, and the suite of models approach allows them to complement each other in order to generate better policy outcomes. Within the SARB's suite, there are two key models that play a prominent role in forecasting growth and inflation. The first is the Bank's "Core" econometric model that is a stylised structural error-correction model estimated on South Africa's historical economic relationships. The second is the Quarterly Projection Model (QPM), which is a structural macroeconomic model built on dynamic stochastic general equilibrium (DSGE) fundamentals.[2,3]

The key difference between the two is that when used for forecasting, the Core model relies on the assumed trend of the repo rate and real exchange rate over the full projection period.[4] In contrast, the QPM allows for both the interest rate and exchange rate to be endogenously determined in the forecast. Here, it is the actual forecasts of inflation and real GDP "output" that ultimately determines the repo rate's path. In addition, the trajectory of the repo simultaneously drives the trend of the exchange rate in the forecast. The QPM is also forward-looking, ensuring that expectations of the future contribute to the behavioural patterns of economic agents today.

The next section briefly discusses the properties of both models, before the impulse responses of the QPM and Core model are compared for a selection of shocks. Thereafter, historical decompositions are used to analise (explain) South Africa's growth and inflation outcomes since the inception of the inflation targeting policy framework in February 2000. The note then concludes with a table and brief summary of the key differences between the two models.

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2 For technical details on the QPM, see *The Quarterly Projection Model of the SARB*, Working Paper 17/01.

3 Over the last two decades, many central banks have adopted the use of QPM-style models as part of their forecasting and policy analysis process. A non-exhaustive list includes the Bank of Canada (1996), the Reserve Bank of New Zealand (2015), the Czech National Bank (2003), the Hungarian National Bank (2013), and more recently, the Reserve Bank of India (2016).

4 The MPC usually makes the assumption that the real effective exchange rate will remain unchanged from its current level, while the nominal repo rate remains fixed at the prevailing rate.

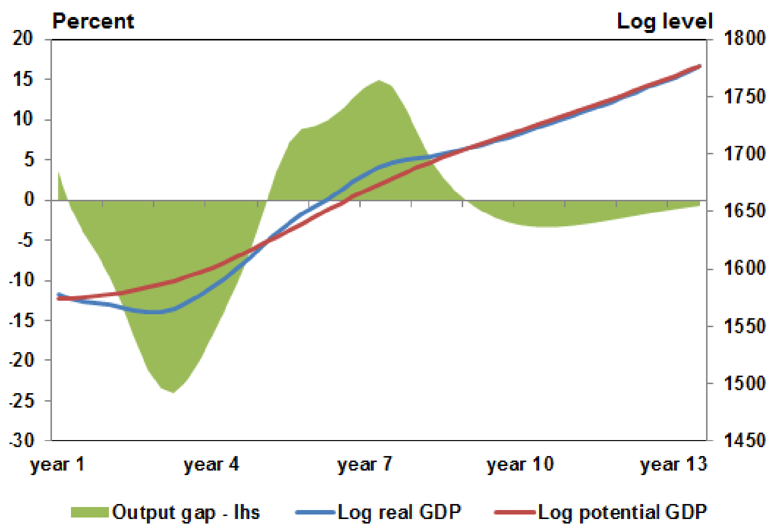
Properties of, and comparisons between the Core and QPM models

The Core model provides a highly detailed representation of the South African economy. The various components of aggregate demand are modelled separately to allow for focussed discussions on the individual roles of consumption, investment, government expenditure, and net exports to real GDP.[5] In terms of inflation, headline CPI is broken down into its core component, food prices, and the administered price component (including the prices of fuel and electricity). The various equations of the model are individually estimated with historical data that roughly spans the previous two decades.

The QPM is a "gap model" that provides a more aggregated view of the economy and how it can be expected to evolve over time. These so-called gaps reflect the degree to which the economy deviates from its long-run equilibrium path, and there are four key gaps that are of particular interest: (1) the output gap; (2) the exchange rate gap; (3) the inflation gap; and (4) the real interest rate gap. Within this structure, given other shocks to the economy, monetary policy closes these gaps over time and thereby generates convergence back to the long-run equilibrium path.

