South Africa's monetary policy independence: evidence from a Global New-Keynesian DSGE model

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Abstract

We study the response of South African monetary policy decisions to foreign monetary policy shocks. We estimate the extent of foreign monetary policy pass-through by augmenting standard Taylor rules and comparing the results within the context of a Global New-Keynesian Dynamic Stochastic General Equilibirum (DSGE) model. The general equilibrium model captures important spill-over effects that would otherwise have been ignored in a single equation setup. The results show that the relationship between foreign monetary policy shocks and South African interest rates is complicated - South Africa does not import foreign monetary policy directly, but is still affected. Except for the U.S. an increase in foreign interest rates lead to a decrease in South African interest rates - highlighting the complex channels that monetary policy authorities have to monitor outside of its economy.

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1. Introduction

How independent are monetary policy interest rate decisions really? An economy with a flexible exchange rate and mobile capital flows should have monetary policy independence - a framework which we often refer to as the impossible trinity. In reality, however, central banks care what other central banks do - and domestic monetary policy is often contingent on monetary policy decisions abroad. Theoretically considerations like purchasing power parity, uncovered interest parity and exchange rate pass-through count in the decision-making objectives by central banks (most New-Keynesian models used by central banks model these features). Edwards (2015) suggests that monetary policy pass-through is a consequence of immobile capital (the so called "fear to float") - the active channel is an exchange rate depreciation with pass-through effects to domestic prices. I.e. domestic interest rates increase to stem capital outflows and are concerned about the inflationary impact of a depreciating exchange rate. There is some evidence that suggests that the South African Reserve Bank (SARB) reacts to exchange rate movements (Gupta and Jooste, 2014) in this manner.

We have two objectives in this paper relating to monetary policy contagion in South Africa. That is, we compare simple estimates (partial equilibrium) of South Africa's monetary policy reaction function to changes in interest rates by India, Brazil, China and the U.S. and analyse the interest rate response in a general equilibrium model of the world (with shocks primarily emanating from India, Brazil, China and the U.S.). To our knowledge this is the first study that has conducted an analysis on the contagion effects of global monetary policy decisions on South Africa.

Frankel et al. (2004) argue that countries with flexible exchange rates are shielded to some extent from foreign monetary policy shocks. If, however, higher foreign interest rates attract capital flows the domestic currency could likely depreciate. The exchange rate pass-through to inflation becomes a credible concern for monetary policy. If the exchange rate pass-through is high in an inflation targeting country then domestic interest rates are not truly independent from foreign monetary policy shocks. The central bank might be tempted to raise interest rates on the basis to stem an outflow of capital (i.e. compete against foreign monetary policy for capital) and to keep inflation within its target range or target level.

The argument becomes more complicated if we think of central bank strategies in a game theoretic setup where central banks are either cooperative or non-cooperative. If they cooperate then a central bank cuts interest rates when inflation is high in another country to cause a currency appreciation (Taylor, 2007) - with the risk of increasing domestic inflation.

Other factors, besides interest rates, determine the flow of capital; and these factors should be taken account of in any monetary policy decision. Interest rates tend to be correlated when i.) business cycles across countries are synchronized and ii.) when systemic shocks hit the world economy (Frankel et al., 2004). However, if the primary central bank objective is inflation targeting, as in South Africa, then the central bank should know how exchange rates affect inflation. Monetary policy is not truly independent if they are hindered by exchange rate movements - in this case foreign reserves are inadequate to cause a desired change in the exchange rate; interest rates are used instead (see Calvo and Reinhart (2000)). Central banks are then required to have the foresight to understand both how other countries' monetary policy decisions affect them and be able to anticipate changes in interest rate decisions by countries that affect the domestic economy more.

A large number of studies show that free-floating exchange rate countries do in fact import foreign monetary policy. Frankel et al. (2004) as an example show that for any rise in interest rates in the U.S. developing countries increase theirs by almost the same extent (this is since 1990). For South Africa (over the period 1990-1999) they find a long-term interest rate pass-through (from the U.S.) of 1.75 and a half-life (i.e. half the time it takes to adjust to the long-term) of 8 day.[i]

Unfortunately these studies miss important features: i.) endogeneity is not completely taken care of; ii.) equations are not structural and iii) general equilibrium in a domestic and global context is ignored. The latter is perhaps the key missing ingredient. Idiosyncratic monetary policy shocks have economy-wide reaching affects such as a general decrease in economic activity and a general decrease in inflation. Output and inflation decreases may serve as systemic shocks - an economic contraction in the U.S. decreases output of its trading partners. The foreign interest rate shock is then outweighed by the foreign output shock - implying that monetary policy need not necessarily import foreign monetary policy. Ignoring these general equilibrium effects in a reduced form equation might lead to misspecification and incorrect inference - something we address in this study.

