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Chris Loewald and Rashad Cassim

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Contents

Page

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Enquiries
Head: Research Department
South African Reserve Bank
P O Box 427
Pretoria 0001

Tel. no.: +27 12 313-3911
0861 12 SARB (0861 12 7272)

Dispersion of Inflation Expectations - March 2015

Shakill Hassan and Siobhan Redford

Abstract

We construct cross-sectional measures of dispersion in inflation expectations, based on the extent of disagreement in survey data (a rough proxy for inflation uncertainty); and document how these measures evolve over time. The good news is that dispersion of inflation expectations has reduced substantially since 2000. The bad news is that expectations are converging on the upper bound of the official target range. The inter-quartile range of expectations is systematically entirely above the mid-point of the official target range since at least 2008.

Keywords: forecast disagreement; inflation uncertainty; behavioural macroeconomics.

> "(...) people are insufficiently sensitive to distributional data even when such data are available. Indeed, (...) people rely primarily on singular information, even when it is scanty and unreliable, and give insufficient weight to distributional information." (Kahneman and Tversky (1977).)

1. Introduction[1]

Survey data show considerable disagreement about inflation ahead. The degree of dispersion in beliefs about future inflation is a non-trivial indicator for monetary policy.[2] First, it may indicate how firmly expectations are anchored.[3] Wide disagreement about inflation ahead means no convergence in the vicinity of the average forecast. If the inflation targeting policy is credible, not only should the central tendency of medium and long-term inflation expectations match the official target; but these expectations should also tend to converge on the target. Second, dispersion in inflation expectations is a rough proxy for uncertainty about future inflation. Inflation uncertainty affects the term premium in bond markets, which forces a wedge between short and long-term interest rates, beyond the effect of interest rate expectations. Third, high dispersion means that the expectations of a large number of economic agents will (necessarily) be proven substantially incorrect, once the level of realized inflation becomes known -- irrespective of what that level is. The consequent updating and revisions to plans may impact aggregate fluctuations.[4]

[1] With thanks to Alain Kabundi for helpful comments, and to staff at the Bureau for Economic Research for data.

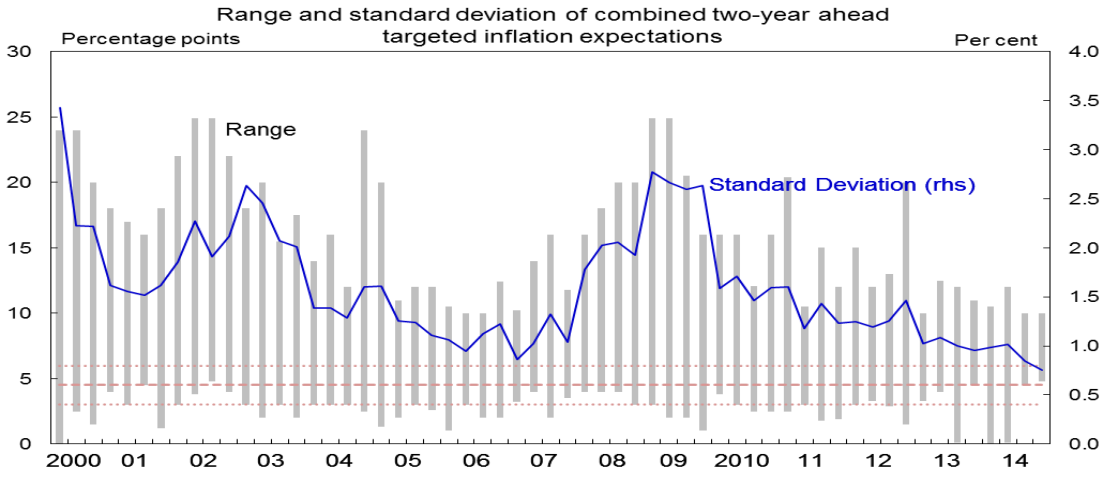
[2] Inflation expectations play a crucial role in an inflation targeting regime - they affect realised inflation, as well as the output cost of controlling inflation, and therefore monetary policy effectiveness. This is well understood, and reasonably studied in South Africa. The subject of this note is the extent of disagreement, or the dispersion, about these expectations. Interesting recent work recognizes heterogeneity in expectations, but is concerned with the evolution of group averages, rather than their dispersion. (Reid (2012), Walter, Johnson and Johnston (2013), Kabundi, Schaling and Some (2014).)

3 Inflation expectations are "well anchored" if long-term expectations are relatively impervious to temporary shocks. See Orphanides and Williams (2005) and Bernanke (2007) for generally accepted definitions.

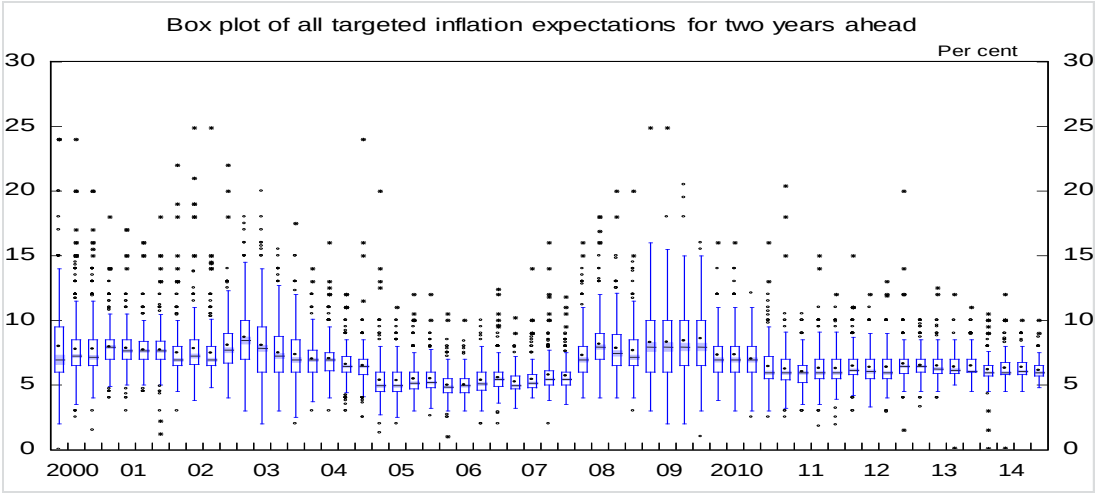
[4] Mankiw, Reis and Wolfers (2004, p. 210, 242) go as far as suggesting that "disagreement may be a key to macroeconomic dynamics." See Mankiw and Reis (2002), Khan and Zhu (2002), and subsequent literature on sticky information. On disagreement as a proxy for uncertainty, see for example Giordani and Söderlind (2003), Bachmann, Elstner and Sims (2013).

Table 1: Range, standard deviation, and interquartile range for two-year ahead expected inflation, all respondents, from 2000 to 2014

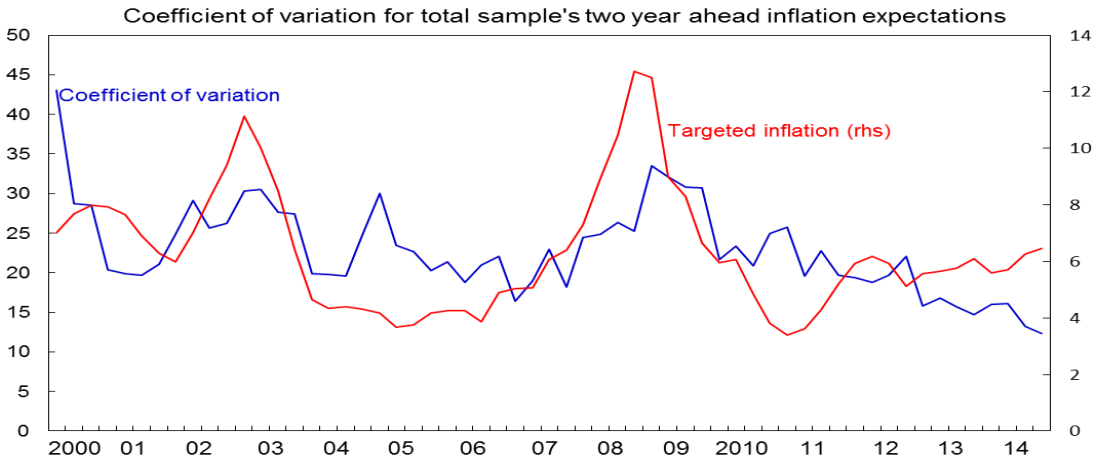
Full range and standard deviation



Inter-quartile range



Coefficient of variation and realised inflation



Source: authors' calculations; BER data

This note documents the extent of disagreement about expected inflation in South Africa, using simple and intuitive measures of dispersion. We show that the level of dispersion, within each group of respondents and overall, can be very high, with an average distance between the maximum and minimum expectation (the range) of 13 percentage points for the complete sample; that it varies significantly over time, with a maximum range of 24 percentage points (in early 2000), and a minimum of 5 percentage points (end of 2014); and that it is currently (latest available data) at its lowest level since the surveys began - for each group of respondents. The inter-quartile range, which represents the most likely spread of beliefs, is of course narrower, and quite stable in recent years. The cross-sectional standard deviation of inflation expectations is at a record low by the end of 2014.

In sum, dispersion has reduced, and substantially; observations are increasingly concentrated in the vicinity of the average (or median) forecast. The problem is that the likely (inter-quartile) range of expectations is *entirely* above the mid-point of the official target range (of three to six percent) since at least 2008; that of price setters (business and trade unions) expectations, since 2007. If we exclude an implausible forecast of inflation near zero (made in three quarters between 2013 and 2014), then for all but one of the past six quarters, the full range of expectations is above the mid-point of the target range -- i.e., statistically speaking, nobody expects inflation to hit the mid-point from above at the two year horizon.[5] Consequently, and as documented elsewhere, the average (and median) expectations, which have been relatively stable, exceed the mid-point of the official target band by about 150 basis points. Disagreement has fallen and expectations are converging, but on the upper bound of the target range. This is true for all groups of respondents.

2. Dispersion of two-year ahead beliefs

We use the entire cross-section of each quarterly Inflation Expectations Survey, organized by the Bureau for Economic Research, on respondents' inflation expectations, from the second quarter of 2000 to the fourth quarter of 2014. Respondents are drawn from business and trade union representatives, and professional economists in the financial sector. The average number of observations per quarter is 366, with high predominance from business sector responses (average of 337 observations per quarter, compared to 13 and 16 from labour and analysts, respectively).

The extent of disagreement and its evolution are summarised in the exhibits in Tables 1, 2 and 3. The measures of dispersion are the following: the range of the distribution, which is the difference between the highest and the lowest forecast; the inter-quartile range, which excludes forecasts in the highest and lowest quartiles; the standard deviation, which is arguably the most widely used measure of dispersion; and the coefficient of variation which is the ratio of the standard deviation to the average forecast. These are all calculated for each quarter, using the survey data available for that quarter – i.e., they are cross-sectional measures, and not based on the past observations.

We only report here the results for beliefs about inflation two years ahead. The other horizons for which historical BER data are available (inflation in the current year and one year ahead) are too short for monetary policy to have an effect on inflation; well-anchored medium and long expectations do not preclude high oscillation in short-term (less than one year ahead) expectations.[6]

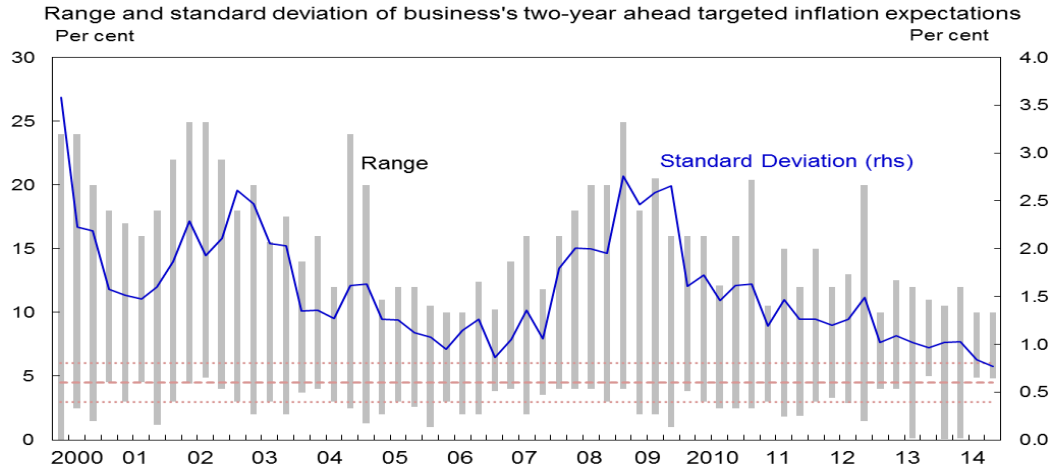
Table 1 shows the evolution of the different measures of dispersion using the full sample of respondents. Observe the gradual reduction in the standard deviation, the narrowing and stability of the inter quartile range, and relative stability of the median (the line segments inside the rectangles), towards the end of the sample period.

[5] Note that 2014 saw an extreme reduction in the price of crude oil; this could have an effect on the distribution of forecasts reported in early 2015, but mainly for short-term horizons.

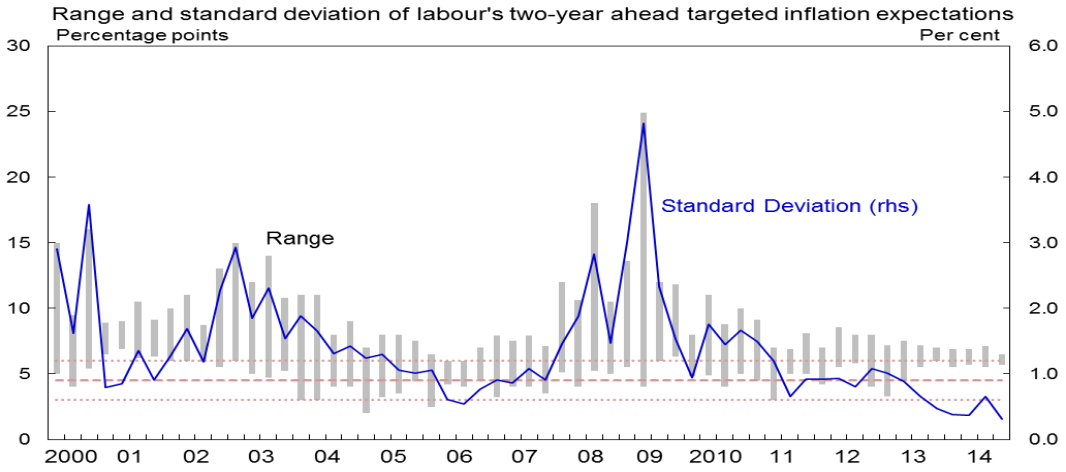
[6] BER survey data on expectations for inflation five years ahead are also available, but only from 2011.

Table 2: Range and standard deviation of two-year ahead expected inflation, by business, labour, and financial analysts, from 2000 to 2014

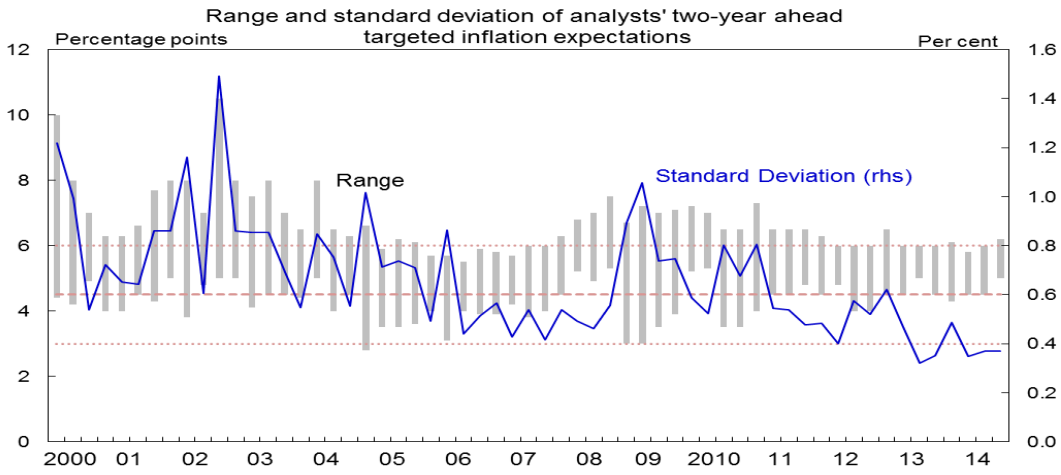
Dispersion of business expectations



Dispersion of trade union expectations



Dispersion of financial analysts' expectations



Source: authors' calculations; BER data

2.1 Range and standard deviation

The figures in Table 2 show the quarterly evolution of the range (outliers included) and standard deviation of inflation forecasts, by business, trade union and analyst respondents.[7]

The standard deviation of expected inflation is at its lowest level since the introduction of inflation targeting. This applies to each group of respondents. The same peak in standard deviation of expected inflation, at or near the end of 2008 was observed in advanced economies, especially the US and UK.[8] It reflects variance in recent past inflation (oil and food price shocks); dispersion as a proxy for uncertainty; and of course, less than perfectly anchored expectations.[9]

The range oscillates, in central tendency, but remains wide. This is largely due to outliers (a few extreme expectations on the up and down sides) which distort the visual representation of the more likely range.

2.2 Box plots and inter-quartile range

The figures in Table 3 show the evolution of box plots for the same forecasts. The length of the central rectangle gives a visual representation of the location of the inter-quartile range, an indication of the more likely range of variation in expectations, excluding extreme observations.[10] The outliers are shown outside the boxes, above and below the end of the vertical lines. The number of large outliers (among business respondents) calls for caution when reporting mean forecasts, as these can be weak indicators of central tendency. The number of extreme observations has reduced markedly.

Note how the inter-quartile range reduced (indicating increased convergence of expectations), and stabilized. This is a tentative sign of some degree of recent anchoring of expectations, given the observed evolution of inflation -- that is, we show declining dispersion and an increasingly stable range of expectations, despite some variability in observed inflation, and high variability in crucial drivers of inflation, especially the exchange rate and commodities prices.

Remark 1 *By all measures of dispersion, and for each group of respondents, we observe a significant reduction in disagreement about inflation two years ahead.*

This is very clear for all groups of respondents. However, the convergence is, for each group, at or very near the upper bound of the inflation target range. Indeed, observe that:

Remark 2 *The entire inter-quartile range (of expected inflation two years ahead) is systematically above the mid-point of the official inflation target range, since at least 2008, for each group of respondents; and since 2007 for price setters.*

That is, *to the extent* that median and mean long-term forecasts are relatively insensitive to the data and news flow, expectations are increasingly firmly anchored (there is less disagreement); but the emerging focal point is too high for a target range of three to six percent.[11] This finding corroborates and strengthens those in previous reports based only on the mean of each group's forecasts, regarding the Bank's implicit target (e.g., Walter, Johnson and Johnston (2013), Kabundi, Schaling and Some (2014)).

[7] The survey data includes a decimal expectation from a business respondent in three recent quarters (expectations of 0.1, 0.07 and 0.1 percent in Q3-2013, Q1 and Q2-2014, respectively). We ignored these when illustrating the complete range, and replaced them by the next lowest forecasts. We preserve all observations as reported in the box plots however.

[8] See Gerlach, Hördahl and Moessner (2011).