The drivers of the QPM's four most important gaps are discussed in greater below:

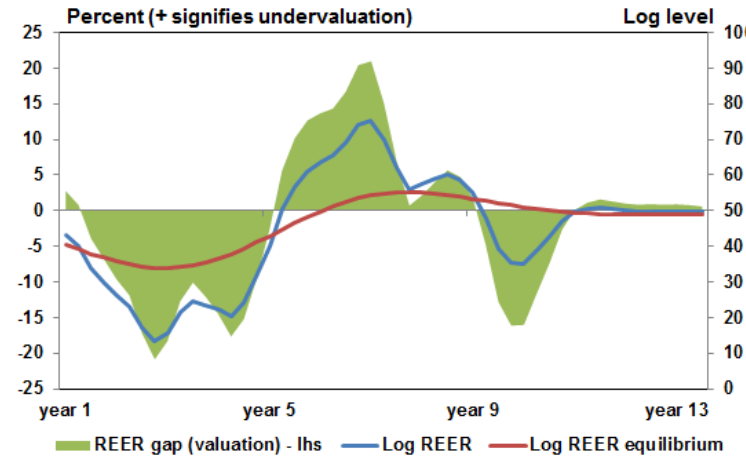
1. **The output gap:** The deviation of the level of output from its potential level. If the current level of real GDP is the same as potential, this gap would be zero and there would be no excess or insufficient demand exerting pressure on inflation. The output gap and these concepts are illustrated in the hypothetical graph below:



   The three key factors in the QPM that influence the domestic output gap are the real interest rate gap, the real exchange rate gap that captures the extent that the over/undervaluation of the currency impacts on the countries net export position, and foreign demand pressures expressed in the form of a foreign output gap.

2. **The real exchange rate gap:** The deviation of the real exchange rate from its equilibrium level. The deviation of the exchange rate shows to what extent the currency is either over/undervalued, or the pressure that the currency is exerting on growth and inflation. The real exchange rate gap and these concepts are hypothetically illustrated below:

[5] Other important channels incorporated in the Core model, include the balance sheets of households, the current account of the balance of payments and the banking sector.



The real exchange rate in the model is determined by an uncovered interest parity condition (UIP) that relates expected currency movements to the risk-adjusted differential between real interest rates at home and abroad. Similarly, the equilibrium trend of the real exchange rate is defined by an equilibrium UIP condition (i.e. where the interest rates at home and abroad are represented by their neutral levels and the equilibrium country risk premium).

3. **The inflation gap:** The deviation of the rate of headline CPI inflation from the mid-point of the three to six per cent inflation target band. Driven *inter alia* by the two gaps stated above, wage pressures and the expectations of future inflation. The QPM allows for the headline CPI to be explicitly decomposed into its non-core and core subcomponents, where non-core inflation components such as food, fuel, and electricity are separately defined.

   - CPI food inflation is determined by international food prices, the exchange rate, domestic demand, and input costs related to labour and fuel.

   - Fuel prices are primarily determined by the international oil price and the exchange rate.

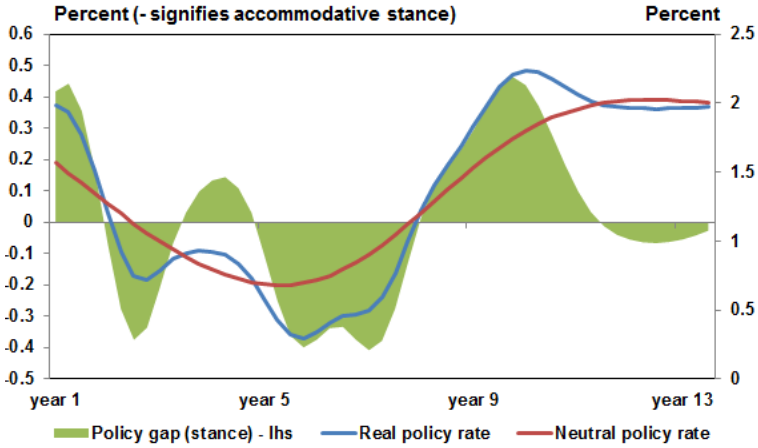
   - Electricity inflation is generally treated as exogenous, and is assumed to follow a prescribed path over the forecast period.