2. Methodology

To illustrate and highlight the extent of importing foreign monetary policy we estimate two types of single equation. We estimate simple monetary policy reaction functions, similar to Edwards (2015), to study how responsive the SARB is to changes in monetary policy abroad. This reduced-form specification serves as a baseline discussion. The interpretation of this regression is straightforward and relies on an error correction structure:

$$\Delta r_t = \alpha + \beta_1[r_{t-1} - r^f_{t-1} - x^i_t] + \beta_2 r^f_{t-1} + \beta_i x^i_t + \varepsilon_t \qquad (1)$$

In equation (1) $r_t$represents the domestic monetary policy rate, the error correction coefficient is β_1 and should be bounded between (-1,0), r^f_{t-1} is the foreign nominal interest rate and x^i_t captures various controls such a inflation, output and the exchange rate (rand-U.S. dollar), i.e. core elements of the Taylor rule. It is assumed that the error term, ε_t, is *i.i.d.* Perfect contagion, or perfect monetary policy pass-through would entail that -$\frac{\beta_2}{\beta_1} = 1$, this is the long-run. The data is primarily sourced from Quandl and the official website of the South African Reserve Bank (www.resbank.co.za) with foreign interest rates taken from International Monetary Fund's (IMF's) International Financial Statistics (IFS) database.

Our main empirical approach, however, is an augmented Taylor rule with a specification similar to Leigh (2005). The original Taylor rule is specified as:

$$r^r_t = r^* + \pi^e_t + (\beta_1 - 1)(\pi^e_t - \bar{\pi}) + \delta_1 \tilde{y}_t$$

where π^e_t is the expected inflation rate. We may rewrite this as:

$$r^r_t = \alpha + \beta_1 \pi^e_t + \delta_1 \tilde{y}_t$$

[i] Frankel et al. (2004) use Treasury bill rates as a measure of interest rates instead of the actual monetary policy rate.

This allows us to obtain a specific solution for the inflation target ($\alpha = r^* - (\beta_1 - 1)\bar{\pi} \rightarrow \bar{\pi} = \frac{r^*-\alpha}{\beta_1-1}$)

The measure of inflation target gives an indication of how responsive the SARB is to movements in foreign monetary policy. We follow Taylor (2007) and augment (1) to include a response to foreign interest rates.

Assume that central banks directly take foreign monetary policy decisions into account yielding the following Taylor rules:

$$r_t^r = r^* + \alpha_1 r_t^{rf} + (\beta_1 - 1)(\pi_t^e - \bar{\pi}) + \delta_1 \tilde{y}_t \tag{2}$$

$$r_t^{rf} = r^* + \alpha_2 r_t^r + (\beta_2 - 1)(\pi_t^{e,f} - \bar{\pi}^f) + \delta_2 \tilde{y}_t^f \tag{3}$$

Equation (2) represents the monetary policy response of the home country while equation (3) represents the monetary policy response of the foreign economy. $\tilde{\pi}$ is the inflation deviation from target and $\tilde{y}$ is the output deviation from steady state. Furthermore, we follow Hoffman and Bogdanova (2012) and assume that interest rates gradually adjust (allowing for a smoothing term) ($r_t = \rho r_{t-1} + (1-\rho) r_t^r$).

Solving for r_t^r using (2) and (3) yields:

$$r_t^r = \frac{1}{1-\alpha_1\alpha_2}[\theta + \beta_1 \pi_t^e + \delta_1 \tilde{y}_t + \alpha_1((\beta_2 - 1)(\pi_t^{e,f} - \bar{\pi}^f) + \delta_2 \tilde{y}_t^*)] \tag{4}$$

where $\theta = r^* - (\beta_1 - 1)\bar{\pi} \rightarrow \bar{\pi} = \frac{r^*-\theta}{\beta_1-1}$

The inflation target is thus affected by α_1. A large $\alpha_1$could result in monetary policy mistakes and would change the implicit inflation target.