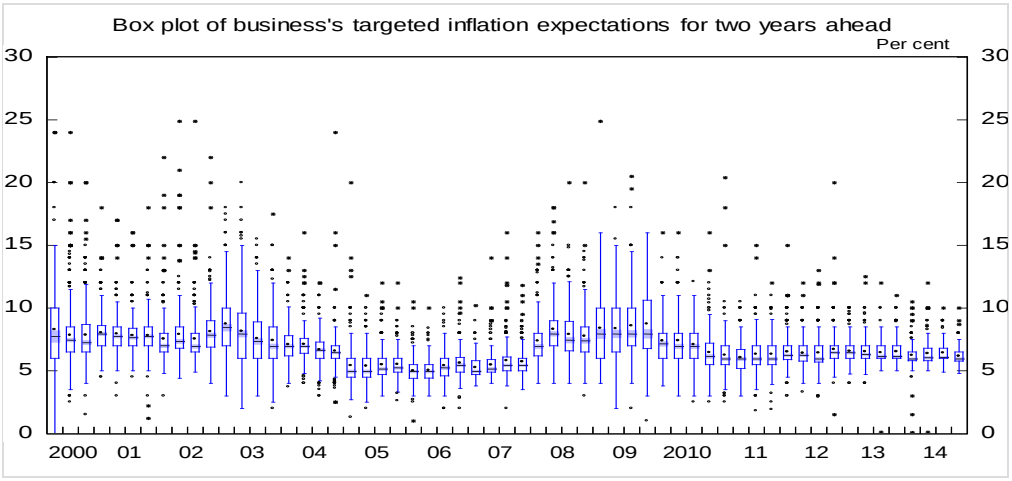
[9] We also document the evolution of the coefficient of variation, a measure of dispersion which controls for the effect of changing mean levels - see the appendix.

[10] The central boxes represent, at each point in time, the range containing the fifty percent of observations which span the first to the third quartiles of the distribution of forecasts. (See the appendix for detail.)

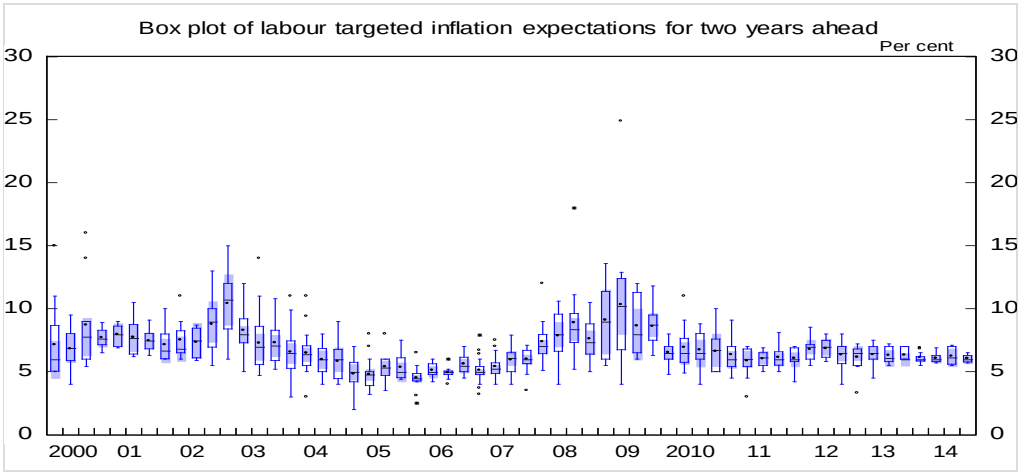
[11] It is not clear that expectations of price setters are well anchored. Realized inflation has been comparatively stable.

Table 3: Box plots for two-year ahead expected inflation, by business, labour, and financial analysts, from 2000 to 2014

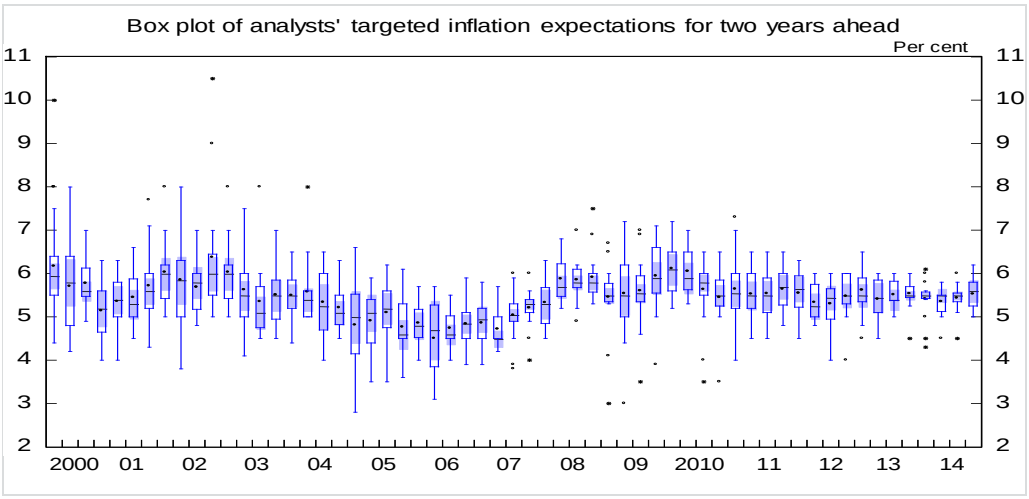
Dispersion of business expectations



Dispersion of trade union expectations



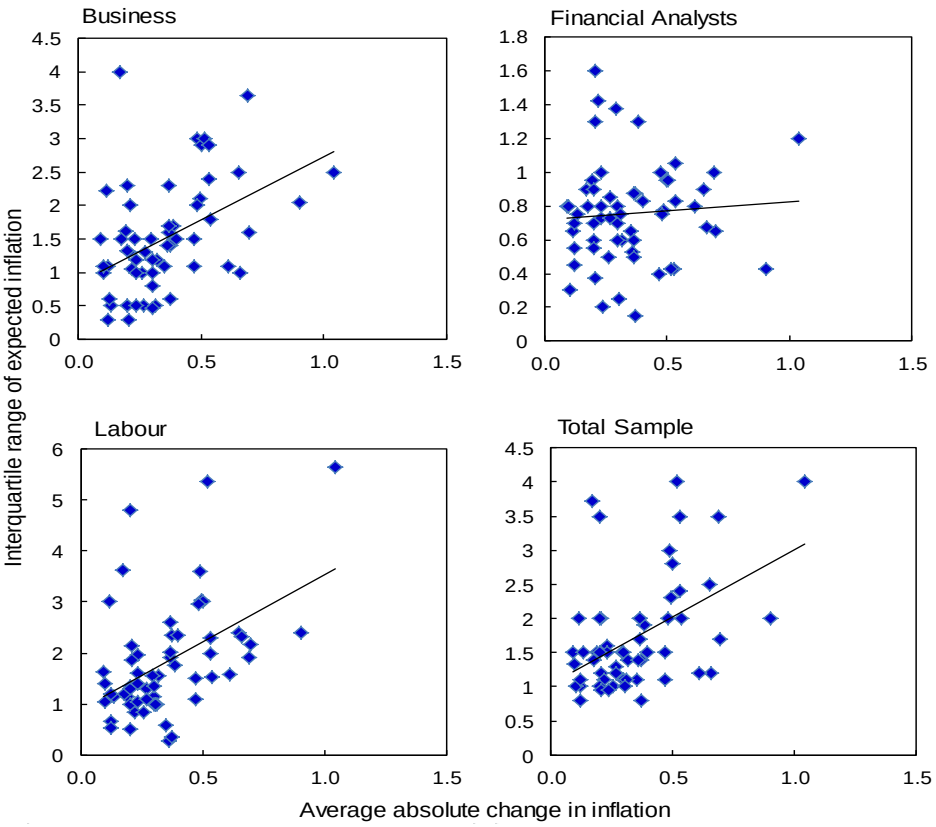
Dispersion of financial analysts' expectations



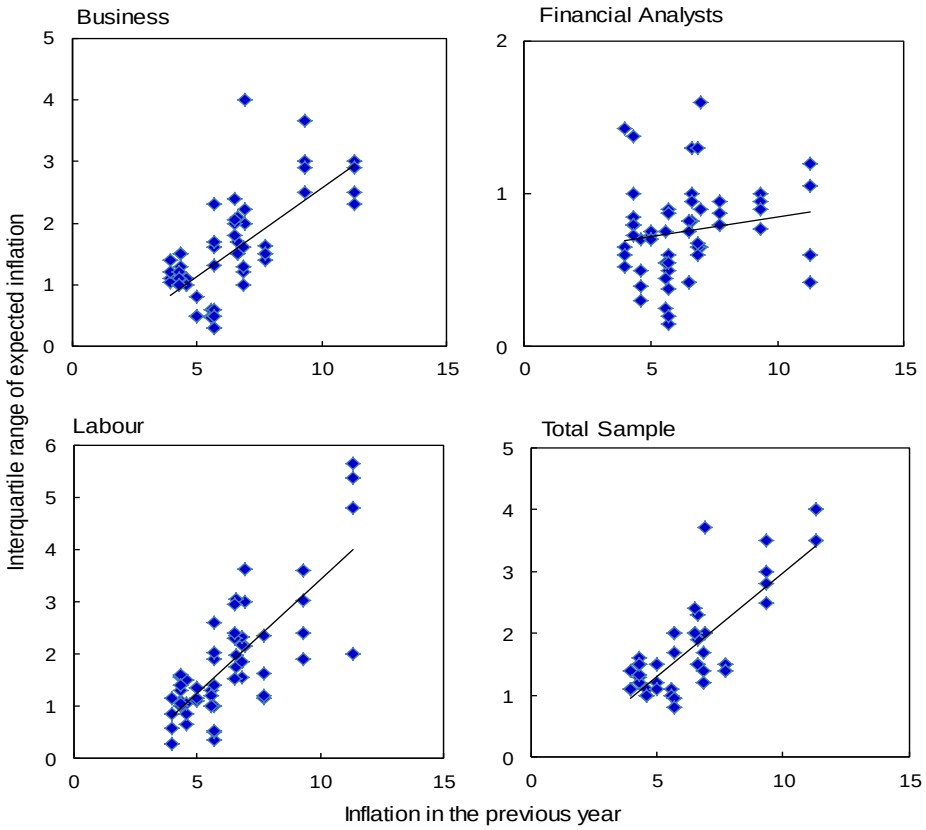
Source: authors' calculations; BER data

Table 4: Drivers of disagreement

A: inter-quartile range and past inflation variability



B: inter-quartile range and past inflation level



Source: authors' calculations; BER & SARB data

3. Past inflation and disagreement about inflation ahead

The figures in Table 4 suggest that past inflation (level and variability) affects current dispersion of expectations about inflation ahead. Intuitively, the higher and/or the more volatile the observed rate of inflation, the harder it is to anticipate future inflation. Hence the sharp increases in dispersion around 2002 and 2008. Set A (top four figures) shows scatter plots of quarterly dispersion against the average absolute change in inflation over the previous quarter. Set B (bottom four graphs) shows scatter plots of dispersion against realized inflation over the preceding year.

There is a clear difference between the effect of past inflation on dispersion among analysts, and on dispersion among price setters (business and labour). Dispersion among analysts is not affected by the past level of realized inflation, in sharp contrast to price setters. (Contrast the first and third quadrants against the second quadrant in set B of Table 4.) Dispersion among analysts is however partly responsive to variability of past inflation.

The relationships in Table 4 (see the fourth and eighth quadrants in particular) need further probing, but they are indicative, and consistent with: a) a degree of adaptiveness in domestic expectations formation, especially by labour and business; b) theoretic predictions on the determinants of disagreement; and c) available international evidence, based on United States data.[12]

Realized inflation is publicly observable, so it is an element of the common information set. Different beliefs about inflation ahead must therefore reflect differences in how respondents process this information, plus the effects of other determinants of inflation expectations. Clearer understanding of the determinants of dispersion or disagreement about inflation (and other macro variables) requires further work.

4. Conclusion

Trehan and Zorrilla (2012, p.2) observe that disagreement about the inflation target is "as problematic" as uncertainty about the central bank's commitment to its target. We document decreasing disagreement; therefore less uncertainty about the Reserve Bank's commitment; but with increasing agreement on commitment to an implicit target in the vicinity of the six percent upper bound of the target range.

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[12] See Ehlers and Steinbach (2007) on expectations formation in South Africa; and King (2004), Mankiw, Reis and Wolfers (2004), Williams (2004) and Cápistran and Timmermann (2009), on theoretic predictions and US evidence.

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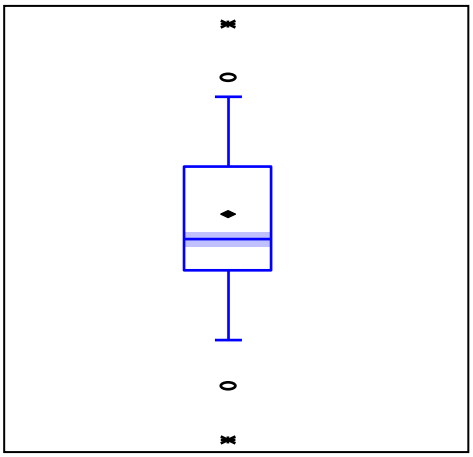
6. Appendix

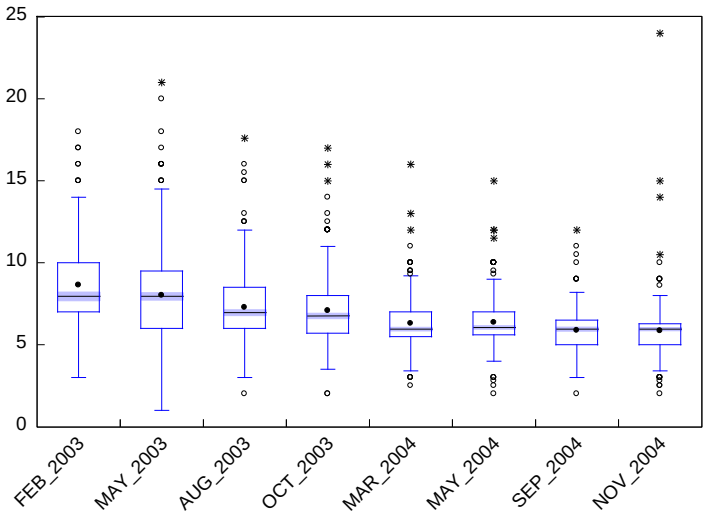
6.1 The information in box plots

A box plot is a graphic representation of a number of descriptive statistics for a dataset. It displays the mean, median, first and third quartiles, and outliers for the data. It is also a useful tool in understanding the dispersion and skewness of data and hence gives an indication of the distribution of the data.



The box (rectangle in the middle) represents the 50 per cent of observations falling between the first and third quartiles. Inside the box the median is indicated by a horizontal line (the median is the point at which the sample is split in half, such that half the sample is below the median and half above the median). The shaded area around the median indicates the 95 per cent confidence interval for the median. The solid black diamond indicates the mean of the data (this being the average value of all observations). The whiskers are the vertical lines that extend upward and downward from the box. They end at the last data point that falls within the first quartile minus 1.5 times the inter-quartile range (which is calculated as the difference between the third and first quartiles) and the third quartile plus 1.5 times the inter-quartile range (these are indicated by the "staple" at the end of each whisker). The circle indicates near outliers which are observations which fall between 1.5 times the inter-quartile range and 3 times the inter-quartile range below the first quartile and above the third quartile. Far outliers, as indicated by the star are further than the bounds for the near outliers.

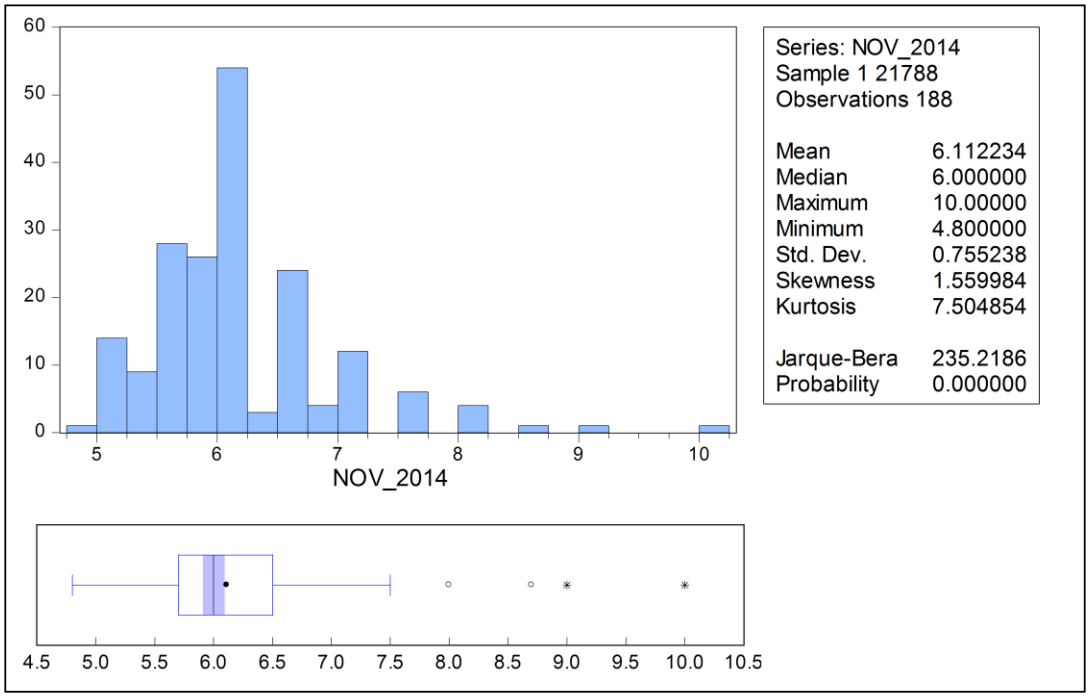
Figure 1: Box-and-whisker plots for the surveys held during 2003 and 2004



An advantage from the presence of the 95 per cent confidence interval as provided in the box plots is that is allows for comparison of the medians of multiple datasets. In the case of the expectations survey data, the differences in the medians across a number of surveys. The figure below shows the box plots for the surveys held during 2003 and 2004. During this period, the median expectation of CPI inflation fell from 8 per cent to 6 per cent. Comparing the 8 per cent median for the February 2003 survey and the 6 per cent median from the November 2004 survey, the fact that the confidence intervals do not overlap suggests that these medians are significantly different from each other.

6.2 A snapshot: the extent of disagreement in November 2014

The exhibit below illustrates the relationship between the box plot and the distribution of data. It shows a histogram and box plot (which has been rotated) for the same dataset. In this case, the dataset is the expectations for two-year ahead CPI inflation in South Africa for all participants in the Bureau for Economic Research's inflation expectations survey as reported in November 2014.