   Core CPI is split into core services and core goods, with both subcomponents largely determined by real wage pressures, the real exchange rate gap, imported inflation, the output gap and inflation expectations.[6]

4. **The real interest rate gap:** The deviation of the real (short-term) interest rate from its neutral level.[7] The real interest rate gap illustrates to what extent monetary policy is considered to be accomodative or restrictive, and is calculated as the nominal interest rate minus expected inflation. Here, the nominal short-term interest rate is determined by the central bank's policy reaction function as depicted by a "Taylor-type" rule. The nominal repo rate in this version of the Taylor rule reacts to the deviation of forecast inflation from the target midpoint, as well as the extent of the domestic output gap. The real interest rate gap and the neutral real rate are illustrated in the hypothetical example below:

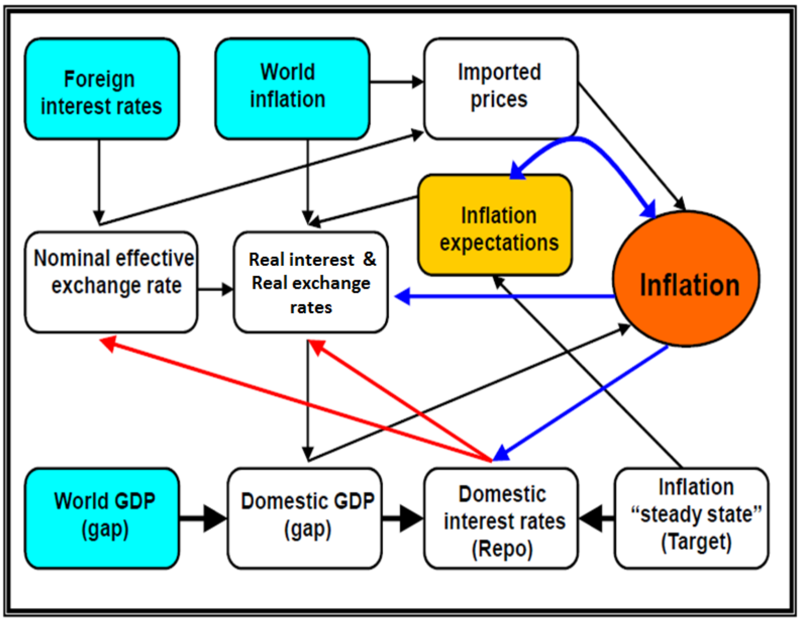
[6] All services in the CPI basket fall under core CPI.

[7] The real interest rate is calculated as the nominal interest rate minus expected inflation, i.e. where the nominal short-term interest rate is determined by the central bank's policy reaction function.



The results of the model show how long it takes for the variable to return back to its equilibrium level, and what it will take (in the form of a change to the interest rate and/or exchange rate) for the prevailing imbalance to work itself out and equalise the system. The Taylor-type rule according to which the repo rate is set in the model can be calibrated to represent the current, or past, behaviour of monetary policy in generating the optimal path to get inflation back to target. In addition, it is the neutral level of the interest rate that is of importance, since it reflects that specific level of the real interest rate that does not affect either inflation or the real economy in equilibrium. Figure 1 provides a description of the monetary policy transmission mechanism in a typical QPM, with many of the key channels and features the same as in the SARB's current QPM.

Figure 1: The Monetary Policy Transmission Mechanism in the QPM



Source: De Jager (2007)

QPM impulse responses and comparisons to the Core model

The following graphs illustrate the main properties of the QPM by means of a selection of once-off exogenous shocks to the model. All shocks are performed in reference to the model's equilibrium or steady state, so that the starting values of all variables and gaps are set at zero when the shock takes place – i.e. their steady states. The set of temporary shocks imposed on the QPM are all unexpected unitary one per cent shocks to the very first period, so that the economic interpretation of the shock therefore depends on which part of the monetary transmission mechanism the impulse enters and then how this gradually feeds through to the rest of the models variables. The shocks are compared to the equivalent core model responses.