Finally, our general equilibrium analysis focuses on a Global New Keynesian model. The multi-country rational expectations toolbox of Dees et al. (2014) is a good choice for this framework. An IS equation, a Phillips curve and an exchange rate equation is estimated for each country separately using the Instrumental Variable approach. The model is closed with a standard Taylor rule. The authors use quarterly data for the estimation and all variables are expressed as deviations from steady state, where the steady states are model consistent (i.e. no exogenous filter is used). It is important to note that each country is linked to each other via the IS and exchange rate equation and each foreign output or exchange rate component is weighed by total trade. This setup is suitable for our study: The degree of monetary policy pass-through is subject to movements in output and the exchange rate and not directly related to the foreign interest rate. To make a direct link one would have to augment the Taylor rule to include foreign interest rates. The general form of the three equations from Dees et al. (2014) is specified as:

$$\tilde{\pi}_{i,t} = \beta_{i,b}\tilde{\pi}_{i,t-1} + \beta_{i,f}E_{t-1}(\tilde{\pi}_{i,t+1}) + \beta_{i,y}\tilde{y}_{i,t-1} + \varepsilon_{i,st} \tag{5}$$

$$\tilde{y}_{i,t} = \alpha_{i,b}\tilde{y}_{i,t-1} + \alpha_{i,f}E_{t-1}(\tilde{y}_{i,t+1}) + \alpha_{i,r}\left(\tilde{r}_{i,t} - E_{t-1}(\tilde{\pi}_{i,t-1})\right) + \alpha_{i,e}\tilde{r}e_{i,t} + \alpha_{i,y^*}\tilde{y}_{i,t-1}^* + \varepsilon_{i,dt} \tag{6}$$

$$\tilde{r}_{i,t} = \varphi_{i,b}\tilde{r}_{i,t-1} + \varphi_{i,\pi}\tilde{\pi}_{i,t} + \varphi_{i,y}\tilde{y}_{i,t} + \varepsilon_{i,mt} \tag{7}$$

Equation (5) is the Phillips curve (both backward and forward looking), equation (6) it the IS curve that is affected by foreign output and equation (7) is the monetary policy rule. Exchange rates are measured as an AR(1) with the cointegrating relationships establishing both UIP and PPP conditions.

3. Results

We use data from IMF's IFS database to estimate equations (2) and (4) covering the period of 2000q1-2013q4, which covers the inflation targeting period in South Africa.[ii] Figure 1 suggests that there is a positive relationship between South Africa's monetary policy rate and that of its trading partners, except for India.[iii] This implies either that there is a common shock that drive interest rates across countries or that the one of the central banks import monetary policy decisions from abroad.

The dynamic regressions of Table 2, however, imply that the SARB import only monetary policy decisions from the U.S. Fed as opposed to its trading partners; the coefficient is insignificant. The rest of the specifications in Table 2 imply that South African interest rates decrease in response to an increase in interest rates in Brazil, China and India; all the coefficients are significant. This has interesting consequences regarding the response of capital flows and prices. If South Africa competed for foreign capital, a decrease in its interest rates could likely lead to a further outflow of capital and possibly an exchange rate depreciation - in this case the SARB is cooperative. Prices could increase if exchange rate pass-through is high.

We feel, however, that the specification in (1) is not robust and test it against estimates from equation (4). Except for the inclusion of the U.S., the monetary policy import coefficient is markedly different from Table 1 (see Table 2). We observe a reverse in sign for Brazil and increase in size for both China and India. This has important implications for inflation targeting if the SARB really did respond to interest rates in this fashion. The implied inflation target, given the different specifications, would vary between 0% and 8.6%. The base Taylor rule (i.e. without any country response) implies that the inflation target is 5.65%. Assuming that only the U.S. specification is correct given the corresponding results in Table 1 and Table 2, we would observe a higher inflation target: 5.88%, which is still within the target range of 3%-6%.

[ii] The toolbox estimates the New Keynesian equations from 1980Q2 up until 2011Q2.
[iii] Russia is excluded from the list due to a lack of data in the toolbox.