Distribution of data from the November 2014 survey of inflation expectations as shown as a histogram and box plot

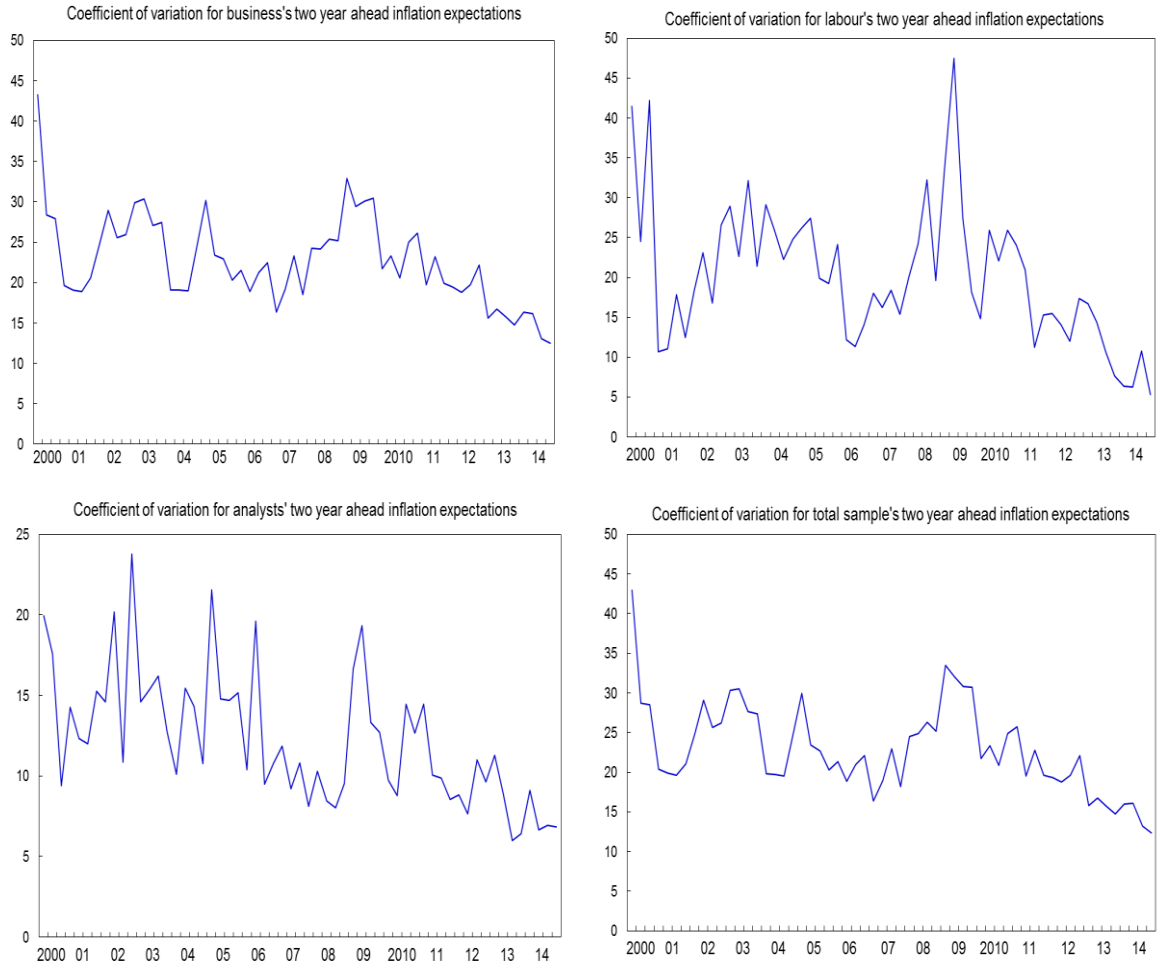
The existence of outliers only to the right of the distribution can be seen in both plots. The median is below the mean because the data are right-skewed, so the mean is upward biased due to the presence of outliers. Another observation when looking across the histogram and box plot is that the majority of observations fall between 5.5 and 6.25 (in the case of the histogram, with over 100 observations between these points) and in the case of the box plot between 5.7 and 6.5 (accounting for 94 observations). The box plot is slightly more accurate in this case as it pins down exactly where the data splits rather than the histogram which places observations within arbitrarily determined bins.

6.3 Coefficient of variation

Common statistics used to describe data include the median, mean, standard deviation, variance, minimum and maximum. As seen in the previous section the box-and-whisker plot provides a graphic representation of this information. When comparing different series, the use of these raw statistics can be misleading as they can be measured in different units, or in the case of the inflation expectations data used for this analysis, at different periods (with different means). One measure that is effectively unitless is the

coefficient of variation. It is calculated as the standard deviation of a series divided by its mean; and provides a measure of the variation of the data in relation to the data's mean. This measure is also comparable across different series and identifies series that display greater or less variation relative to other series. In the case of the expectations data, the total sample exhibits a pattern that suggests that the dispersion of inflation expectations during recent surveys is significantly lower than when the survey began in 2000.

Table 5: Coefficient of variation for two year ahead inflation expectations



The reported coefficients of variation for the financial analyst and labour samples are adjusted for the bias induced by their small cross-sectional samples, by multiplying the coefficient by (1+(1/4n)) where n is the number of observations in that quarter.[13]

[13] See Sokal, R., and F. Rohlf, 2012, Biometry, New York: Freeman and Co.

The end of global reserve accumulation – and its implications
February 2016

Jean-François Mercier

Abstract

Fast accumulation of official FX reserves by the world's central banks has gradually tapered off in recent years, and reversed modestly in 2015. Weaker export proceeds among commodity exporters, capital account deterioration and shifting policy choices have been the key factors behind reduced accumulation. Such a background is unlikely to change in the next couple of years, suggesting that relatively stability in global reserves looks most likely. Such a pattern could help reduce the size and durability of global external imbalances relative to the past decade, as well as result in more accurate pricing of government debt relative to other assets, and limit risks of excessive credit creation. However, it may also make it more difficult to attract capital inflows for a country like South Africa, which is dependent on portfolio flows for the funding of its external deficit and whose bond market is highly influenced by changes in US bond yields.

Introduction

From the early 2000s to the last couple of years, many central banks – mostly in the emerging world but also in the developed world, and for a diverse set of reasons – embarked on a significant accumulation of official foreign exchange reserves. This process has stalled in the past few quarters, and in fact, there have been numerous media reports of some countries (in particular China) intervening in the FX market by selling reserves. In this note, we look at the key factors that drove both the acceleration and the slowdown in reserve accumulation, and conclude that the next few years should, instead, usher in a period of more stable global reserves. In light of the macroeconomic impact of ample reserve accumulation in recent years, we then point out how this potential new paradigm could result in reduced global current account imbalances (both in size and duration); a re-pricing of government bonds versus other assets; and more muted money supply and credit growth in specific countries. Finally, we look at the potential indirect impact for a small, open economy like South Africa, which is neither the source nor the recipient of large reserve flows but has been dependent on international capital inflows in the last decade or so.

The end of global accumulation

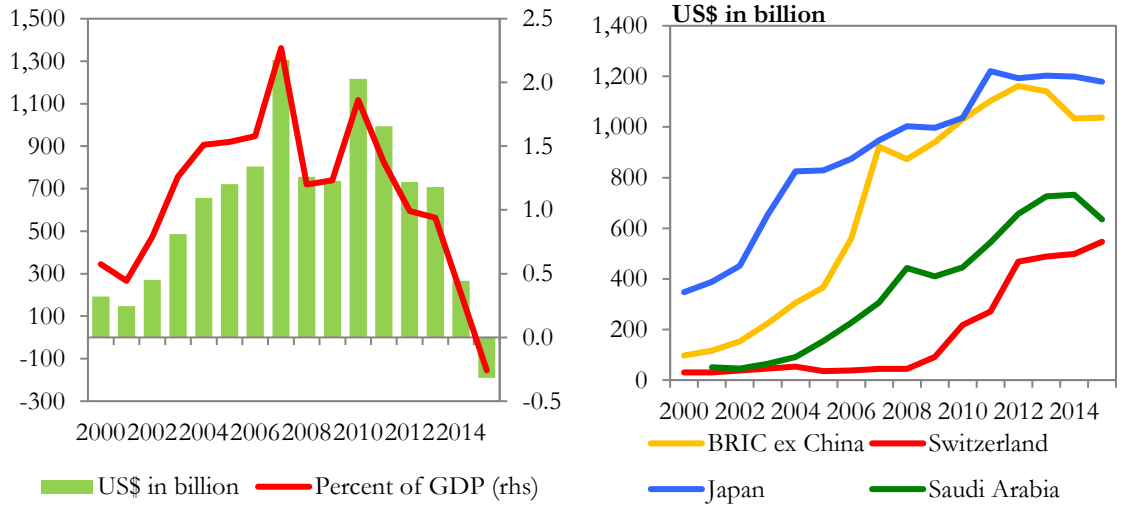
A long era of official reserve accumulation has gradually come to an end. According to the IMF's Composition of Foreign Exchange Reserves (COFER) data, the overall level of world FX reserves peaked at US$11,98 trillion in 2Q 2014, having risen from as low as US$1,64 trillion 15 years earlier, an average increase of 14,1 per cent a year. However, five quarters later (the latest data available), they have fallen by US$780 billion, or by roughly 6½ per cent. Admittedly, a large part of that decline probably reflected the appreciation of the US dollar versus other major currencies over the period, which reduced the dollar value of non-dollar assets. However, if we adjust the change in reserves for exchange rate moves based on the currency composition of reserves (as published by COFER)[1], the

[1] For the 42 per cent of total reserves that are unallocated (i.e. reporting central banks do not provide the currency composition to the IMF), we assume a similar composition to the allocated ones, that is, as of 2Q 2015, 64 per cent US dollars, 20 per cent euros, 5 per cent sterling, 4 per cent yen, 2 per cent for both Canadian and Australian dollars, and 3 per cent other currencies.

broad message remains the same: Following a gradual pickup in the 2000s and a temporary lull at the height of the Global Financial Crisis, reserve accumulation tapered off from 2011 onwards and reversed marginally in the first three quarters of 2015. Expressing reserve accumulation as a share of world GDP, one gets a similar bell-shaped curve, with a high of 2,3 per cent of GDP in 2007 (see Figure 1).

Much has been written about the key role played by China in the global accumulation of reserves over the past two decades and, of late, their decline. Indeed, from US$80 billion in 1Q 96, Chinese reserves surged to a peak of US$ 3,99 trillion by June 2014, before subsequently falling by US$ 663 billion by December 2015. And it was not all valuation effects: For instance, Barclays estimated that between September 2014 and August 2015, the People's Bank of China intervened to the tune of US$167 billion, most of it in July-August 2015.[2] But the tapering, or partial reversal, of reserve accumulation has not been limited to China. Other large emerging countries (Russia in 2014, Brazil and Indonesia from mid- to late 2014) also experienced declines in reserves; the drop was even more pronounced for some oil exporters, in particular Saudi Arabia (see Figure 2). Among more advanced economies, we have seen a plateauing of Japanese reserves since 2011, and a much reduced pace of accumulation by traditional large reserve holders like Switzerland, South Korea, Taiwan and Hong Kong.

Figures 1 and 2: Estimated global accumulation of official FX reserves (left) and official reserve levels in selected countries (right)



Note: The data on Figure 1 are adjusted for valuation effects.

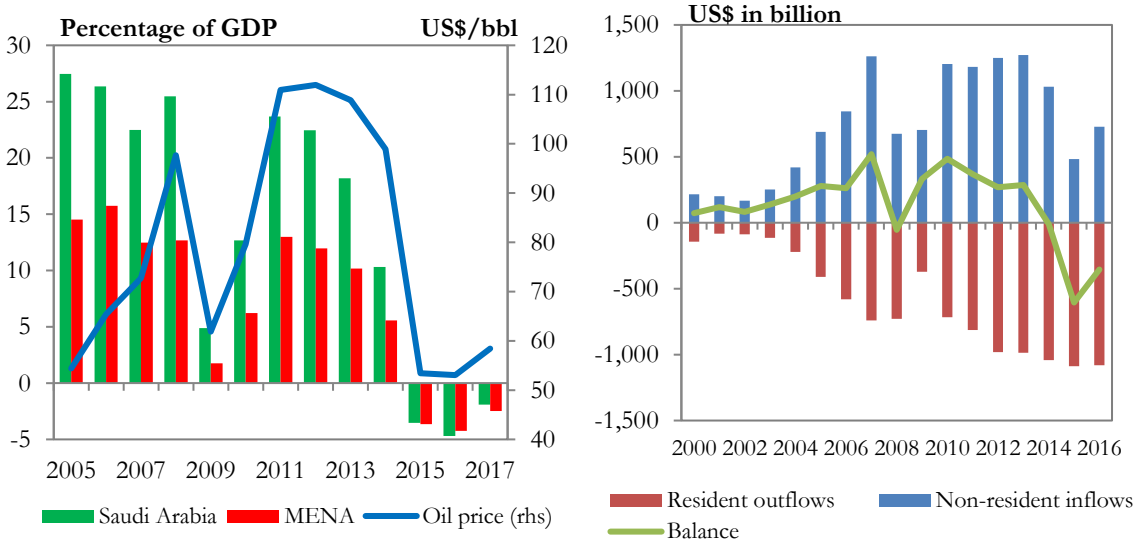
[2] See "China: The heavy cost of intervention", Emerging Markets Research, Barclays, 3 September 2015. In addition, the December decline in Chinese official reserves (US$108 billion) does not appear to be related to valuation effects, as the US dollar was relatively stable on the month.

Underlying reasons are probably here to stay

Reasons for tapering the pace of reserve accumulation tend to vary across countries. In the case of oil exporters, the sharp decline in the oil price curtailed, or even removed their ability to accumulate FX assets. Economic and financial sanctions played a similar role in Russia in 2014. Among many other emerging markets, falling terms of trade and/or worsening private capital inflows (as trend growth and other fundamentals deteriorated) similarly weighed on the balance of payments. In China, the liberalization of the capital account, the repayment of FX loans by domestic corporates and a policy goal of re-balancing the economy towards a consumer-driven model (implying greater tolerance for real exchange rate appreciation) probably played the key role. Policy considerations also appeared to explain the end of reserve accumulation in Japan (as the BoJ was able to weaken the yen more effectively via purchases of domestic bonds than via FX intervention) and Switzerland (where the SNB expressed its reluctance to see its balance-sheet grow further relative to the country's GDP, and removed a cap on the franc).

What is common among these different factors, however, is that they seem unlikely to fade away quickly. Barring an unlikely return to the commodity "super-cycle", it is unlikely that commodity exporters will suddenly experience a sharp improvement in their current account, or a surge in FDI inflows into their resource sector. It is interesting to note, for instance, that the IMF expects current account deficits to persist in Saudi Arabia, and the whole MENA region, in 2016-17 (see Figure 3).[3] Among other EM countries, the combination of prospective gradual tightening in the US and the lack of a strong rebound in EM growth may preclude the repeat of the large-scale portfolio flows into EM that were the norm in recent years. Already, in 2015, the Institute of International Finance projected that net capital flows to emerging markets would be negative for the first time since 2008 (see Figure 4).[4] Finally, policy considerations – such as economic rebalancing in China or concerns related to the cost of elevated reserve holdings in other countries –seem likely to persist.

Figures 3 and 4: Oil price and current account in Saudi Arabia / MENA (left) and capital flows to and from emerging markets (right)



Sources: IMF, Bloomberg and IIF

[3] The IMF's forecast is based on an average oil price assumption of U$50.36/bbl in 2016; thereafter, the oil price is assumed to be unchanged in real terms over the medium term.
[4] See "Capital Flows to Emerging Markets", Institute of International Finance, October 1, 2015

Is there a risk of rapid reserve "de-cumulation"?

While the odds of renewed, high reserve accumulation are low, are we at risk of the opposite happening – i.e. a sharp drawdown in global official reserves? As discussed above, China probably intervened heavily in July/August, and again in December. Yet authorities also have made it clear they did not seek significant FX depreciation, at least not on a trade-weighted basis. This should reduce an incentive for private capital outflows. Furthermore, China's capital account is only being liberalized gradually, and recent developments suggest that in the event of sizable capital outflows, the authorities would not hesitate to delay, or even temporarily reverse, liberalization. Equally, authorities may step up the liberalization of capital *inflows* as an alternative to selling reserves.

Other emerging countries may at times resort to FX sales to limit the scale of currency depreciation, or even deal with shortages of foreign exchange in local capital markets.[5] But it is hard to see a broad-based shift towards aggressive FX intervention in the EM world, especially at a time when international institutions (the IMF, the G-20) highlight the benefits of currency adjustment as a shock absorber. Furthermore, not all EM economies have reserves in excess of generally-accepted metrics, and in 2015, some central banks have either been increasing reserves (India), or rebuilding them (Russia). Other countries, in particular MENA oil exporters, have low levels of external debt and may resort to increased FX-denominated bond issuance to fund external shortfalls.[6] As for the more advanced economies which are large reserve holders (Japan, Korea, Switzerland, Hong Kong, Singapore), their current account remain in surplus, reducing the risk they may be forced to sell reserves aggressively in the near future. Overall, rather than large-scale "de-cumulation", a slower, even at times minimal, pace of global reserves accumulation may be the more likely scenario in coming years.

Accumulation coincided with large global current account imbalances

If one compares the degree of global reserve accumulation to a measure of current account dispersion among the world's economies, the correlation seems clear: At the peak of accumulation, many countries' surpluses or deficits were unusually large (see Figure 5). There is, admittedly, a question of causality: Were reserve flows large because some countries experienced unusually large surpluses; or did FX intervention – by preventing the upward adjustment of exchange rates – perpetuate surpluses at unusually high levels? At first, the buildup of large current account surpluses in selective economies had other causes than reserve management policy: These included the commodity super-cycle (oil exporters, Russia, Chile); persistently high levels of ex ante precautionary savings (emerging Asia); or the impact of global trade liberalization, which benefited low labour-cost countries (China, Vietnam).

However, faced with these rising current account surpluses, many countries then opted for aggressive reserve accumulation *rather than* allowing sizable currency appreciation. The rationale differed across countries, ranging from commitment to pegged exchange rates (GCC countries), to export-oriented growth strategies (China and other countries in emerging Asia), to concerns about deflation risks (Japan, Switzerland, Israel). Nonetheless, the common theme was a reluctance to allow the balance of payments to adjust via FX appreciation, suggesting that global current account imbalances lasted longer than would have been the case without reserve accumulation. If that was indeed the case, one would now expect to see global exchange rates being more responsive to

[5] This can happen, for example, if a current account-deficit country faces portfolio outflows and is unable – for reasons of loss of creditworthiness or strains in its banking sector – to borrow dollars offshore in order to fund net importers and repay exiting investors.

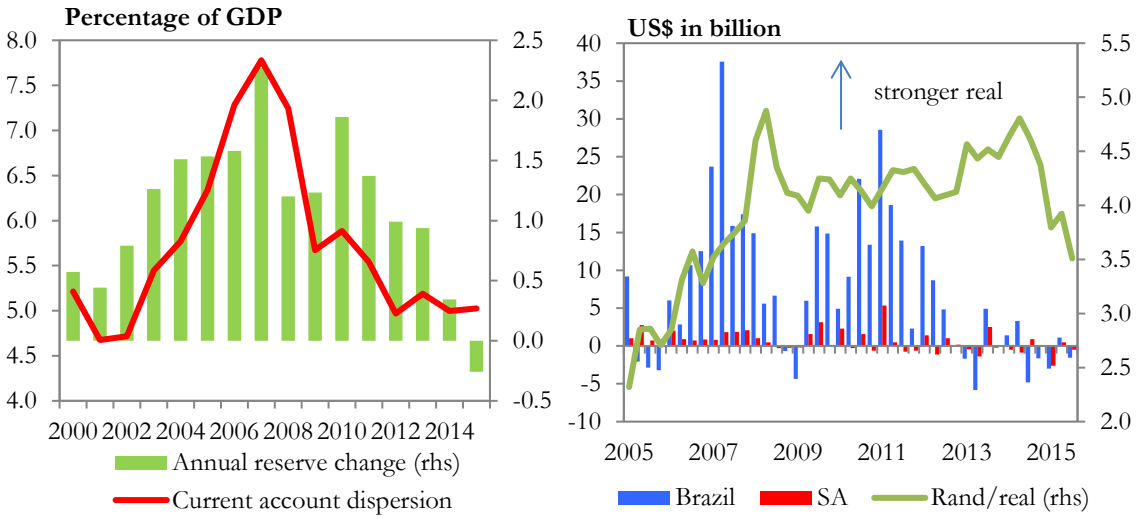
[6] See "Saudi Arabia to tap global bond markets as oil fall hits finances", Financial Times, 10 November 2015

current account imbalances, and for these imbalances to be more transient, than in the past decade or so.

What was the role of private capital flows?

Admittedly, the above analysis does not take private capital flows into consideration. If reserve accumulation is merely a perfect substitute for private flows, its impact on macroeconomic variables should be neutral. Under that view, absent intervention by a surplus-country central bank, there would be private capital outflows of a similar amount. It is difficult to fully discard this hypothesis: After all, private cross-border flows reached unusually high levels in the mid- to late 2000s, well in excess of official reserve flows. There were also instances when heavy intervention seemed to have little impact on the exchange rate: For example, between 2010 and 2012, Brazilian intervention exceeded that of the SA Reserve Bank, even after adjusting for the relative economic size of the two countries, yet the real outperformed the rand (see Figure 6). It seemed that even as the Central Bank of Brazil (BCB) bought dollars to limit appreciation, more capital flowed in, in anticipation of eventual appreciation.