Figure 2: Repo rate shock

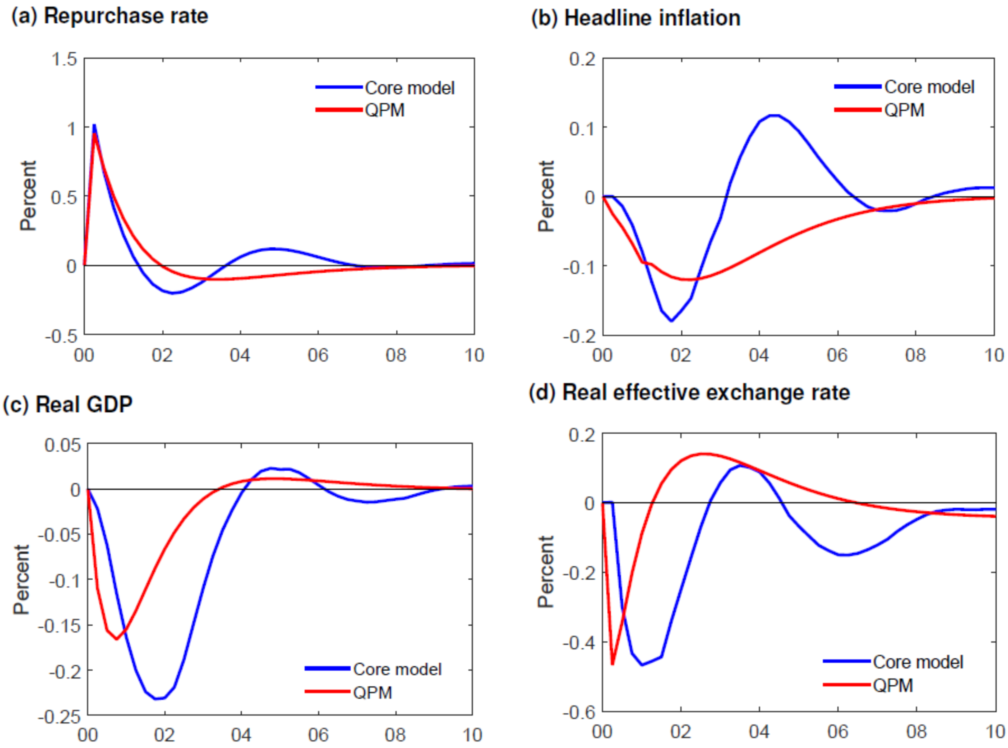
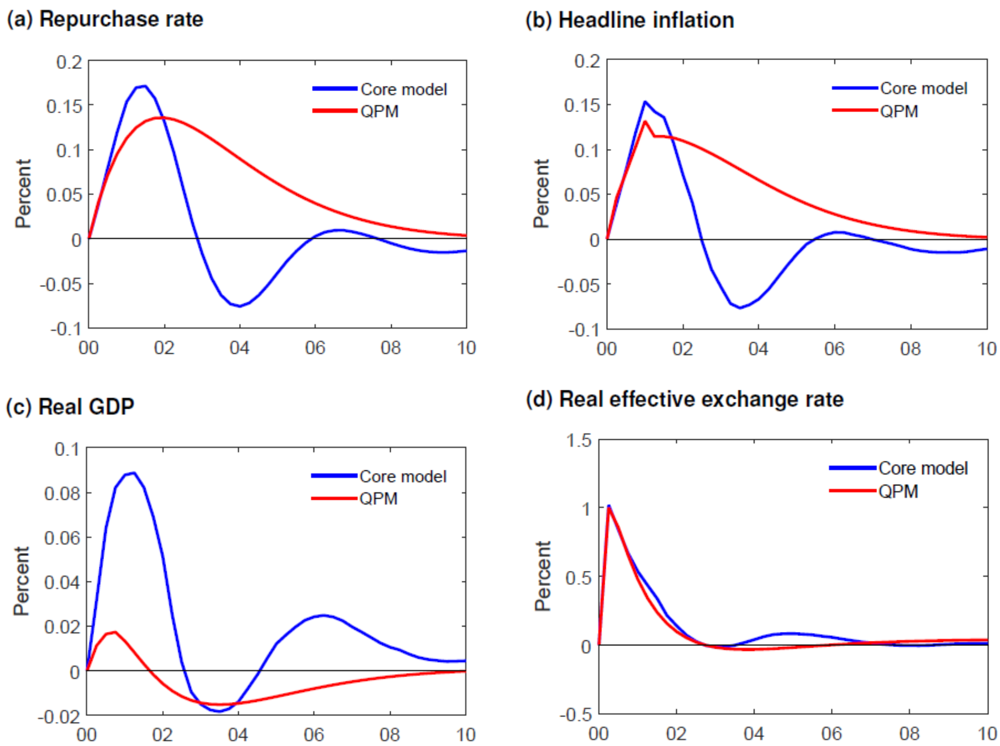