Figure 1: A simple relationship between interest rates

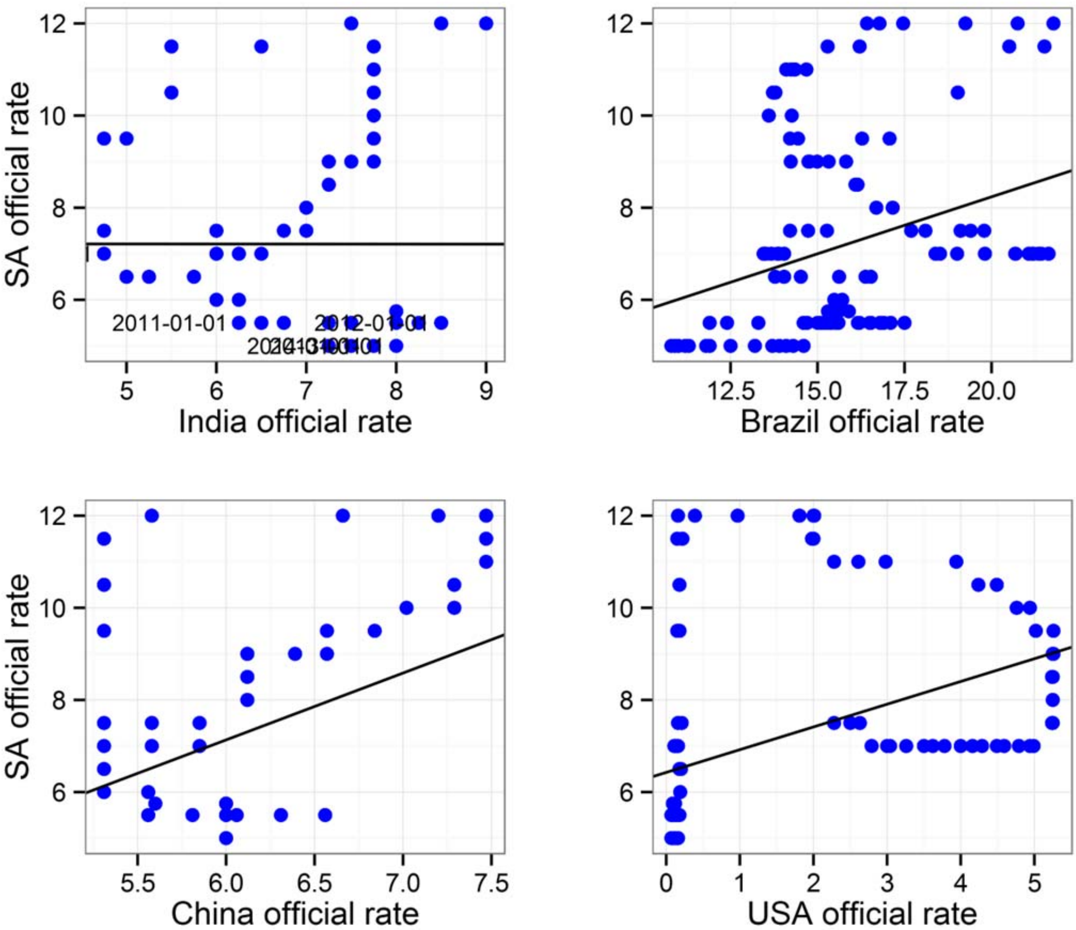


Table 1: Dynamic regressions

	USA	India	Brazil	China
Ect	-0.25***	-0.21***	-0.22***	-0.15**
r^*_{t-1}	0.24	-0.57*	-0.18*	-0.73
Δr^*_{t-1}	-0.20	0.11	-0.06	0.70***
Inflation dev	0.12	0.17	0.07	0.10
Output dev	0.27**	0.30***	0.35***	0.24***
R^2	0.71	0.76	0.78	0.78
F-stat	14.71***	17.58***	19.77***	20.40***
DW	1.70	1.87	2.06	2.24

Notes: *,**,*** imply statistical significance at 10%, 5% and 1%, respectively; Ect: Error-Correction Term.

Table 2: Taylor (2007) estimate on the weight of α_1

	No country[iv]	USA	India	Brazil	China
θ	4.96***	5.12***	8.47***	3.72***	20.08***
α_1		0.26***	-0.17	0.26***	-3.97***
β_1	1.54	1.49***	1.62***	1.50***	1.86***
$\bar{\pi}$	5.65	5.88	0	8.57	0
R^2	0.95	0.96	0.95	0.97	0.96
SE	0.50	0.47	0.51	0.43	0.05