Figures 5 and 6: Dispersion of current account balances vs. global reserve accumulation (left) and quarterly changes in FX reserves in Brazil and South Africa vs. rand/real exchange rate (right)



Note: Our measure of global current account dispersion is the standard deviation of current account balances in all countries with a nominal GDP in excess of US$50 billion at least once over the past three years, excluding oil exporters (to remove "outliers").

However, we do not think this was always the case. Some emerging countries have a fairly limited private fund management industry or banking system; others have capital or prudential controls in place that limit the ability of the private sector to boost overseas assets. Even in industrial countries like Japan does one find indications of "home bias" among private investors. In such cases, the private sector is either unable or unwilling to fully substitute itself to official reserve managers. Furthermore, even if the private sector recycles current account surpluses overseas, it may only do so once the currency has appreciated enough to make offshore investments attractive – unlike official reserve managers, who are much less driven by profit and valuation considerations.

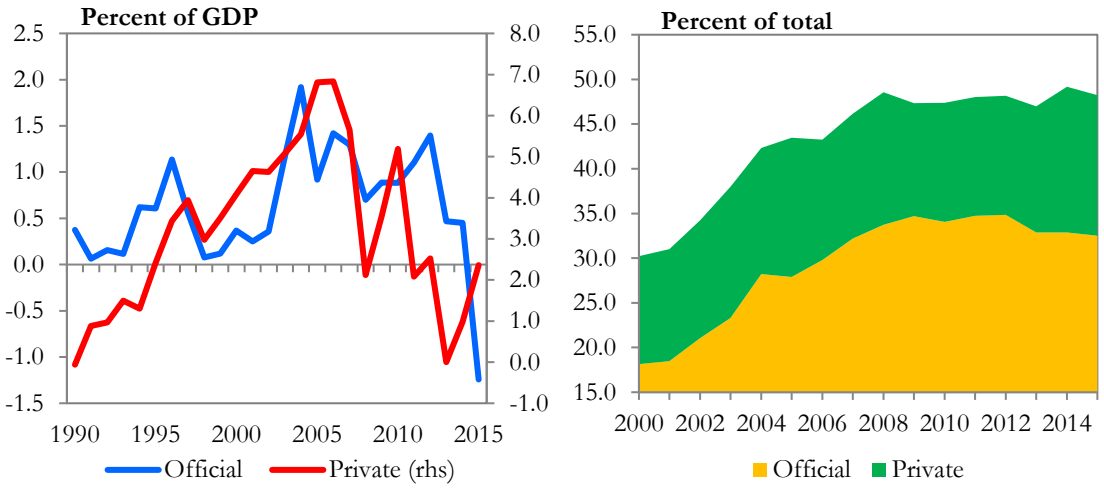
Finally, when looking at the situation of the *recipients* of reserve flows, there is no evidence that official purchasers of their financial assets displaced non-resident private purchasers. Rather, in the case of the United States – historically the biggest recipient of reserve inflows – the analysis of TIC

data since 1990 shows a positive correlation of 47 per cent between official and private foreign purchases of US securities (see Figure 7). Data from the Bank of England show a similar pattern in non-resident flows into UK government bonds. Overall, therefore, it would seem that in both cases, official reserve accumulation "crowded in" private non-resident flows into these markets, making it even easier to sustain relatively large current account deficits.

Potential implications for long-term interest rates and currencies

The end of official reserve accumulation may also impact the relative price of financial assets in the developed world – in particular, since official FX purchases were mostly invested in government bonds, one would expect, *ceteris paribus*, to see the latter under-perform other assets in the future. In light of the elevated share of US dollar reserves, the US Treasury market may be the most exposed. From 2000 to 2014, net annual foreign official purchases of US Treasuries contributed to a rise in foreign holdings of US Treasuries to 49,2 per cent of the outstanding stock by 2014, from 18,1 per cent in 2000 (Figure 8).

Figures 7 and 8: Net non-resident purchases of US securities (left) and foreign holdings of US Treasuries as a percentage of outstanding debt stock (right)



The negative effect could be compounded if the past correlation between official and private non-resident purchases continues to hold, and reduced official purchases (or sales) entice private offshore investors to also reduce their exposure to the US Treasury market. Even if this is not the case, and private non-resident investors "make up" for the lack of official purchases, they are more likely to buy other, higher-yielding assets than Treasuries.[7] A 2012 Fed discussion paper estimated that a decline of US$100 billion in official inflows into US Treasuries (in a given month) could push five-year US yields up by 40-60 basis points in the short run, and by 20 basis points once the response of private foreign investors to higher yields is factored in.[8] Furthermore, other studies have shown that in the Eurozone too, the rise in non-resident purchases of government bonds in 2000-06 exerted meaningful downward pressure on yields.[9]

[7] TIC data show that between 2005 and 2014, US Treasuries made up 66 per cent of official non-resident purchases of US securities, but only 46 per cent of private non-resident purchases.
[8] See "Foreign holdings of US Treasuries and US Treasury yields", by D. Beltran, M. Kretchmer, J. Marquez and C. Thomas, Federal Reserve International Finance Discussion Papers No. 1041, January 2012
[9] See "Capital inflows and euro-area long-term interest rates", by D. Carvalho and M. Fidora, ECB Working Paper No. 1798, June 2015

In fact, some commentators have described the prospect of further EM central bank sales of government bonds as akin to some form of "quantitative tightening" that could reverse some of the benefits of earlier Fed purchases of US Treasuries, and more than offset the impact of continued government bond purchases by the ECB and the BoJ.[10] It may be too early to draw such a conclusion: EM FX intervention will not follow a straight pattern, and therefore, it may not have the "signaling" effect that pre-committed purchases (as in QE) had on bond yields. Nonetheless, at a time of likely Fed policy normalization, the end of reserve accumulation adds an upside risk to core government bond yields.

Whether it will have an impact on major currencies is debatable. To the extent that most reserve accumulation resulted in purchases of US bonds, and that these purchases "pulled in" private non-resident inflows as well, the end of accumulation should on balance be US dollar-negative. However, the period of strongest official inflows into US securities did not coincide with a particular strong dollar; and the mid-2014 to early 2015 dollar appreciation occurred despite the lack of strong central bank dollar accumulation. At best, the end of accumulation may be a factor limiting further US dollar appreciation in coming years versus other major currencies, in spite of growth and interest rate differentials that favour the dollar, on balance, versus the euro and the yen.

Reserve accumulation, credit and inflation

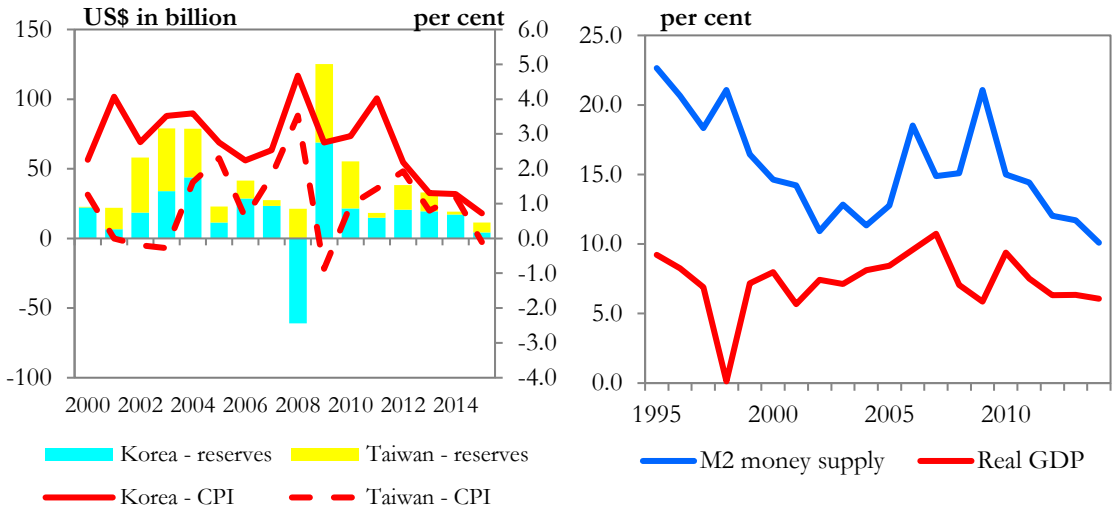
Another uncertainty is the implications that the end of reserve accumulation would have for domestic variables like inflation, money and credit, especially in emerging countries. To the extent that the buildup of reserves (in countries with current account surpluses) prevented FX appreciation, it removed a potential disinflationary force and may have, on balance, kept inflation artificially high. While other factors no doubt were at work, it is nonetheless interesting to note that in countries like Korea and Taiwan, reduced reserve accumulation (in 2014-15) coincided with stronger nominal exchange rate appreciation than in earlier years and a downtrend in consumer price inflation (see Figure 9).

At the same time, reserve accumulation, if not fully sterilized via central bank monetary operations, will inflate the monetary base and – unless the money multiplier collapses – also boost broader money and credit aggregates. Some commentators have argued that, in Asia in particular, sizable reserve accumulation was not fully sterilized, and have pointed to correlations between reserves growth and monetary aggregates, as well as, more generally, the availability of external financing and domestic credit growth.[11] Recent history does indeed suggest that money growth was high, even taking account strong growth in the real economy, in Asia in the years of accumulation (see Figure 10). Thus, to the extent that a flat trend in global reserves equally dampens credit creation, it would reduce the risk of growing inflation risks and/or domestic asset price bubbles and financial instability in the "accumulator" countries.

[10] See "The great accumulation is over: FX reserves have peaked, beware QT", Deutsche Bank Markets Research, 1 September 2015, and "Will emerging economies cause global quantitative tightening?", Gavyn Davies' Blog, Financial Times, 14 September 2015

[11] See "The rise and fall of Asia FX reserves", Bank of America-Merrill Lynch, Rates and FX Research, 03 August 2015; and "China: beyond peak reserves", Emerging Market Macro and Strategy Outlook, Citi, 21 August 2015

Figures 9 and 10: Reserve accumulation and inflation in selected countries (left) and money supply and real GDP growth in East Asian countries (right)



Note: The columns on the left-hand chart indicate reserve accumulation, the lines inflation rates. Data on the right-hand chart are GDP-weightded averages for China, Hong Kong, Malaysia, Philippones, Singapore, Indonesia, Korea and Thailand.

Implications for South Africa would be indirect

The end of global reserve accumulation, if confirmed, would probably not have direct implications for the South African economy and markets. Because of its large current account deficit, South Africa was never able to accumulate reserves at the pace, say, of some of the larger emerging Asian economies, or of oil exporters. Equally, as the rand is not classified as a "reserve" currency, it is unlikely that domestic securities benefited in any significant way from reserve-related inflows. Nonetheless, the end of accumulation could have important indirect effects for South Africa, among which:

- A situation where global external imbalances are, on average, less pronounced than in the past, could make it difficult for SA to sustain the kind of large current account deficits it had around 2013-14. A deficit of 5,0-6,0 per cent of GDP would "stand out" even more against peers, potentially undermining South Africa's creditworthiness. At the same time, reduced global cross-border capital flows could mean that SA financial assets are priced more on the back of domestic fundamentals than global risk appetite;
- Any move that pushes equilibrium US bond yields higher might be transmitted to the local bond market, in light of the historically strong correlation between US and SA longer-term yields. This could steepen (ceteris paribus) the domestic yield curve and increase refinancing and debt servicing costs for National Treasury and large state-owned enterprises. It may also negatively affect private fixed capital formation, to the extent that long-term yields are used to benchmark the viability of investment projects;
- On a more positive note, though, reduced global reserve accumulation may ease the pressure on SA to "keep pace with peers" and build a stronger reserve buffer (which carries costs for the fiscus). While South Africa's reserves are relatively low by most agreed metrics, a situation where peers continued to accumulate reserves would have meant an ongoing *relative* deterioration of SA's FX reserve position, with potential negative implications for creditworthiness.

Conclusion

While the outlook for global reserve accumulation remains contingent on many factors (the outlook for commodity prices, relative growth in emerging versus advanced economies, the pace of policy normalization in the US), it nonetheless appears likely that the fast buildup of reserves seen over the past decade or so is unlikely to be repeated near term. On balance, this may have positive implications for global financial stability, as large current account imbalances might not persist as long as in the past and currency movements could play a greater, quicker role in their resolution. More stable global reserves levels could also result in more accurate pricing of financial risk (especially for government bonds relative to other assets) and reduce the risk that incomplete sterilization of intervention feeds into excessive credit creation.

However, to the extent that cross-border capital flows also decline, it could make it more difficult for countries with large current account deficits and relatively fragile fundamentals to indirectly benefit from large global capital flows. South Africa risks falling into that category, as the changing patterns in global capital flows occurs at a time when domestic growth has slowed, public debt has risen as a share of GDP and the current account deficit remains relatively high. Pricing of the rand and SA financial assets may therefore become increasingly dependent on how global investors perceive these fundamentals, highlighting the importance of domestic policies that support growth and price/financial stability.

Sacrifice Ratio Based on the Time-Varying Phillips Curve for South Africa – October 2016

Alain Kabundi

Abstract

This analysis estimates the sacrifice ratio for the South African economy using quarterly data of annual inflation rate and unemployment rate from 1994Q4 to 2014Q4. The sacrifice ratio is derived from a time-varying Phillips curve. The results show that the estimated time-varying sacrifice ratio depends on the slope of the Phillips curve and the inflation persistence. The flatter the Phillips curve, higher is the sacrifice ratio. In addition, higher the persistence of inflation, lower is the sacrifice ratio. The decline in the sacrifice ratio observed in 2000s is caused by the two factors, whereas the recent increase is mainly due to the decline in inflation persistence.

1 Introduction

The consensus in the literature is that there is a trade-off between inflation and the real activity (or output gap) over the short-term, but the relationship is less evident in the long run. The Phillips curve is an important channel through which monetary policy affects inflation. Monetary policy affects inflation mainly through its impact on the output gap, inflation expectations, and the exchange rate. To reduce inflation permanently policymakers should try to minimise output loss, also known as sacrifice ratio. This note estimates the sacrifice ratio for South Africa using a time-varying Phillips curve.

2 The Model

Assume the Phillips curve, using the unemployment rate, is of the form

$$\pi_t = \pi_t^e - \alpha_t(u_t - u_t^n) + \varepsilon_t \tag{1}$$

where π_t is the inflation rate between time $t-1$ and t, π_t^e is expected inflation, u_t is the time t unemployment rate, α_t is the slope of the Phillips curve, and ε_t is a residual capturing other factors such as supply (cost-push) shocks. Here is the natural rate of unemployment that prevails when inflation is equal to expected inflation ($\pi_t = \pi_t^e$) and when shocks are absent ($\varepsilon_t = 0$).

Assume the inflation expectation is a weighted average of past inflation and the inflation target, given by

$$\pi_t^e = \rho_t \pi_{t-1} + (1-\rho_t)\pi_t^* \tag{2}$$

The derivations in the appendix yield the sacrifice ratio

$$SR = \frac{1}{\alpha_t \sum_{i=1}^{\infty} \rho_t^i} \tag{3}$$

From (3) it follows that the SR associated with a percentage point increase in inflation for k periods is

$$SR = \frac{1}{\alpha_t \sum_{i=1}^{k} \rho_t^i} \tag{4}$$

It is clear from (4) that the *SR* depends on the slope of the Phillips curve (α), which captures the degree of the response of inflation to excess demand factors and the extent of the short run trade-off faced by policymakers, and the inflation persistence (ρ), which measures the degree to which current inflation depends on past inflation. The *SR* increases when the Phillips curve is flat, i.e. when α is low. Similarly, the *SR* tends to increase with less inflation persistence (or low ρ). A flat Phillips curve requires a larger output gap for a permanent reduction in inflation of one percentage point. However, with a steep Phillips curve, small changes in the output gap are required to achieve a larger reduction in inflation. In this instance the cost of disinflating is low.

It is essential to highlight that there are positive and negative policy implications associated with the *SR* and the inflation persistence. They depend largely, on the one hand, on the relationship between the inflation persistence and monetary policy, and the other hand, on the relationship between the inflation persistence and negative supply shocks.

First, consider the relationship between inflation persistence and monetary policy. When inflation responds weakly to policy, lowering inflation is costly, and the *SR* is large. In this instance monetary policy has temporary effects on inflation. It therefore requires more episodes of interest rate increases to bring inflation permanently down because the impact of monetary policy shock on inflation is short-lived. But if inflation responds fully and over time to initial interest rate increase, then fewer policy changes are needed to bring inflation down.

Second, the opposite is true when we consider the relationship between the inflation persistence and negative supply shocks. In this case a less responsive inflation, i.e. inflation anchored to the official target, is positive for the economy in that policymakers do not need to react when the economy is affected by negative supply shocks since these shocks are temporary. They can just wait until the effects of shock dissipate and then inflation reverts back to the level before the shock. But with high inflation persistence, negative supply shocks have long-lasting effects on inflation. It means that policymakers are compelled to react to prevent inflation from rising more rapidly, and they may lose credibility if they don't.

3 Sacrifice Ratio for South Africa

Figure 1 depicts the sacrifice ratio for South Africa estimated with equation (4). The *SR* is estimated using $k = 4$, in other words we increase inflation permanently by 13 for a year. It is evident from Figure 1 that the sacrifice ratio in South Africa has been changing over time. It declines steadily from the highest value of 3.1 in 1995Q4 to around 1 in 2003, and stays relatively constant until the recent Global Financial Crisis (GFC). It then increases and stabilises since 2011 at roughly 1.5. The results indicate high costs of disinflating in the 1990s compared with the 2000s. Since the GFC the output gap needs to widen by 1.53 for a permanent fall in inflation by 13. The question arises as to which of the two factors, namely, the slope of the Phillips curve and the inflation persistence, explains movements in the *SR*.

It is evident from Figure 2 that both factors contribute to changes in the *SR*. Higher values of the *SR* recorded in the beginning of the sample can mainly be due to a flatter Phillips curve. And both factors contribute to persistent decline in the *SR* and lower values attained prior to the crisis. However, from 2008 onward, the slope portrays a mild decline whereas the fall in inflation persistence is somewhat

noticeable. It suggests that the rise in the *SR* in the post-crisis period is caused by the decline in the inflation persistence.

To assess the robustness of these results, we estimate the Phillips curve using the output gap instead of the unemployment gap. We divide the sample size into two periods, namely, the pre-crisis period from 2000Q1 to 2008Q1, and the post-crisis sample covering the period ranging from 2008Q1 to 2014Q1. The results of the estimation are depicted in Table 1. They are in line with the estimation using the unemployment gap. Overall, the inflation persistence is high, even though it has declined lately. And the Phillips curve is flat with a mild increase in the latter period. The sacrifice ratio is 1.18 for the pre-crisis period and 1.15 after the crisis. According to this specification the sacrifice ratio is low and remains unchanged. These numbers are extremely low when compared with the most recent *SR* for the OECD, which varies between 3.33 and 5.43.[1] The rising *SR* in most of OECD countries is owing to both the flattening of the Phillips curve and the stabilisation of inflation. These outcomes sway Gillitszer and Simon to title their recent work "Inflation Targeting: A Victim of its own success?"[2]

4 Conclusion

This note estimates the sacrifice ratio for South Africa from 1994Q4 to 2014Q4 with a time-varying Phillips curve. The results show that the sacrifice ratio has changed considerably from 3.1 in the 1990s to between 1 and 1.5 most recently. The movement in the sacrifice ratio depends on the slope of the Phillips curve and the inflation persistence. The slope of the Phillips curve largely explains the movement in the sacrifice ratio at the beginning of the sample. The decline in the sacrifice ratio observed in the 2000s is caused by both factors. Finally, the inflation persistence is the main driving force behind the recent increase in the sacrifice ratio since the financial crisis.

[1] See Blanchard, O., Cerutti, E. and Summers, L. (2015), "Inflation and Activity - Two Explorations and their Monetary Policy Implications", IMF Working Paper 15/230
Blanchard, O. (2016), "The Phillips Curve: Back to the '60s?" American Economic ReviewReview: Papers fl3 Proceedings, 106(5): 31-34.