Figure 3: Real exchange rate shock

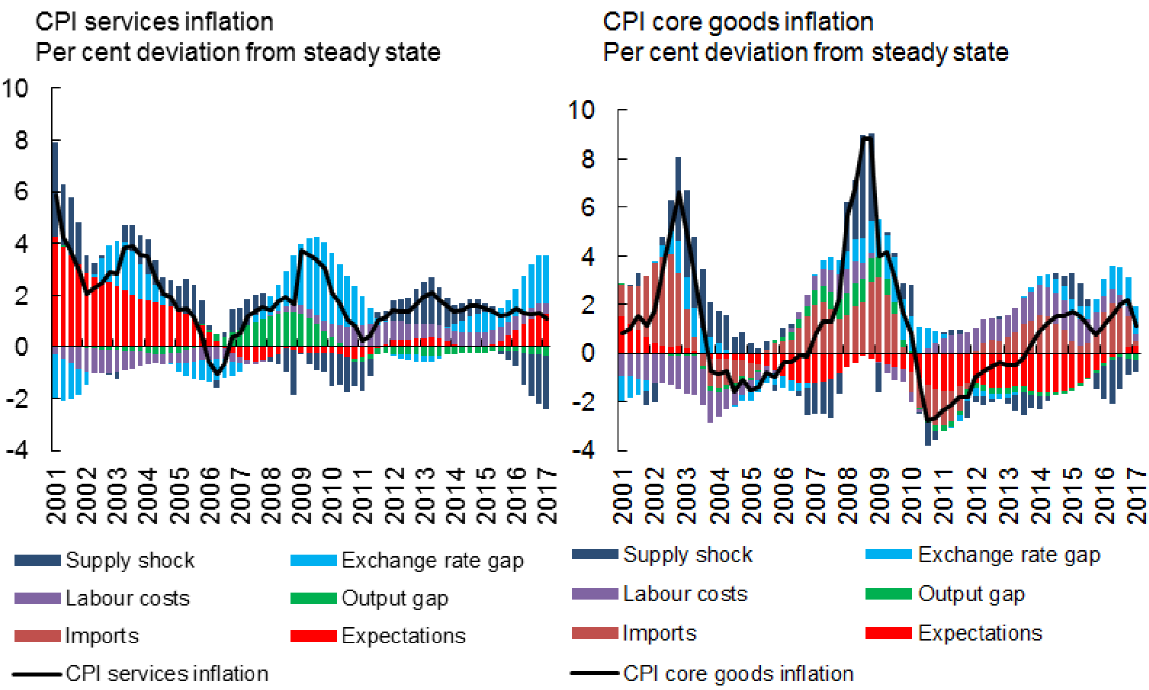


Figures 2 and 3 show that the models react fairly similarly when it comes to the imposition of temporary or transitory shocks over the initial three year policy horizon. The inherent difference in the structures of the models (i.e. where the core model is largely backward looking, while the QPM more forward looking), generally explains the different reactions to the impulse shocks over the longer term. More importantly, the results of the shocks suggest that both models converge back to zero over the longer term which confirms model stability.