Notes: *,**,*** imply statistical significance at 10%, 5% and 1%, respectively

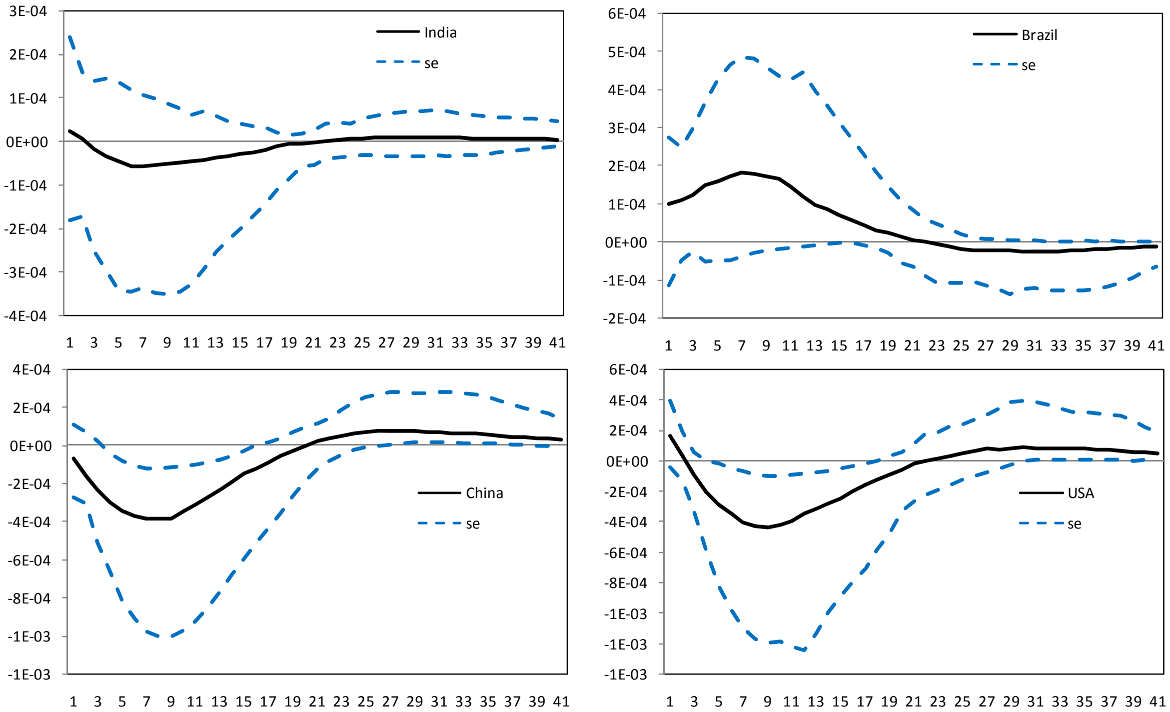
The specification in equations (1) and (4) miss important feedback channels such as the actual output and inflation response and the spill-over effects of these responses. One might be tempted to argue that using the good instruments for the equations will address this issue. Unfortunately it does not given that there are global economic spill-over effects that these equations are not able to capture. Take an increase of interest rates in China as an example: This will most likely reduce or stabilise inflation and cause a contraction in output. China is an important importer. A decrease in Chinese output should decrease its demand for foreign goods and cause a contraction of foreign output for its trading partners. But China's non-trading partners will also be affected if their economies are tied to China's trading partners. To address this issue one would need a global model with well specified structural equations that take into account global effects of domestic shocks.

In Figure 2 we plot South Africa's monetary policy response to shocks in foreign interest rates. In all the specifications equilibrium is achieved after about 21 quarters. This implies that a shock in foreign interest rates has a lasting impact on domestic interest rates. South African interest rates increase for about three quarters before declining in response to interest rate shocks in the U.S. The initial rise in rates corresponds to our finding in Table 1 and Table 2. The subsequent decline would suggest that there are significant spill-over effects (lower U.S. output) to warrant a decrease in South African rates. The results for Indian and Chinese interest rate shocks also confirm the results obtained above, while the impact of Brazilian interest rate shocks on South African interest rate are comparable to Table 2.

It is important to note that the model assumes an underlying steady state generated from linear equations. The economic response to these shocks could differ as economies transition from various states such as a low to high output gap state.

[iv] This is similar to the results obtained in Ortiz and Sturzenegger (2007).

Figure 2: Global New-Keynesian model: South African interest rate response to foreign monetary policy shock



4. Conclusion

We study the independence of monetary policy in South Africa in a context of global monetary policy shocks. We estimate various Taylor rules augmented with foreign monetary policy and compare these results to a global general equilibrium model. The global general equilibrium model takes into account various spill-over effects, such as output and inflation, which would not be captured in the Taylor rule equations.

The results unequivocally show that South African monetary policy is affected by interest rate shocks abroad. The results, however, show that the SARB does not simply import foreign monetary policy decisions in a straight forward fashion. Global spill-over effects such as lower growth from trading partners as a consequence of monetary policy effects South Africa. Apart from the U.S., South African interest rates decrease in response to an increase in interest rates from Brazil, China and India. How independent is monetary policy then really given that it reacts to many shocks that are not directly computed or observable from pure interest rate decisions abroad? Since inflation and output are partly determined by factors outside the domestic policy realm monetary policy is not and cannot be independent from decisions abroad. In a sense the optimal monetary policy literature misses an important channel if it ignores foreign shocks.

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