[2] Gillitzer, . and Simon, J. (2015), "Inflation Targeting: A Victim of Its Own Success", International Journal of Central Banking, 11(1): 259-287.

Figure 1: Sacrifice Ratio from a Time-Varying Phillips Curve

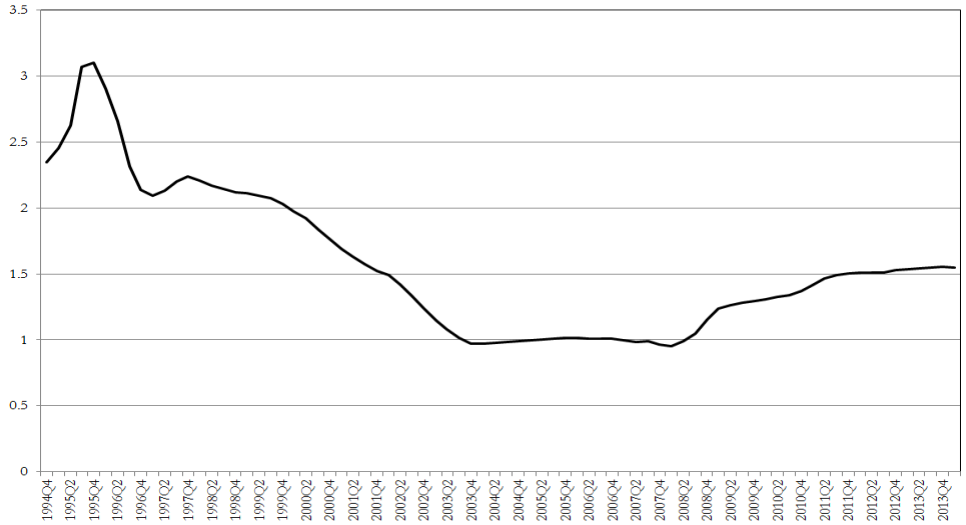


Figure 2: Slope of the Phillips Curve and Inflation Persistence

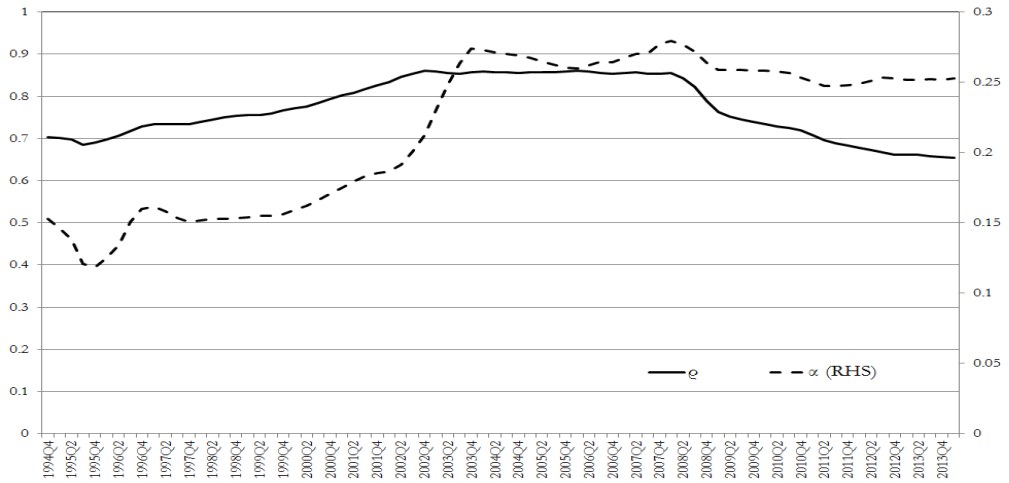


Table 1: Phillips Curve using the output gap

	2000Q1 to 2008Q1	2008Q1 to 2014Q1
ρ	0.88	0.75
α	0.24	0.29

Appendix

Combining equations (1) and (2) yields

$$\pi_t = \rho_t \pi_{t-1} + (1-\rho_t)\pi_t^* - \alpha_t(u_t - u_t^n) + \varepsilon_t \tag{A.1}$$

or

$$\pi_t = \rho_t L\pi_t + (1-\rho_t)\pi_t^* - \alpha_t(u_t - u_t^n) + \varepsilon_t$$

where L is the lag operator, such that $L\pi_t = \pi_{t-1}$.

We can derive the sacrifice ratio from (A.1) as follows

$$\begin{aligned} \pi_t(1-\rho_t L) &= (1-\rho_t)\pi_t^* - \alpha_t(u_t - u_t^n) + \varepsilon_t \\ \pi_t &= (1-\rho_t L)^{-1}\left[(1-\rho_t)\pi_t^* - \alpha_t(u_t - u_t^n)\right] \\ \pi_t &= (1-\rho_t L)^{-1}(1-\rho_t)\pi_t^* - \alpha_t(1-\rho_t L)^{-1}(u_t - u_t^n) \end{aligned} \tag{A.2}$$

We can represent $(1-\rho_t L)^{-1}$ using the Taylor series as follows

$$\frac{1}{1-\rho_t L} = \sum_{i=0}^{\infty} \rho_t^i L^i \tag{A.3}$$

Hence, equation (A.2) becomes

$$\pi_t = \sum_{i=0}^{\infty} \rho_t^i L^i (1-\rho_t)\pi_t^* - \alpha_t \sum_{i=0}^{\infty} \rho_t^i L^i (u_t - u_t^n) \tag{A.4}$$

or

$$\pi_t = \sum_{i=0}^{\infty} \rho_t^{i\,i} (1-\rho_t)\pi_{t-i}^* - \alpha_t \sum_{i=0}^{\infty} \rho_t^i (u_{t-i} - u_{t-i}^n)$$

From (A.4) we obtain the sacrifice ratio

$$SR = \frac{1}{\alpha_t \sum_{i=1}^{\infty} \rho_t^i} \tag{A.5}$$

To zero and beyond? Estimating South Africa's structural trade balance – January 2017

Theo Janse van Rensburg and Erik Visser

Abstract

The South African trade balance has improved significantly over the last three years from a 2.1 per cent of GDP deficit in 2013 to an estimated 0 per cent in 2016. According to the model developed in this note, roughly three-quarters of this improvement is cyclical and one quarter structural. If the export and import drivers were at their equilibrium (or structural) levels in 2016, the trade balance would have been -1,3 per cent of GDP – instead of the estimated 0 per cent. The trade balance could therefore deteriorate again should export and import values return to their trend values.

Introduction[1]

South Africa's trade balance has improved substantially over the past three years, from -2,1 per cent of GDP in 2013 to an estimated 0 per cent of GDP in 2016[2]. Should this trend continue, South Africa might be on the way to realising the kinds of trade balances obtained in the early 2000s, around 3½ per cent of GDP, which then closed the current account deficit entirely.

However, the improvements in the trade balance appear to have been largely of a cyclical nature. As these trade account drivers such as global and domestic demand, commodity prices, REER, etc. return to their trend values, our modelling suggests that the trade balance will deteriorate.

More precisely, the estimated model suggests that when the export and import drivers are at their trend (or equilibrium/structural) levels, the structural trade balance would have been -1,3 per cent of GDP in 2016, compared to an actual outcome of 0 per cent (Table 1). Put differently, the actual 2016 trade balance (0 per cent) was above the structural level (-1,3 per cent) due to favourable cyclical factors, as cyclical imports in nominal terms (largely due to cyclically weak oil prices) were more depressed than cyclical exports.

1 The authors are indebted to David Fowkes and Theresa Alton for useful comments and editing suggestions.

2 2016 refers to the average for the first three quarters of the year, unless otherwise indicated.

Table 1: Trade balance (as % of GDP)

Year	Actual	Structural	Cyclical
	A = (S+C)	S	C
2007	-0.9	2.2	-3.0
2008	-0.6	1.4	-2.1
2009	1.1	0.6	0.6
2010	2.2	-0.4	2.6
2011	1.6	-1.1	2.8
2012	-1.1	-1.6	0.4
2013	-2.1	-1.6	-0.4
2014	-1.7	-1.5	-0.2
2015	-0.9	-1.3	0.5
2016	-0.0	-1.3	1.2

Note: Totals may not add up due to rounding

Methodology

In order to distinguish the structural and cyclical components of the trade balance, we employ a three-step methodology.

First, we estimate equations for merchandise export volumes and prices and do the same for merchandise import volumes and prices over the 1996–2016 period. The equations are depicted in Appendix A. From the equations we identify the following drivers:

- Merchandise exports volumes = f(REER, world import volumes, availability of electricity[3])
- Merchandise exports prices = f(Commodity prices, world PPI, Rand/US$, NEER[4])
- Merchandise imports volumes = f(Real GDP, REER, output gap, trend variable)
- Merchandise imports prices = f(Oil price, world PPI, Rand/US$, NEER)

In the *second* step, we identify equilibrium (or structural) values for each of the drivers (such as commodity prices and the output gap). These are obtained by fitting an HP filter through the data[5] – an approach similar to how Macro Models define potential GDP[6] (or structural GDP). Although this method is not unproblematic, it provides for a consistent assessment of all the structural drivers. Another benefit is that an HP filter (mostly) ensures that the average cyclical component over the long run is zero[7]. Although it is easy to criticize this approach, it would be difficult to suggest an alternative method/specification that can be consistently applied across all the structural drivers, still resulting in a cyclical component that has a zero mean over the cycle.

In the *third* step, these values are used to calculate overall structural values for merchandise import and export volumes and prices. For each variable the cyclical component is calculated as the

3 Electricity availability is defined as electricity output divided by GDP (at basic prices) and suggests that when electricity output rises at a faster pace than total GDP, exports would increase and *vice versa*.

4 Commodity and oil prices are converted to rand using the Rand/US$ exchange rate, whilst the world PPI is converted to rand using the NEER.

5 End point problem of HP filter (partly) overcome by extending the out-of-sample series with growth rates recorded over the 2010 to 2015 period.

6 Our HP methodology suggests an output gap of +0,3 per cent and -0,7 per cent for 2015 and 2016 respectively.

difference between actual and structural values. For example, import prices might be said to be cyclically low if oil prices, world PPI and the NEER are below their HP-filter trend.

After completing the three steps it is possible to calculate both the cyclical and structural trade balance, reflecting the difference between the respective nominal merchandise export and import values. Likewise, it is possible to derive the cyclical and structural merchandise terms of trade.

Structural trade balance and terms of trade

The merchandise trade balance improved from -2,1 per cent in 2013 to an estimated 0 per cent in 2016 (Figure B1). Our model shows that a large part of this improvement was cyclical (Figure B2). The structural trade balance improved by 0,4 per cent of GDP, helped in particular by structurally better terms of trade (Figures T1 and T2). Yet this structural balance nonetheless remained negative at -1,3 per cent of GDP. The remainder of the trade account adjustment, to an actual trade balance of 0 per cent, reflected cyclical factors.

Figure B1: Trade balance

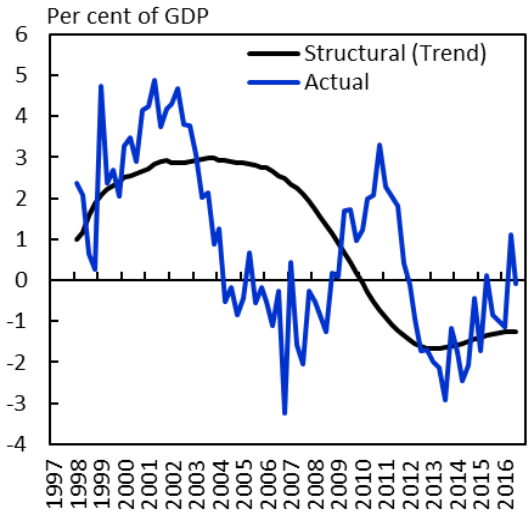


Figure B2: Trade balance

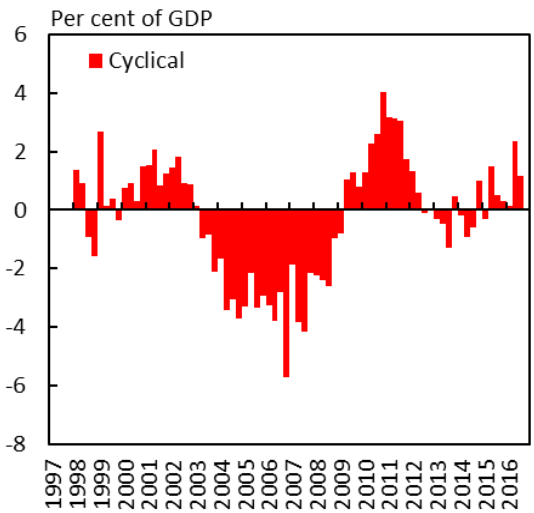


Figure T1: Merchandise terms of trade

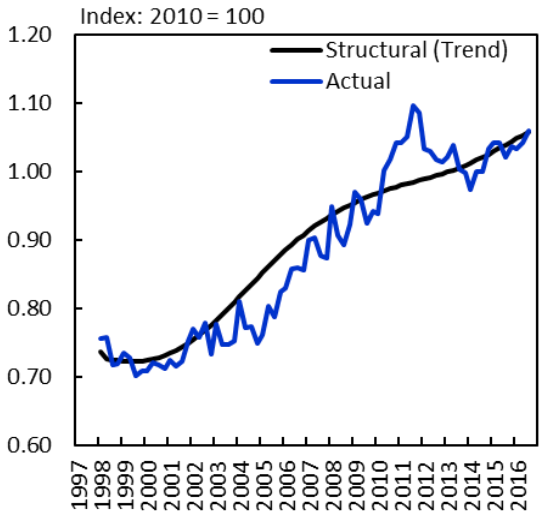
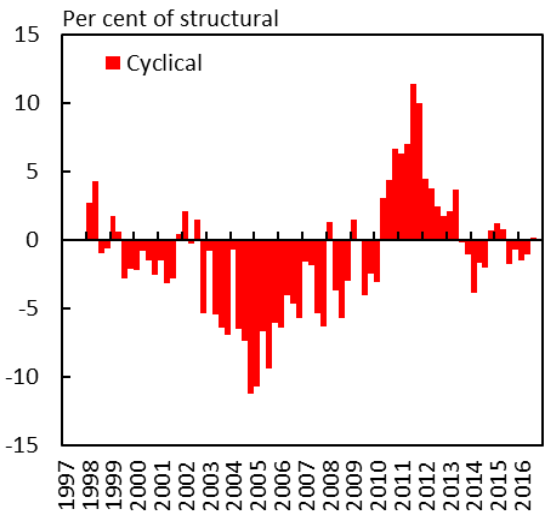


Figure T2: Merchanise terms of trade



In the following two sections we analyse the structural drivers of the trade balance in more detail, by examining the drivers of nominal merchandise exports and imports.

Structural nominal merchandise exports

As indicated earlier, structural nominal merchandise exports are derived from export volumes and prices. In 2016 export volumes were above structural levels, mainly because of a below equilibrium REER. However, export prices were significantly below equilibrium, largely due to US$ commodity prices being cyclically weak. As a result, the overall impact on nominal merchandise exports in 2016 was only marginally negative (Figures E1 and E2).

Figure E1: Nominal merchandise exports

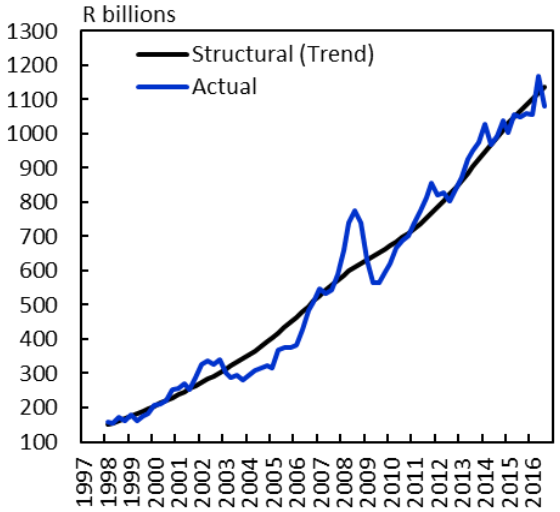
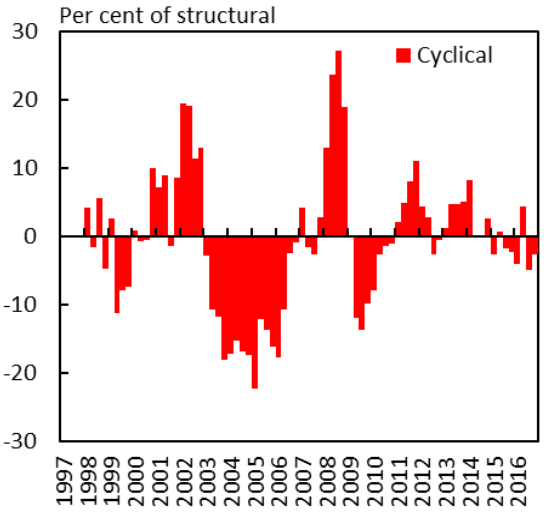


Figure E2: Nominal merchandise exports



Next, we examine the drivers of structural merchandise export volumes and prices in more detail.

Structural merchandise export volumes

The estimated equation for merchandise export volumes (Appendix A, equation 1) suggests that the structural level is a function of the REER, world import volumes and the availability of electricity. Merchandise export volumes were almost 3 per cent above equilibrium levels in 2016 (Appendix E, Figures E(i) and E(ii)), mainly due to a below equilibrium REER (Appendix E, Figures E(iii) and E(iv)).[8] This was partly offset by world import volumes and the electricity availability indicator being slightly below equilibrium levels (Appendix E, Figures E(v) to E(viii)).

Figures E(v) and (vi) indicate that global import volumes (a proxy for South Africa's export demand) appear to have slowed from pre-crisis growth rates to a slower trend rate. But the post-2010 growth rate is probably reflective of the "new normal" trend – as captured by the HP filter. Consequently, based on this "new normal" HP derived trend, global import volumes were only marginally below equilibrium (i.e. HP filter trend) during 2016.

The other interesting driver of merchandise export volumes was the availability of electricity (Figures E(vii) and E(viii)). We were surprised how significant this variable was. This inspires confidence for higher structural export levels going forward because as additional electricity generation plants are put into use, export volumes should rise significantly. However, thus far, electricity output remains subdued.

[8] In the case of the REER, the HP filter has a slightly negative mean over the cycle, whereas for all other variables the mean is zero. This may indicate that the (HP determined) equilibrium value of the REER is slightly overestimated and that the structural value of the rand might be weaker. If that was indeed the case, the cyclical real export component could be even larger.

Structural merchandise export prices

Merchandise export prices were estimated as a function of commodity prices and the global PPI (both indices converted to rand) (see Appendix A, equation 2). The cyclically weak export prices during 2016 (Appendix EP, Figures EP(i) and EP(ii)) were principally a result of commodity prices being below equilibrium, but also to some extent due to the global PPI currently being cyclically suppressed (Appendix EP, Figures EP(iii) to EP(vi)). This was partly offset by the weak rand (contributing to cyclically strong outcomes)(Appendix EP, Figures EP(vii) and EP(viii)).

Structural merchandise imports

As with merchandise exports, imports are derived from volumes and prices. Both factors contributed to below-trend imports in 2016. Import prices were significantly below equilibrium, largely due to US$ oil prices being cyclically weak. Meanwhile, import volumes were slightly below structural levels, mainly because of the cyclically weak REER and the negative output gap. (Figures M1 and M2).