Historical decompositions from the QPM

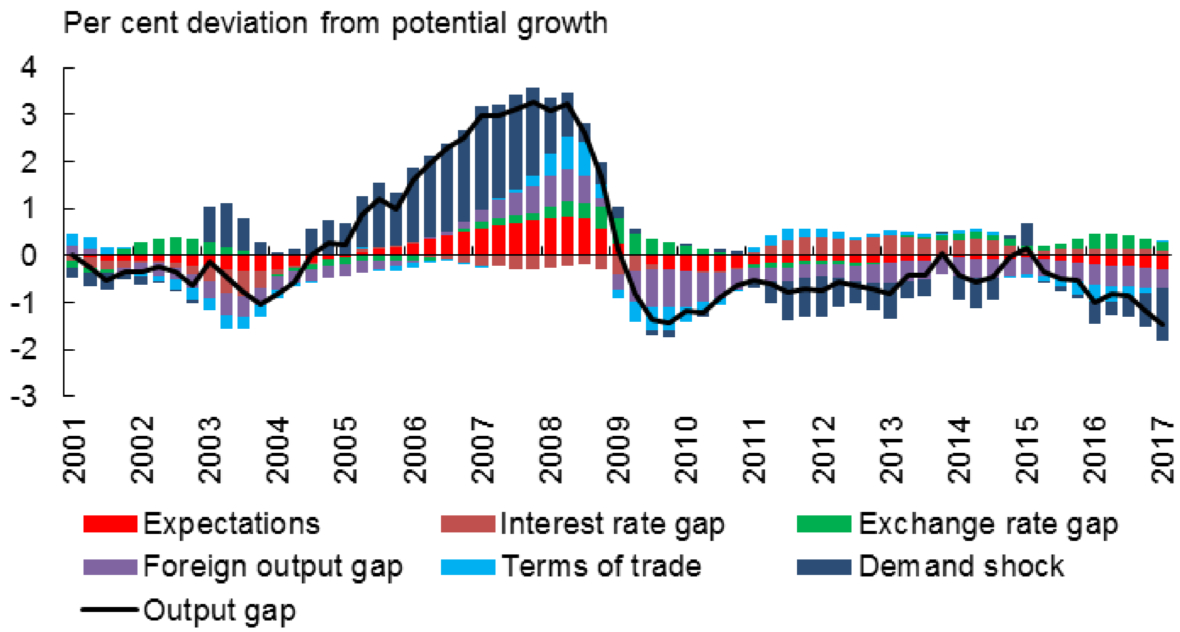
This section looks at how the model properties and data are used to decompose each key variable based on its determinants (from the equation) and shocks. The decomposition narrates the shocks from the model that have contributed to the actual variable deviating from its steady state (i.e. the origin of the pressures causing the deviation). Figure 4 shows the quarterly decompositions of services inflation (left) and core goods inflation (right), as percentage deviations from their equilibrium over the 2001 to 2017 period. The main drivers of the inflation outcomes are the real exchange rate, inflation expectations, demand, real labour costs, and the nominal exchange rate via direct imports. The currency can be seen to contribute significantly to inflation during periods of exchange rate undervaluation (i.e. 2001/02, 2008/09, and 2014 onwards). The QPM highlights the greater relative importance of the exchange rate (through intermediate inputs) and demand in the production process for services, i.e. when compared with the core goods. In addition, the direct impact of the exchange rate can be seen to be more significant, due to the higher weight of imported goods in core goods inflation (labelled imports). The QPM also shows how real labour costs rose after the financial crisis as nominal wages grew while inflation started to decline. The graphs furthermore suggest that insufficient demand has put downward pressure on inflation outcomes since 2010.

Figure 4: Decomposition of Core goods and Services inflation



The decomposition of the output gap in Figure 5 shows that developments in the exchange rate gap, foreign demand gap, commodity price gap (labelled terms of trade), the policy stance (the gap of the real interest rate from its natural rate), and demand shocks drive the extent of the gap. Prolonged periods of rand weakness (rand undervaluation), has helped to narrow the output gap during and following the financial crisis, and more recently since 2014. The world economy was growing strongly and initially supported the more positive output gap during the mid-2000s, but since the great recession this has subsided to contribute negatively to the output gap. Monetary policy is expansionary since 2011, which together with the exchange rate over the last four years helped to close the output gap. By contrast, monetary policy support has lessened since 2014 as interest rates have generally increased in response to the acceleration in inflationary pressures.

Figure 5: Decomposition of the Output Gap



Long-run behaviour of the QPM

The QPM has well defined steady-states, i.e. the long-run values that the variables in the model tend to over time – some of which are shown in the equations and table that follow.

Specifically, these steady-states show the implications of choosing a particular target for inflation over the medium- to long-term. The implications follow from the model being consistent with certain exchange rate relationships put forward in economic theory. Namely, the uncovered interest rate parity (UIP) relationship, the Fisher equation, and the purchasing power parity (PPP) relationship, listed as equations 1 – 3.