Figure M1: Nominal merchandise imports

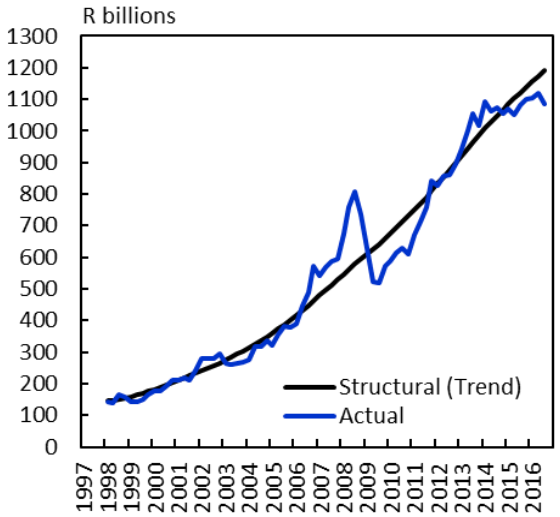
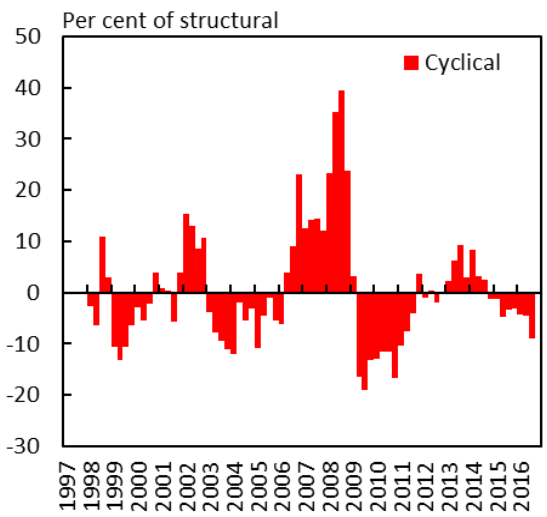


Figure M2: Nominal merchandise imports



We now investigate the drivers of structural merchandise import volumes and prices in more detail.

Structural merchandise import volumes

The estimated equation for merchandise import volumes (Appendix A, equation 3) suggests that the structural level is a function of real GDP[9], the REER, the output gap, and a trend variable.

Merchandise import volumes were slightly (-2,6 per cent) below equilibrium levels in 2016 (Appendix M, Figures M(i) and (ii)). This was largely driven by a below equilibrium REER as well as the negative output gap (Appendix M, Figures M(iii) to (vi)).

Note that our structural and cyclical outcomes for 2016 are based on a potential growth rate of 1,2 per cent and therefore an output gap of -0,7 per cent. Should potential growth be higher and the output gap be more negative, the cyclical import component will be even more negative – resulting in an even larger positive cyclical trade balance than the calculated 1,2 per cent in 2016. The opposite would be true if potential growth is lower, resulting in a smaller cyclical trade balance component.

[9] This is a proxy for domestic demand. We opted for GDP instead of GDE as the former also includes (intermediate) exports.

Structural merchandise import prices

Merchandise import prices were estimated as a function of oil prices and the global PPI (both indices originally in US$ but converted to rand) (See Appendix A, equation 4). The cyclical weakness of import prices during 2016 (Appendix MP, Figures MP(i) and MP(ii)) was principally a result of oil prices being below equilibrium, but also to some extent due to the global PPI currently being cyclically subdued (Appendix MP, Figures MP(iii) to (vi)). This was partly offset by the weak rand (contributing to cyclically strong outcomes)(Appendix MP, Figures MP(vii) and MP(viii)).

The big uncertainty here – and where most criticism might be due – is the structural oil price. The HP filter suggests a "structural" oil price of US$57/barrel in 2016. It would be easy to motivate lower values based on (more recent) structural changes (e.g. shale gas) in the oil market – which would be unknown to the HP filter (probably not even fully accounted for with our guidance of 2010–2016 trends for the out-of-sample period). However, others might argue that structural oil prices might be (slightly) higher. For example, at the time of writing, markets seem to suggest that OPEC could be more successful in sticking to allocated quotas going forward, which may result in structurally higher oil price levels. The advantage of our approach is that we do not take have to take a view, but rather apply our methodology consistently to all variables.

Concluding remarks

The principal takeaway from our study is that the improvement in the trade balance since 2013 has been approximately three-quarters cyclical and one-quarter structural. Had export and import drivers been at their equilibrium (or structural) levels in 2016, the trade balance would have been -1,3 per cent of GDP – instead of the estimated 0 per cent. Although both exports and imports have been below equilibrium levels, our models indicate that during a recovery to structural levels, there will be a sharper rebound in imports than exports. In other words, if our model is a reasonable reflection of reality, and when all the cyclical noise is removed, the South African trade balance will be worse than the current levels, and the deterioration will be import driven.

These findings support the SARB's forecast of a widening current account deficit in 2017. They also suggest structural changes will be necessary if the trade balance is to turn positive. Absent such changes, and given a large and persistent deficit on the services, income and transfers account, it is reasonable to describe South Africa's structural current account deficit as between 3 and 4 per cent of GDP.

Appendix A: Estimated equations

Note: Mnemonics at the end of Appendix A

Equation 1: Merchandise export volumes

Dependent Variable: DLOG(EMERCH1)
Method: Least Squares
Date: 25/01/17 Time: 13:23
Sample (adjusted): 1997Q3 2016Q3
Included observations: 77 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMERCH1(-1))	-0.818070	0.114816	-7.125027	0.0000
LOG(WLTM1(-1))	0.726482	0.100789	7.207929	0.0000
LOG(EL11(-3))	0.655820	0.125629	5.220285	0.0000
LOG(REER(-1))	-0.203101	0.056819	-3.574524	0.0006
C	-2.014718	1.097457	-1.835806	0.0706
DLOG(WLTM1)	0.393188	0.199716	1.968737	0.0529

R-squared	0.545509	Mean dependent var	0.005453
Adjusted R-squared	0.513502	S.D. dependent var	0.048889
S.E. of regression	0.034100	Akaike info criterion	-3.844347
Sum squared resid	0.082557	Schwarz criterion	-3.661713
Log likelihood	154.0074	Hannan-Quinn criter.	-3.771295
F-statistic	17.04373	Durbin-Watson stat	2.035930
Prob(F-statistic)	0.000000		

Equation 2: Merchandise export prices

Dependent Variable: DLOG(PEMERCH)
Method: Least Squares
Date: 25/01/17 Time: 13:23
Sample (adjusted): 1996Q1 2016Q3
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(PEMERCH(-1))	-0.029149	0.012807	-2.275978	0.0256
LOG(PCOMMR(-1))	0.036036	0.015930	2.262129	0.0265
C	-0.270823	0.124147	-2.181471	0.0322
DLOG(PCOMMR)	0.137307	0.040822	3.363553	0.0012
DLOG(1/NEER*WLTPPI...	0.451143	0.052236	8.636627	0.0000

R-squared	0.676636	Mean dependent var	0.021772
Adjusted R-squared	0.660053	S.D. dependent var	0.040007
S.E. of regression	0.023326	Akaike info criterion	-4.620139
Sum squared resid	0.042440	Schwarz criterion	-4.474426
Log likelihood	196.7358	Hannan-Quinn criter.	-4.561599
F-statistic	40.80347	Durbin-Watson stat	2.101439
Prob(F-statistic)	0.000000		

Equation 3: Merchandise import volumes

Dependent Variable: DLOG(MMERCH1)
Method: Least Squares
Date: 25/01/17 Time: 13:23
Sample (adjusted): 1996Q1 2016Q3
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(MMERCH1(-1))	-0.418698	0.073824	-5.671609	0.0000
LOG(Y1(-1))	0.385466	0.201750	1.910615	0.0598
LOG(REER(-2))	0.230645	0.045645	5.052970	0.0000
C	-1.766347	2.303439	-0.766830	0.4456
DLOG(Y1)	1.684850	0.707430	2.381648	0.0197
YCU/100	2.094540	0.507001	4.131233	0.0001
@TREND	0.003108	0.001385	2.244454	0.0277

R-squared	0.485669	Mean dependent var	0.011253
Adjusted R-squared	0.445064	S.D. dependent var	0.045210
S.E. of regression	0.033679	Akaike info criterion	-3.863342
Sum squared resid	0.086203	Schwarz criterion	-3.659343
Log likelihood	167.3287	Hannan-Quinn criter.	-3.781387
F-statistic	11.96081	Durbin-Watson stat	2.088550
Prob(F-statistic)	0.000000		

Equation 4: Merchandise import prices

Dependent Variable: DLOG(PMMERCH)
Method: Least Squares
Date: 25/01/17 Time: 13:23
Sample (adjusted): 1996Q1 2016Q3
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(PMMERCH(-1))	-0.165499	0.062196	-2.660943	0.0095
LOG(1/NEER*WLTPPI)	0.101700	0.041160	2.470826	0.0158
LOG(POILR(-1))	0.031381	0.013913	2.255616	0.0270
C	-0.207139	0.090880	-2.279269	0.0255
DLOG(POILR)	0.073749	0.016930	4.356224	0.0000
DLOG(POILR(-1))	0.049533	0.018352	2.699083	0.0086
DLOG(1/NEER*WLTPPI)	0.296094	0.056811	5.211887	0.0000
DLOG(1/NEER(-1)*WLTPPI(-1...	0.110908	0.044553	2.489377	0.0150

R-squared	0.751510	Mean dependent var	0.017101
Adjusted R-squared	0.728317	S.D. dependent var	0.037957
S.E. of regression	0.019784	Akaike info criterion	-4.916442
Sum squared resid	0.029356	Schwarz criterion	-4.683301
Log likelihood	212.0323	Hannan-Quinn criter.	-4.822779
F-statistic	32.40324	Durbin-Watson stat	2.251391
Prob(F-statistic)	0.000000		

Mnemonics

Variable	Description
BCATRADE	Trade balance
EL11	Availability of electricity
EMERCH	Nominal merchandise exports
EMERCH1	Real merchandise exports
MMERCH	Nominal merchandise imports
MMERCH1	Real merchandise imports
NEER	Nominal effective exchange rate
PBCATRADE	Trade balance (% of GDP)
PCOMM	Commodity prices (US$)
PCOMMR	Commodity prices (Rand)
PEMERCH	Merchandise export deflator
PMMERCH	Merchandise import deflator
POIL	Oil price (US$)
POILR	Oil price (Rand)
REER	Real effective exchange rate
REXD	Rand per US$
WLTM1	Real global imports (US$)
WLTPPI	World PPI (US$)
Y1	Real GDP
YCU	Output gap

Appendix E: Merchandise export volumes and its drivers[10]

Figure E(i): Merchandise export volumes

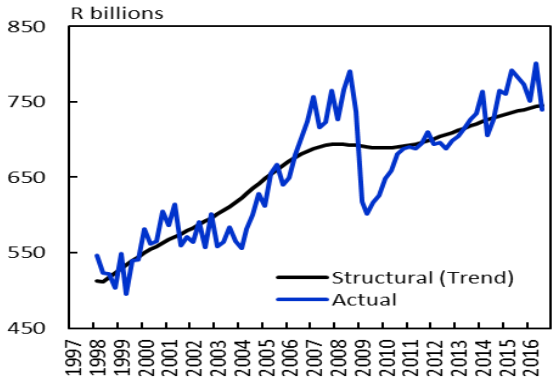


Figure E(ii): Merchandise export volumes

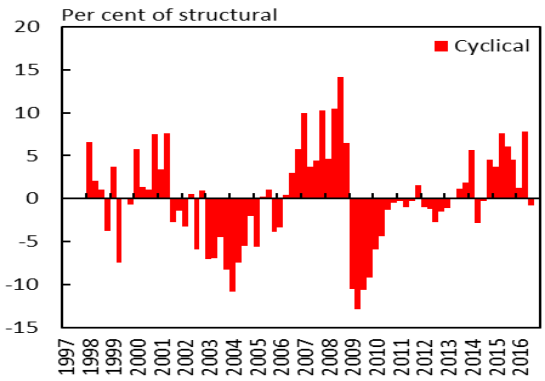


Figure E(iii): REER

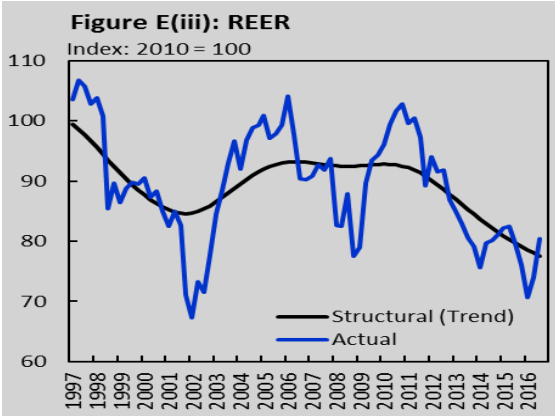


Figure E(iv): REER

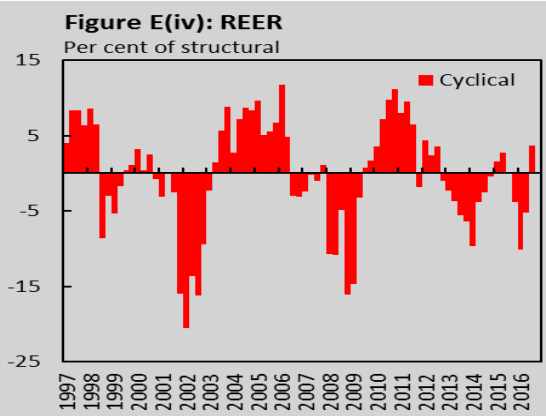


Figure E(v): World import volumes

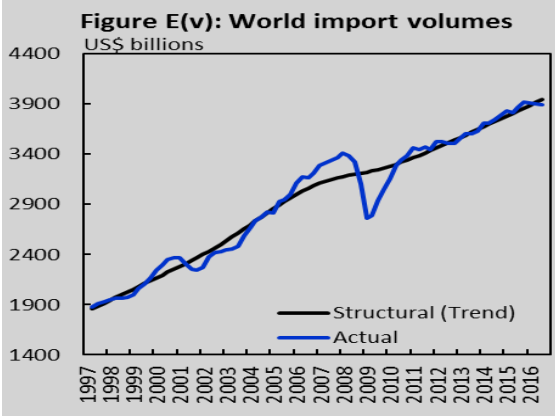


Figure E(vi): World import volumes

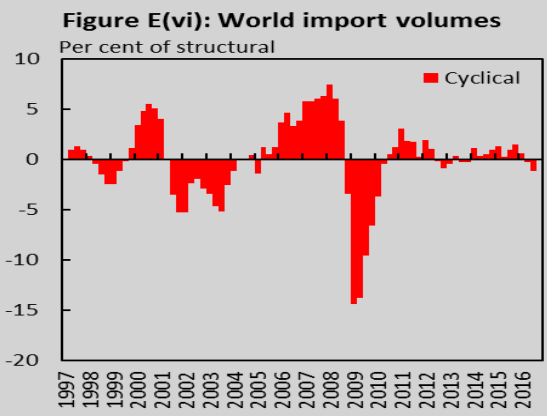


Figure E(vii): Electricity availability

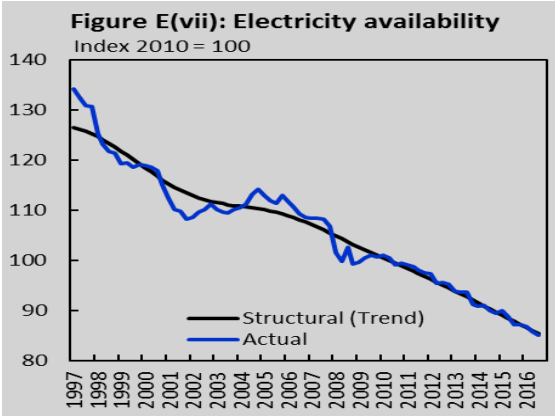
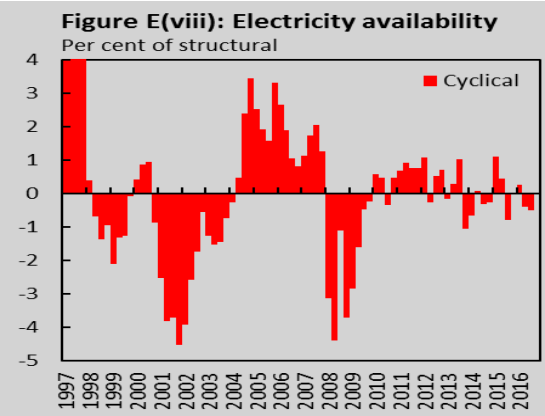


Figure E(viii): Electricity availability



[10] Graphs for structural variables derived from an HP filter approach are depicted with a grey background.

Appendix EP: Merchandise export prices and its drivers

Figure EP(i): Merchandise export deflator

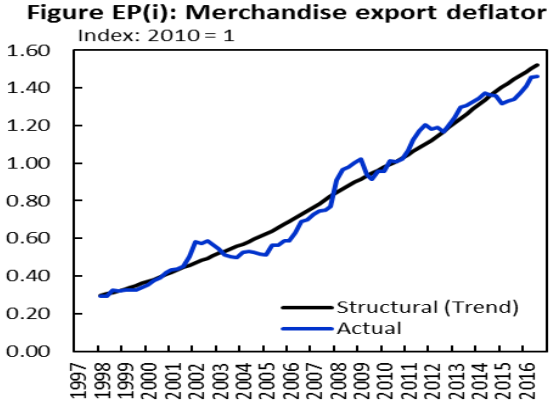


Figure EP(ii): Merchandise export deflator

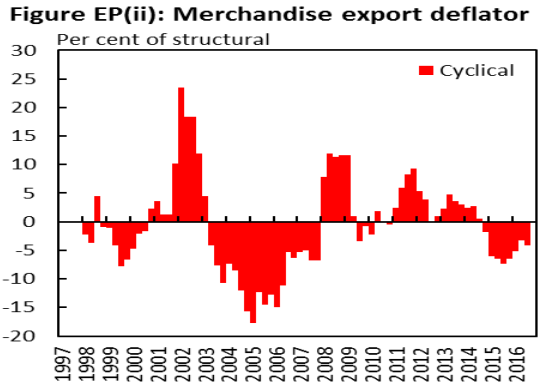


Figure EP(iii): Commodity prices (US$)

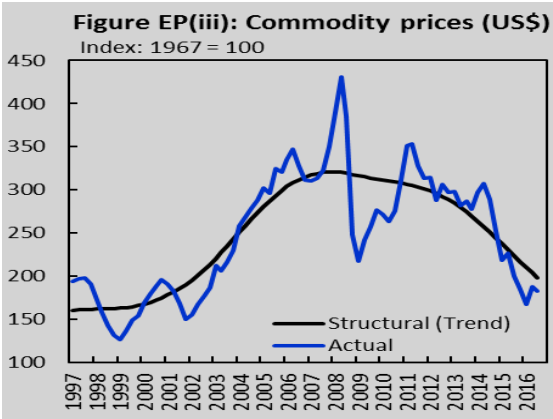


Figure EP(iv): Commodity prices (US$)

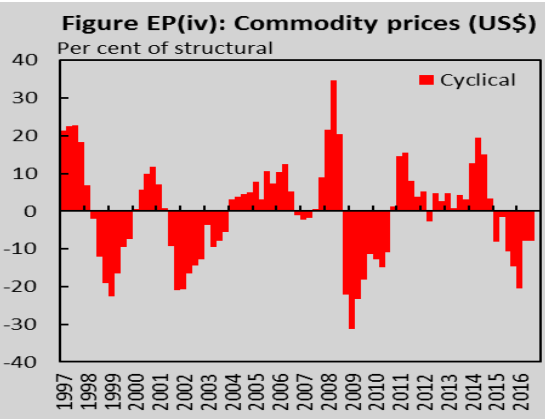


Figure EP(v): World PPI (US$)

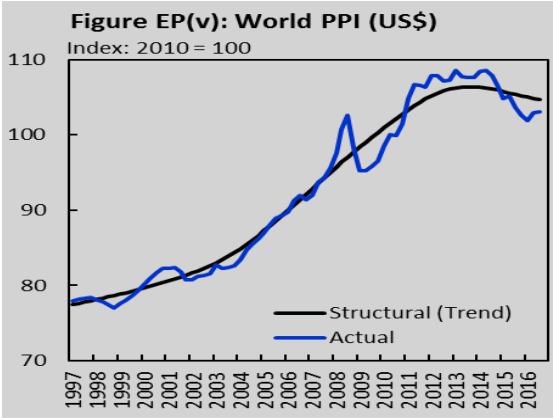


Figure EP(vi): World PPI (US$)

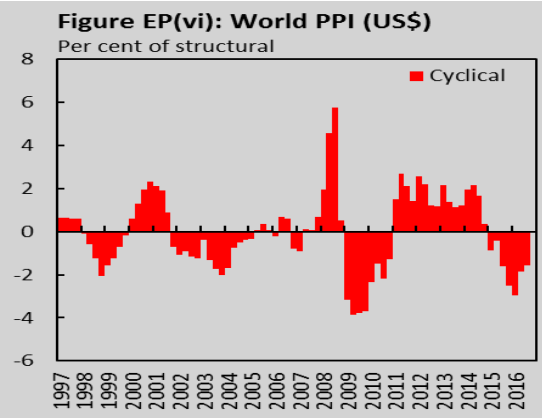


Figure EP(vii): Rand/US$

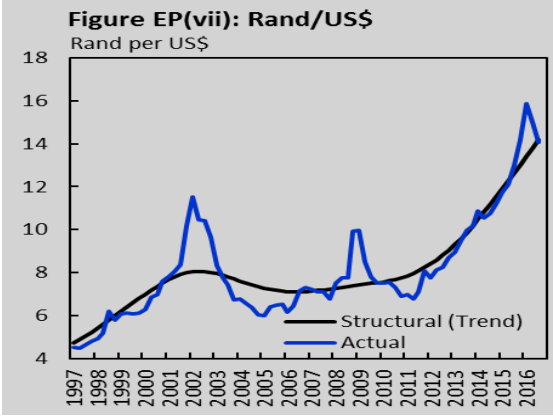
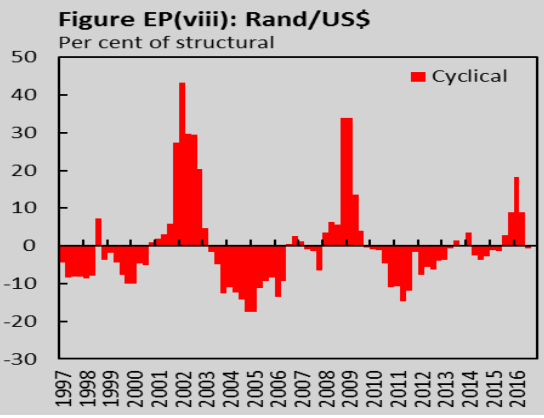


Figure EP(viii): Rand/US$



Appendix M: Merchandise import volumes and its drivers

Figure M(i): Merchandise import volumes

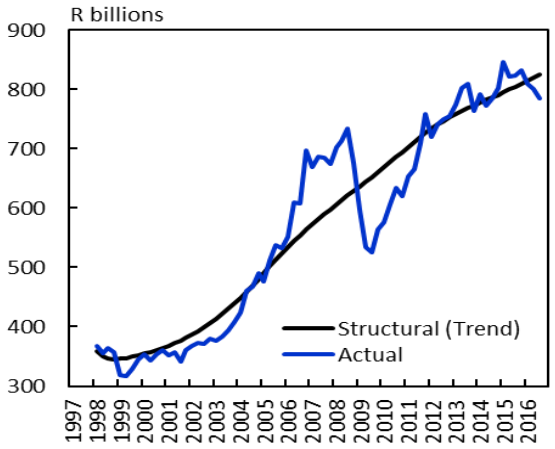


Figure M(ii): Merchandise import volumes

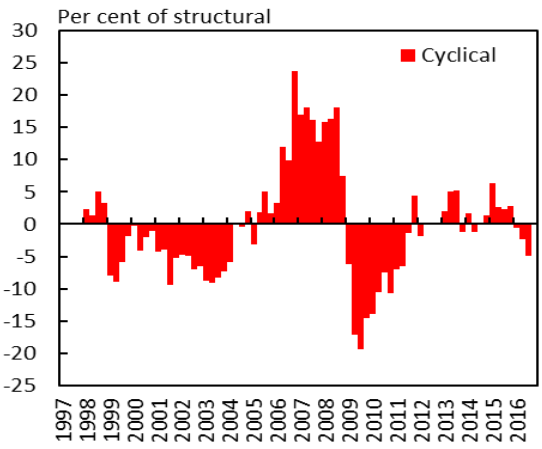


Figure M(iii): REER

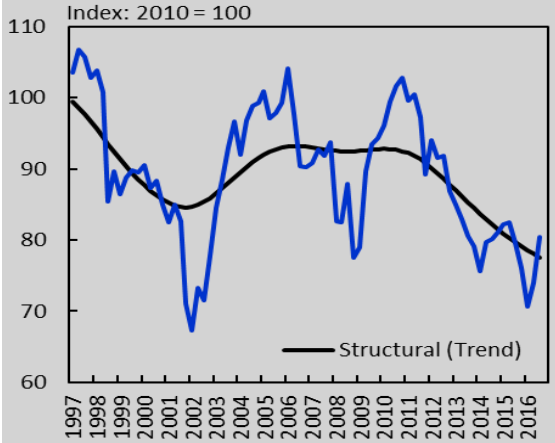


Figure M(iv): REER

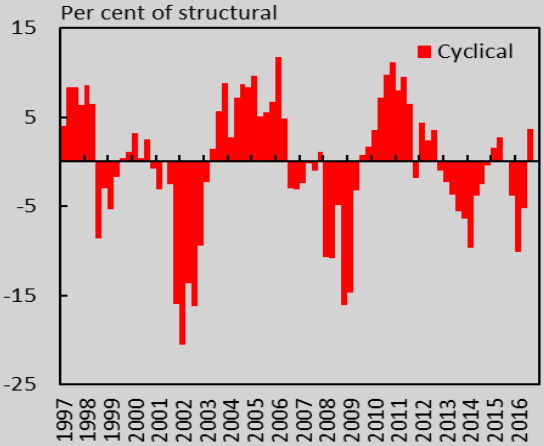


Figure M(v): Real GDP

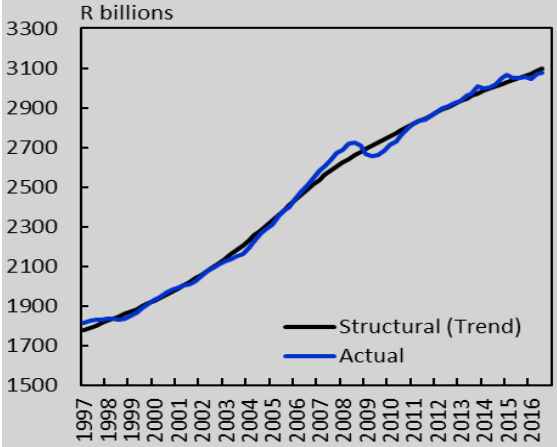
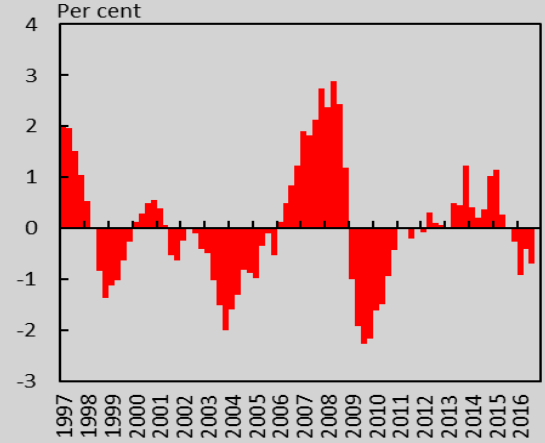


Figure M(vi): Output gap



Appendix MP: Merchandise import prices and its drivers

Figure MP(i): Merchandise import deflator

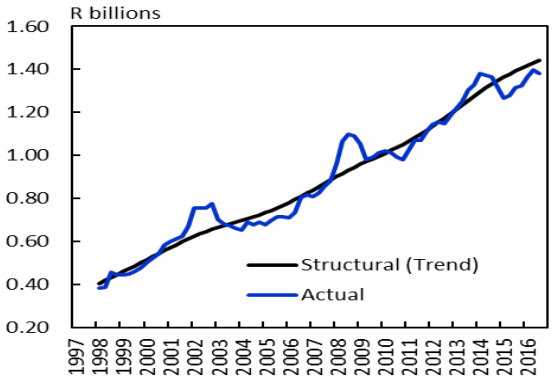


Figure MP(ii): Merchandise import deflator

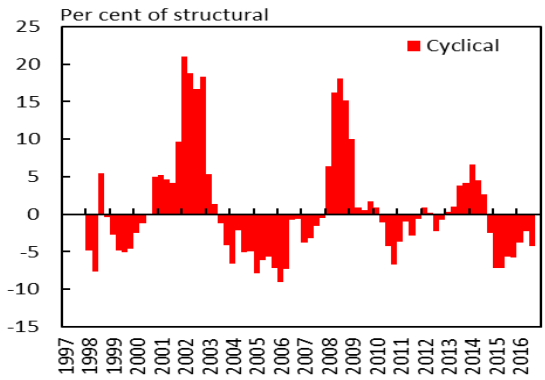


Figure MP(iii): Oil prices

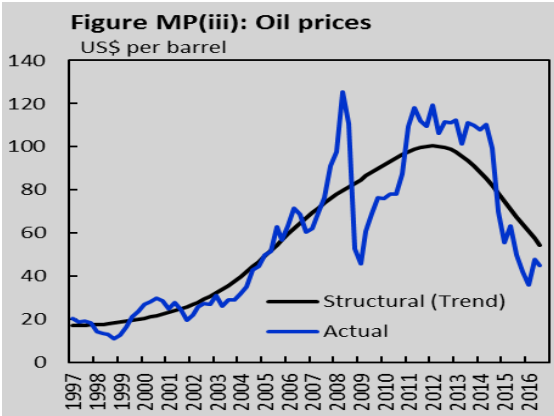


Figure MP(iv): Oil prices

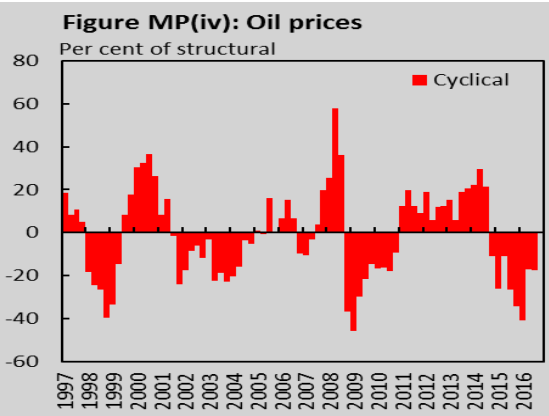


Figure MP(v): World PPI (US$)

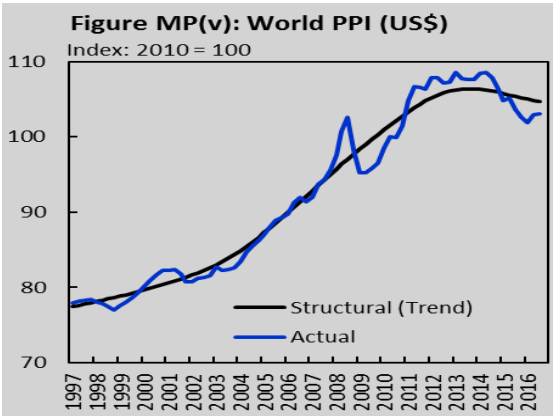


Figure MP(vi): World PPI (US$)

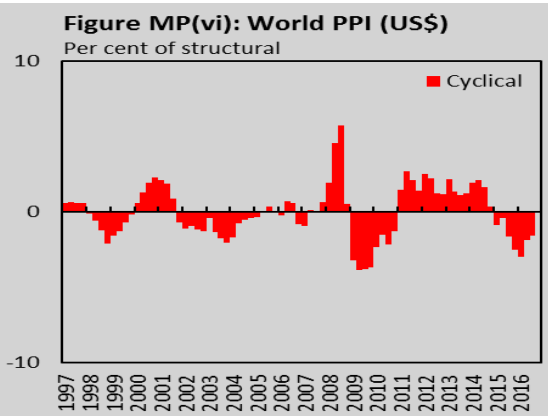


Figure MP(vii): Rand/US$

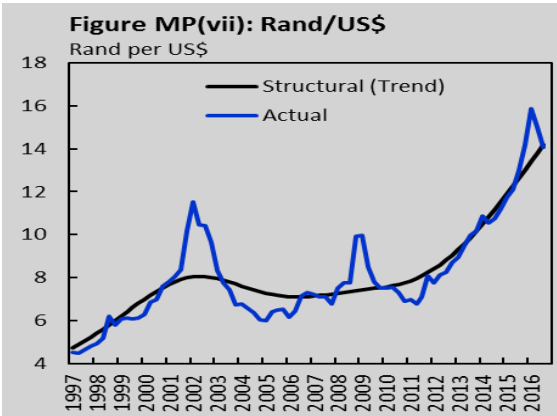
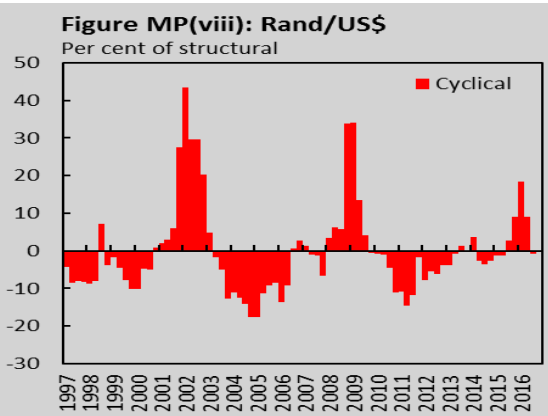


Figure MP(viii): Rand/US$



Going green is good for private fixed investment - April 2017

Nkhetheni Nesengani

Abstract

South Africa's 2008 electricity supply crisis, and the ensuing load shedding episodes that sporadically took place until 2015, necessitated a structured plan that could help to alleviate future electricity constraints in the sector while acting as a catalyst for gross fixed capital spending in other sectors of the economy as well. The private sector's contribution to energy investment was hardly noticeable until the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) commenced in 2013. This note shows that the REIPPP's direct contribution to real GDP and private sector fixed investment averaged 0.52% and 4.0% respectively, between 2013 and 2016. It was a substantial improvement from 0.04% and 0.32%, recorded from 2009 to 2012. The note also shows that a 1% shock to private fixed investment (about R25 billion injected to REIPPP) would directly contribute 0.6% to total fixed investment, while indirectly adding a 0.1% to real GDP.

1 Introduction[1]

Electricity supply shortages caused a substantial drag on growth, as evident from South Africa's weak growth outcomes between 2008 and 2015[2]. Electricity constraints far exceeded threats from other infrastructure bottlenecks such as roads and rail. Since 2011, capital spending by private business in the electricity sub-sector has resulted in a significant contribution by the private sector to overall fixed investment.

The rise of independent power producers (IPP) in the energy sector has helped alleviate some of the supply constraints in this sector. This occurred quite rapidly and highlights the important role of the private sector in providing electricity for the South African economy.

The private sector's contribution to energy investment was hardly noticeable until 2013. The change came about through the Renewable Energy Independent Power Producer Procurement Programme (REIPPP)[3]. This note shows how the stagnation in the rate of investment in electricity by public corporations led to the REIPPP raising private sector investment and hence, total fixed investment. It highlights the significance of renewable energy as a faster way to help address the electricity supply constraints that South Africa encountered in 2008. The note indicates that REIPP contributes significantly to real fixed investment by the private sector, and hence to GDP growth. Keeping the policy on independent power producers open helps to encourage investment in electricity by private businesses, and in the process stimulates both growth and employment.

[1] Many thanks to Mr. Rowan Walter, Ms. Dineo Lekgeu, Mr. Pieter Pienaar, Ms. Pamela Mjandana, and Mr. Shaun De Jager for their valuable comments.

[2] The advent of blackouts in 2008 coincided with the global financial crisis that had a significant economic impact on South Africa's growth. Production and consumption were constrained by both domestic and global factors.

[3] http://www.energy.gov.za/IPP/Electricity-Infrastructure-Industry-Transformation-23September2014.pdf

2 Moderating electricity supply, and/or declining demand: a brief overview

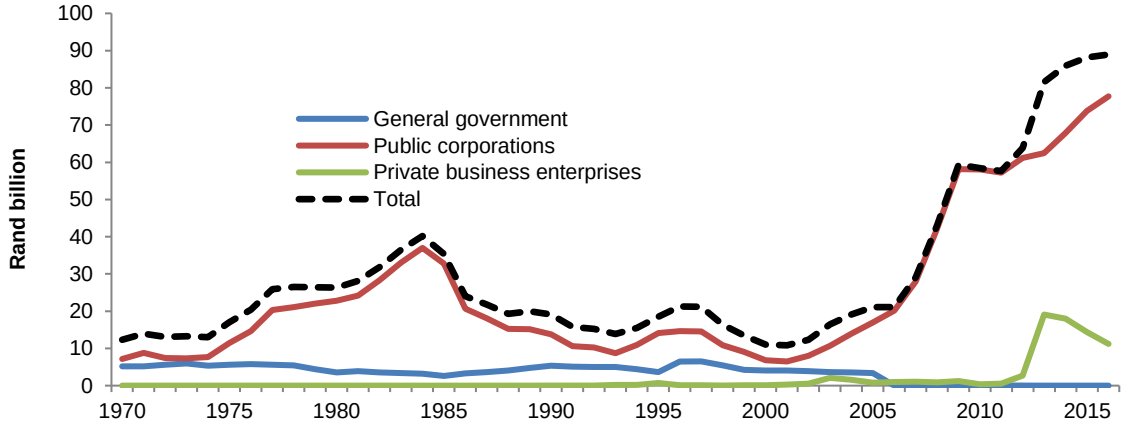
Electricity supply, being a vital cog in the economy, is crucial for underlying confidence in South Africa's future prospects as a stimulus for other investment. Just like infrastructure bottlenecks in roads, rail and air transport can hinder export-led growth; insufficient generation of electricity could have an even bigger negative impact on total fixed investment and economic growth[4]. In the 1970's and 1980's the supply for electricity was mostly greater than the demand[5]. The situation evolved over time culminating in a serious shortage of electricity supply by 2008.

Load-shedding weighed on future business plans[6]. Closing the electricity supply gaps became a challenge following the 2008 electricity disruptions. The effect on the economy could have been even bigger a few years later was it not for planned investments in the sector. Fixed investment projects in the electricity sector that were ongoing at the time of electricity shortages reduced the severity of the slowdown in economic growth. South Africa had to continue prioritising investment in electricity infrastructure so that other sectors (particularly the energy-intensive industries) could find it attractive to invest in the country.

3 Green energy as a supplement to a sector dominated by Eskom

The graphical depiction in figure 3.1a demonstrates a rather meager engagement of the private sector in building capacity for generating electricity from 1970 to 2012. However, a record high participation in capital expenditure in the subsector was recorded in 2013, showing about a 3000% growth rate, albeit from a very low base. Figure 3.1b shows that 2013 stands out as the year where four consecutive quarters contributed in excess of 20% (year on year growth) in electricity infrastructure capital expenditure. That is in line with the bids[7] where companies had committed to deliver on their projects.