UIP relation: $$\underset{(2.5)}{rr} = \underset{(0.5)}{foreign\,rr} + \underset{(2.0)}{prem} + \underset{(0.0)}{E_t\Delta(reer_{t+1})} \quad (1)$$

Fisher equation: $$\underset{(7.0)}{rn} = \underset{(2.5)}{rr} + \underset{(4.5)}{inflation} \quad (2)$$

PPP relation: $$\underset{(2.5)}{\Delta(neer)} = \underset{(0.0)}{\Delta(reer)} + \underset{(4.5-2.0)}{(inflation - foreign\,inflation)} \quad (3)$$

The UIP condition in Equation 1 states that investors will be indifferent between investing in country A and country B if the risk-adjusted (real) rates of return, *rr*, are equal across the two countries.[8] The Fisher equation merely states that the difference between real and nominal rates, *rn*, is the inflation rate. Equation

[8] Where *prem* is the risk premium and $E_t\Delta(reer_{t+1})$ is the expected depreciation of the real effective exchange rate in the next period.

3 states that if a good were priced in a currency common to two countries, then the price of that good should be equal in the two countries (over the medium- to long-term).[9]

Table 1: Steady-states of the QPM

Policy variables	**Domestic**	**Foreign**
Inflation target	4.5	2.0
Neutral real interest rate	2.5	0.5
Neutral nominal interest rate	7.0	2.5
Exchange rates		
Real exchange rate depreciation	0.0	
Nominal exchange rate depreciation	2.5	
Risk-premium	2.0	

Steady state value chosen by policy maker
Steady states calibrated to match data characteristics
Value derived to ensure steady state consistency

Using these equations, we see that an inflation target of 4.5%, taking the steady-states highlighted in yellow in Table 1 as given, implies the the neutral repo rate is 7.0%. Put differently a repo of 7% is the level of the policy interest rate that is consistent with an inflation target of 4.5%.

The key differences between the QPM and the Core model and conclusions

The QPM differs from the core model, by being forward-looking, with a "rational expectations" structure, i.e. relative to the more backward-looking "adaptive" nature of the core model's error-correction model structure. From a model consistency and policy perspective, the QPM is perhaps superior in this regard as it is modelled within a general equilibrium framework that derives the monetary policy stance and exchange rates endogenously.

To conclude, some of the key differences between the models are clarified in the comparison below.

Estimation of model parameters[10]:

QPM

- Model calibration and estimation of parameters with "Bayesian" priors to constrain the mean and variance of the estimated parameter within feasible limits

Core model

- Individually estimated behavioural equations in a cointegrated "error-correction" framework, with the calibration of some of the key homogeneous relationships
- Compiled to generate form the full model

[9] Where $\Delta neer$ is the nominal effective deprecation and $\Delta reer$ is the real effective depreciation. Technically the PPP relationship presented in Equation 3 is stated in terms of growth rates and is therefore the "relative" PPP.

[10] Bayesian econometrics allows the modeller to inform a parameter estimate with his/her prior beliefs about the value of that parameter.

Key focus areas of the model:

QPM
- Endogenous interest rate path
- Output gap and the exchange rate gap
- Inflation rate
- Decomposition of variables into the underlying structural shocks of the model

Core model
- Inflation rate
- Real GDP growth and the components of aggregate demand
- Interest rates and the real exchange rate are exogenous to the model

Disaggregation of the model

QPM
- Highly aggregated model concentrating on the four main gaps
- Disaggregation to sectoral components largely by ratio adjustment, core model scenario results or evidence from supplementary research

Core model
- More disaggregated to illustrate the various sectors of the economy
- Detailed expenditure components classification
- Current account of the balance of payments
- Credit and wealth channels
- Government revenue/expenditures
- Macro-prudential channels

Model shocks/residuals:

QPM
- Shocks provide for other off-model effects not provided for in the model structure
- All shocks are stationary and converge to zero over the projection period to ensure steady-state is achieved

Core model
- Shocks account for other off-model effects not provided for in the model structure
- All residuals are stationary, but do not necessarily converge to zero over the projection period

Model consistency:

QPM
- Model is theoretically consistent
- Interest rate is used as primary lever to converge gaps to steady state research
- Central Bank is an active agent in the economic system, that must work to control inflation
- Model has well defined steady-states (e.g. inflation of 4.5

Core model
- Model is theoretically consistent
- Homogeneity is imposed on behavioural relationships in individual equations to ensure long-run stability of the model
- Results generally converge to the historical average as the steady-state
- Central Bank is a passive agent (constant repo), inflation does not run away without its involvement

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