Figure 3.1a Real gross fixed investment in electricity by sector (2010 constant prices)



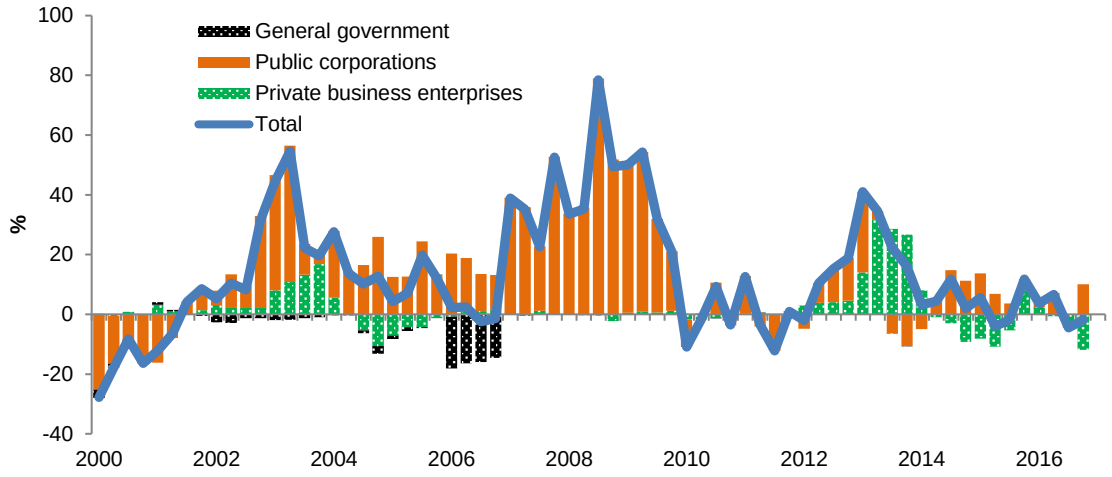
[4] South Africa's electricity intensity at a higher level, and disruption to electricity supply is likely to affect most sectors of the economy. See http://www.ep.liu.se/ecp/057/vol3/028/ecp57vol3_028.pdf on SA's electricity intensity.

[5] Electricity supply to households could easily outstrip consumption because of the large segment of the society that was previously marginalised. From the 1990's it was the policy of the government to connect even the previously disadvantaged segments of South Africa to the national power greed.

[6] Real GDP declined in 2009 partly owing to domestic production constraints linked to electricity supply shortages and sluggish global growth. South Africa's potential output was reduced. The IMF indicated that there was a structural break in potential output around 2008Q4/2009Q1. See *www.imf.org/external/pubs/ft/dp/2011/afr1102.pdf*.

[7] Bids to provide renewable energy were based on a 70% pricing with the 30% related to issues like black ownership in the projects, ability to create new jobs, and the local content in the production process.

Figure 3.1b Quarterly contributions to growth rates in real gross fixed investment in electricity (2010 constant prices)



Eskom, as represented by the public corporation sector above, has been the main contributor to capital expenditure in electricity over time. In the mid-1980s, its contribution to total electricity capex dwarfed both private business corporations and general government. Between 2000 and 2007 the real growth rate in public corporations' capital expenditure in the electricity subsector averaged 17.1%, before increasing to 51.1% at the onset of the 2008 electricity power crisis. But, this high rate of investment was not sufficient to spare the country from load shedding. Given ample space to operate, so-called green energy initiatives can provide a necessary challenge to Eskom in terms of raising its level of efficiency and competitiveness.

4 The REIPPP's role in fixed investment by the private sector

4.1 Fixed investment by private businesses and GDP growth benefit from REIPPP

A role for the private sector in power infrastructure was always going to be accepted with both hands – especially if it proved to be profitable, with minimum risk. The 2008 power crisis reinforced the urgency to increase electricity generating capacity. The department of Energy's bid windows proved to be a huge success as it increased renewable energy generation capacity.

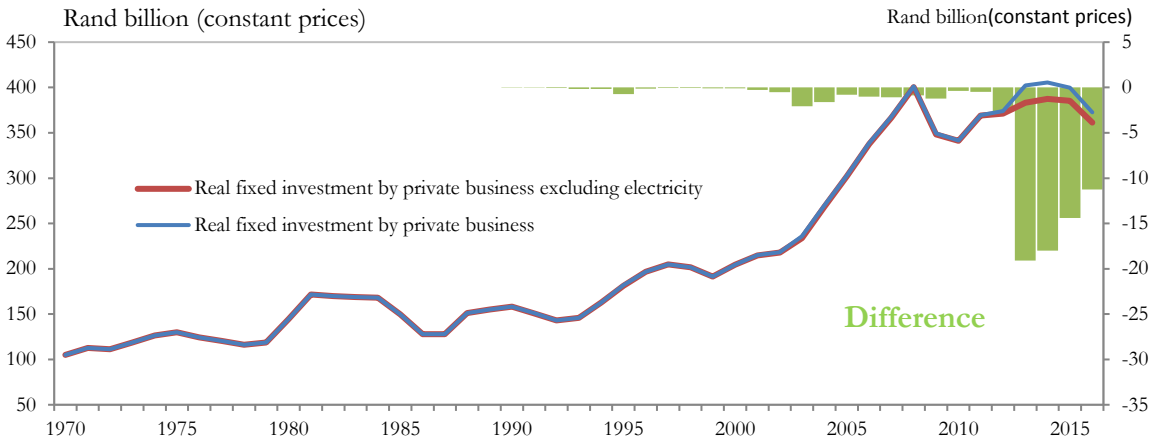
South Africa's economy is energy-intensive – possibly related to the legacy of decades of very low electricity prices and preferential rates to some companies[8]. Investing in manufacturing industries that rely heavily on electricity was encouraged - examples being aluminum smelters, iron ore and steel mills.[9] In the absence of load shedding in the country, it is tempting to assume that all electricity demand is met. However, the question remains as to what percentage of economic activities were shelved or even cancelled because of planners' concerns that there would not be enough electricity to meet their needs. Alternatively, some companies could have chosen to reduce their reliance on Eskom's power and use alternative sources of energy. As a result, the stagnation in electricity consumption was by no means an indication that demand for electricity had stabilized.

[8] Smelters bought electricity from Eskom at lower rates. See http://www.engineeringnews.co.za/article/aluminum-industry-faces-challenges-2012-09-28

[9] University of Cape Town's Energy Research Centre noted the pattern of increased investments in energy-intensive manufacturers in their report titled "Energy policies for sustainable development in South Africa". See *www.iaea.org*.

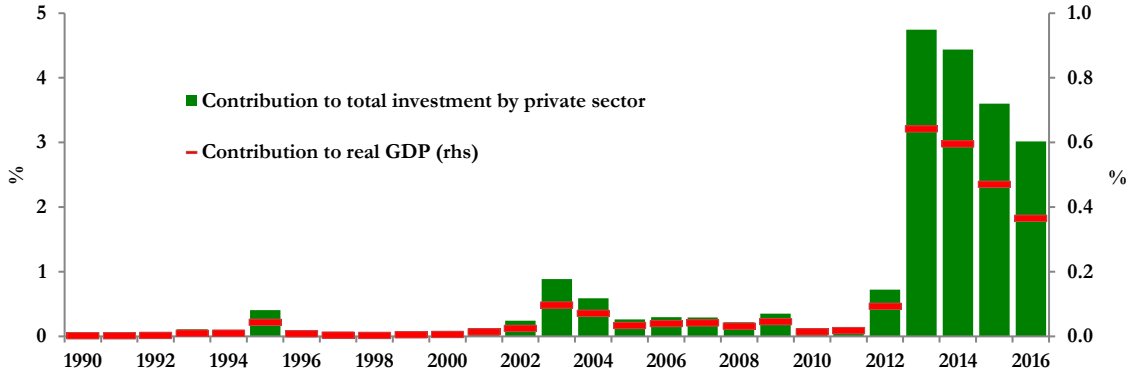
In the midst of the electricity supply constraints, investment in the electricity sub-sector had to gain traction. Expanding electricity capacity would have direct benefits to the economy. Figure 4.1 shows that in 2013, about R19.2 billion (2010 constant prices) came largely from the REIPPP initiatives – contributing 4.7% to total investment.

Figure 4.1 Electricity's noticeable contribution to fixed investment by private business only in recent years



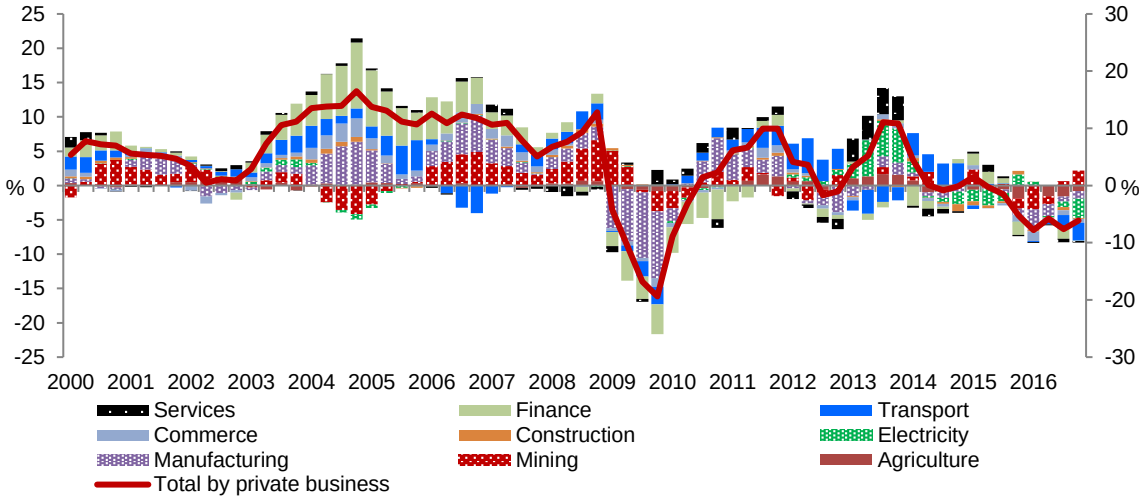
In 2012 and 2013 private sector investment in electricity infrastructure contributed significantly to total fixed investment by the private sector, helping the investment sector to reach its pre-crisis level by the beginning of 2014Q1. However, in 2015 most REIPP projects were winding down, resulting in contraction in capital expenditure in electricity. Nevertheless, a modest recovery became evident in 2015Q4. It is unequivocally clear that once private sector investment starts to accelerate there are significant tangible positive spinoffs to total fixed investment.

Figure 4.2 REIPP's direct contribution to real GDP and private sector's real fixed investment



The bid windows related to REIPPP started in 2011, with a meager contribution to real investment noticeable in 2012. In 2013, about 5% of real fixed investment by private business was attributed to expanding electricity infrastructure. That part of fixed investment contributed to about two-thirds of a percent of real GDP in 2013.

Figure 4.3 Green shoots for investment fade with completed REIPPP projects



Although gross fixed capital formation by private business contracted (based on year on year growth rate) from 2015Q2 to 2016Q4, the electricity subsector still contributed positively, albeit from a relatively low base. Given that the private sector remains the main contributor to total fixed investment in South Africa, any further boost to this sector would add significant value to GDP growth prospects.

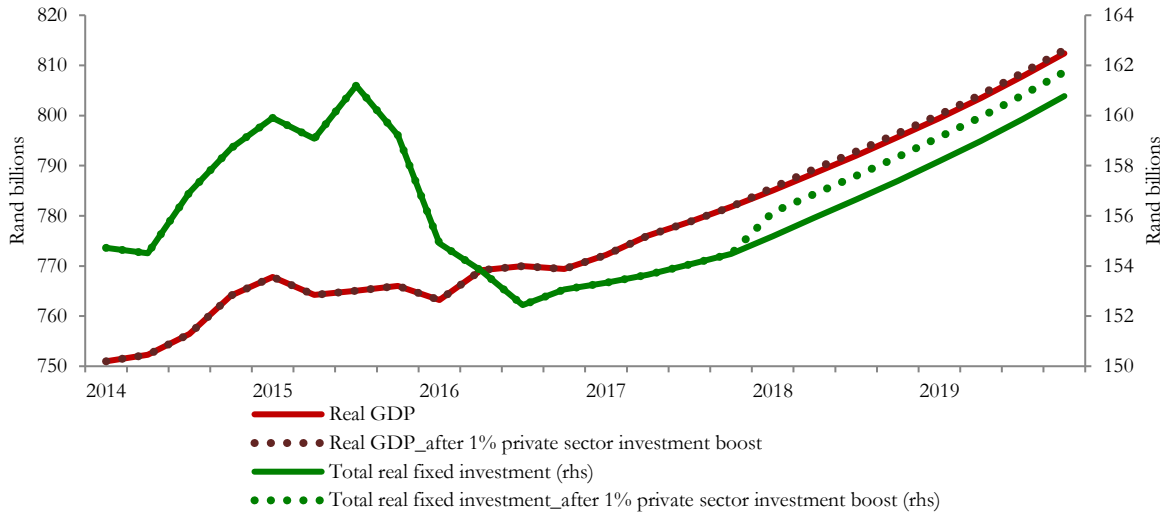
A simulation for a 1% increase to real fixed capital formation by the private sector suggests positive spinoffs to both total investment and GDP growth. The 1% shock to investment is equivalent to R22 870 billion increase in nominal private business expenditure by the electricity sub-sector.

Table 4.1 A one per cent positive shock to private investment (changes from baseline)

	Private business investment	Total investment	GDP
At current prices (R million)	**22 870**	**22 870**	**17 500**
At constant prices (R million)	**15 240**	**15 240**	**11 660**
Per cent (y-o-y real change)	**1.0**	**0.6**	**0.1**

Source: SARB, own calculations

Figure 4.4 Impact of a 1% stimulus to private sector investment (2010 constant prices)



Not all the benefits of a positive shock to investment would be realised in real and nominal GDP growth. This could be due to negative spillovers as various channels linking real investment changes to GDP growth will have different impacts on economic growth. An example here is the associated increase in capital equipment imports used in the renewable energy sector. Ceteris paribus, an increase in South Africa's imports temporarily lowers the country's net-export position. Therefore, the "immediate" benefits of increasing investment in the green energy sector do not fully pass through to GDP, i.e., despite the future positive spinoffs related to capacity increases from the raised capital spending in infrastructure. That being said, the long-term benefits are that the increased infrastructure capacity will support future exports, and therefore improve the net export position, and real GDP growth prospects.

4.2 Choosing the right technology mix

Policy makers should choose the right combination of technology options when increasing South Africa's electricity-generating capacity. Different constraints exist for each option, and a balanced view should be considered for optimising the outcome. There are two key considerations when choosing between the options. First is the urgent need for additional power, while the second relates to the need to go green. Nevertheless, an overall cost/benefits analysis of the projects should be considered.

The global move to cleaner energy resources should encourage South Africa's efforts to develop cleaner forms of electricity capacity. Related to this, the type of technology will determine the speed at which projects are completed and amount of electricity power generated.

Table 4.2 Available technologies to choose from

Technology	***Unit Size***	***Lead Time[10]***	***Capital Cost/KW***	***Operating Cost***	***Fuel Cost***	***CO_2 Emission***
Coal	Large	Long	High	Medium	Medium	High
Nuclear	Very large	Long	High	Medium	Low	Nil
Gas-fired	Medium	***Short***	Low	***Low***	High	Medium
Hygro	Very large	Long	Very high	Very low	Nil	Nil
Wind	Small	***Short***	High	***Very low***	Nil	Nil
Photovoltaic	Very small	***Very short***	Very high	***Very low***	Nil	Nil

Source: International Energy Agency

This table[11] shows the benefits as well as the disadvantages of various means of investment in electricity infrastructure. When South Africa was still faced with severe power shortages, it was ideal to prioritise the technologies with a short lead time for maximum effects. From the options shown, solutions to the short-term problem could continue to come either from photovoltaic, gas-fired or wind technology. It could also be any combination of these.

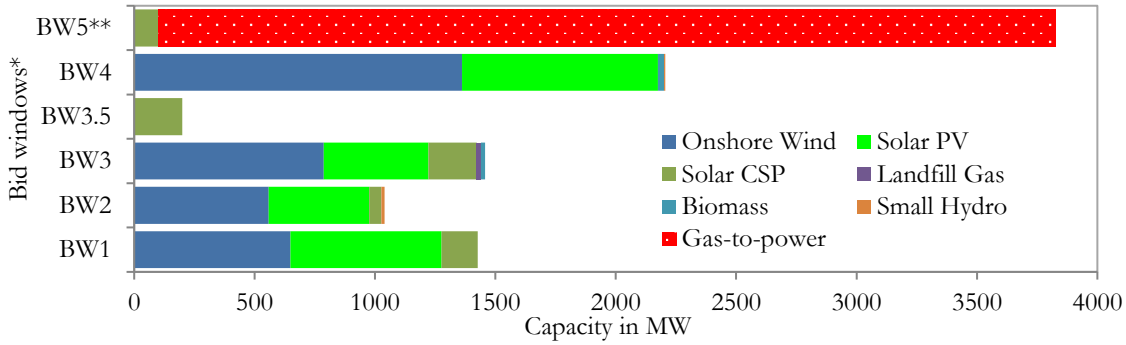
South Africa faces cost constraints and the choice of option also depends on the capital cost per kilowatt that ranges from low (for gas-fired), high (for wind based power) to very high (for photovoltaic). Wind and photovoltaic technologies, although with a higher capital cost per kilowatt, should be encouraged as they are considered renewable sources of energy. Private companies have

[10] Lead time is the amount of time needed to build a given type of power plant varies by technology. Projects with longer lead times increase financing costs. Each year of construction represents a year of additional interest charges before the plant is placed in service and starts generating revenue (http://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf).

[11] This table is extracted from IEA: (http://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf)

thus far focused on these three since 2013 as they can be carried-out by different companies at the same time, but in different locations.

Figure 4.5 South Africa's choice of technology mix: REIPPP's experience



* The bid windows (BW1 to BW4) are for the period between 2011 and 2015.
** BW5 is the expected bid window based on South Africa's intention to procure 3726MW of power

The future is in clean energy, and South Africa needs to position itself for that. Bloomberg noted[12] that:

> *"Cheaper coal and cheaper gas will not derail the transformation and decarbonisation of the world's power systems. By 2040, zero-emission energy sources will make up 60% of installed capacity. Wind and solar will account for 64% of the 8.6TW of new power generating capacity added worldwide over the next 25 years, and for almost 60% of the $11.4 trillion invested."*

In 2016 the SA government published the "Integrated Energy Plan (IEP) and the Integrated Resource Plan (IRP) for public comment"[13]. Renewable energy is very much a part of the country's IEP.

The coal-fired Medupi and Kusile power stations are the recent mega fossil fuel power stations to be built in South Africa, and both (even before they are fully commissioned) have significantly alleviated domestic electricity supply constraints. But as the country moves with the global trends of increasing cleaner energy, going green seems to be the future for energy generation.

5. Summary and recommendations

REIPPP, as a policy, benefits fixed infrastructure investment, as well as economic growth within a fairly short space of time. The small unit sizes and short lead time mean that several projects can go on simultaneously, and be managed by different companies, resulting in a greater deal of success to complete the projects. The benefits are generally realised quickly and demonstrates how a successful program like this could attract significant private sector investment into a previously closed sector. Enhanced capital expenditure on green energy could have positive knock-on effects on GDP growth.

[12] Bloomberg's New Energy Outlook 2016 (http://www.bloomberg.com/company/new-energy-outlook)
[13] See www.gov.za/speeches/minister-tina-joemat-pettersson-media-briefing-integrated-energy-plan-and-integrated for details.

Initiatives to attract private business entrepreneurs to the renewable energy sector encourages competition amongst bidding companies. The 2008-type electricity crisis and the ensuing load shedding episodes that sporadically took place until 2015, necessitated a structured plan that could help to alleviate future constraints in the electricity sector and act as a catalyst for gross fixed capital spending in other sectors of the economy.

The right combination of technology should be chosen to address the short-term as well as the long-term needs. Although it is still at a very small scale, the REIPPP policy could play a significant role in terms of diversifying the sources of electricity generating capacity. Continuing with the REIPPP policy would help to raise capacity, and to further deepen the technological skills in the sector.

The study shows that renewable energy projects have the potential to directly contribute 4% to total fixed investment in the near term. However, the impact of the increase in energy related capital expenditure annually does not fully contribute to GDP growth as it raises imports without immediately increasing exports. Nevertheless, over the long term the increased infrastructure capacity could benefit exports, thereby improving SA's net-export position. Moreover, there are other developments in new energy technologies and possibly some employment gains associated with the REIPPP initiatives that could benefit GDP growth and employment.