Navigating Optimal Inflation Targeting in South Africa: A Regime-Switching DSGE Approach

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Roadmap

Research questions and background

1. What is the optimal Inflation Target?
2. Why is it important for South Africa?
3. What has the literature found?
4. What are the gaps in the literature?
5. How do we address this problem?
6. What are the results we find in this study?

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  - Decision influencing price-setters, attention from economic analysts, forecasters, and policymakers alike
  - Ad-hoc target setting, often based on historical averages - need for a more robust framework
  - Risk of setting too high an inflation target and the risk of setting too low a target

WHY IS THIS IMPORTANT (AND FOR SOUTH AFRICA)?

INFLATION TARGET IN SA

-
    - IT framework since 2000 with the goal of maintaining inflation between 3% and 6%

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  - Reserve Bank Governor Lesetja Kganyago outlines: “The emphasis on the 4.5% midpoint had helped lower inflation through "clear and credible communication rather than treating 3% to 6% as a ‘zone of indifference’”

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  - SoE commodity-exporting features of SA economy: international trade, exchange rate mechanisms

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    - SoE commodity-exporting features of SA economy: international trade, exchange rate mechanisms
    - Heteroscedastic external shocks and fluctuations in terms of trade influence macroeconomy and monetary policy decisions

Literature Review

Studies

- **IT and Friedman rule** : Friedman (1969), Foley and Sidrauski (1969),Woodford (1990): a zero nominal interest rate (welfare cost of inflation and the value of money)
- **Developing and EMEs:** 1% above the general 2% inflation of advanced economies (Schmitt-Grohe and Uribe (2011))
- **Central Banks and positive inflation rate**: lean towards low but positive inflation rates to preempt outright deflation, emphasizing the importance of a higher inflation target for financial intermediation Smith (2002)
- **Sacrifice ratio**: Ball (1994), Cecchetti and Rich (2001), Loewald et al. (2022): inflation-targeting countries have lower sacrifice ratios than non-inflation targetters

Literature Review

Studies

- **Low nominal interest rates:** in recessionary environments underscore the complexities of inflation targeting: Summers (1991), Eggertsson and Woodford (2003), Adam and Billi (2006)
- **Computational macro**: Andrade, Galí, Le Bihan and Matheron (2019) dilemma of lower and higher inflation targets for both the U.S. and euro area
- **South Africa**: Honohan and Orphanides (2022), Demertzis and Viegi (2005), Ndou and Gumata (2024), Horn, Martin, Pretorius, Daan (2025): better stabilization in low inflation environment

Gaps in the Literature
Optimal IT

- Lack of models considering optimal IT in commodity-exporting economies like South Africa
- Lack of models to address the computational complexities of changing IT and associated monetary policy reaction function and loss function of SARB
- Impact of varying volatilities and asymmetries largely unaccounted within such an environment

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How do we address these problems?
Model and methodology

- *Novel Contribution*:

1. Extension of macro framework to incorporating key features of commodity exporting economies
2. Regime-switching mechanism into the setup to analyse optimal IT and counter-balancing risk of too low and too high an IT
3. Critically appraise loss function of SARB
4. How monetary policy reaction function affects inflation target
5. How responding to external shocks affect the monetary strategies

Preview of the Results

Answering the research problems

- Optimal IT depends on the central bank's objectives and its monetary policy responses
- Strong response to external shocks to mitigate macro volatilities
- Optimized monetary policy rule with higher concern for inflation bring better price stability

Plan of Presentation
Roadmap

1. The regime-switching model
2. DSGE:
   2.1 Model parameterization

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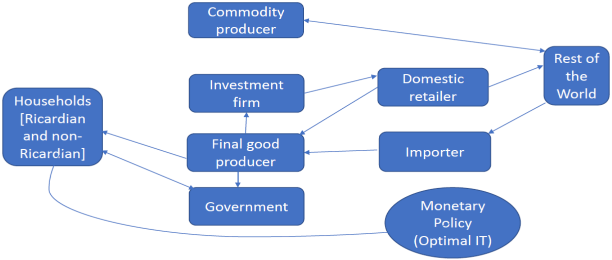
   2.3 Results
   2.4 Sensitivity and robustness

Model

Flow chart



Model

Features

- SoE with non-commodity and commodity good sectors
- Ricardian and non-Ricardian consumers
- Labour supply and wage-setting by Ricardian households
- HH supply labour and invest in domestic bond and foreign bond
- Price setting in domestic and imported goods sectors

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MODEL
FEATURES

- Final good which is a composite of intermediate home and foreign goods
- Consumption, investment and government consumption of final good
- Monetary policy is subject to shifts in commodity price volatilities
- The economy is subject to heteroscedastic shocks of a potentially hostile economic environment

Features elaboration

Structural, MTM, ER dynamics, International Trade

- **Structural Features**: The model encompasses the unique characteristics of a developing commodity-exporting economy like South Africa, including its key sectors such as commodities alongside other sector.
- **Monetary Policy Transmission Mechanisms**: Incorporates various channels through which monetary policy impacts the economy, including interest rates
- **Trade balance and exchange rate dynamics**: Models the dynamics trade balance and exchange rate, considering South Africa's position in global trade and capital flows.
- **Regime Switching**: Incorporates a regime-switching mechanism to capture shifts in the economic environment, including periods of stability and crisis

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Features

Commodity price process and production

- Commodity prices usually quoted in foreign currency (USD) and the effect of exchange rate

$$rer_t p^*_{c,t} = p_{c,t}$$

- $AR(1)$ for real commodity price $p^*_{c,t}$ (prices set in world market)

$$\frac{p^*_{c,t}}{p^*_c} = \left(\frac{p^*_{c,t-1}}{p^*_c}\right)^{\rho_{c,1}} e^{\sigma_{p^*_c}(r_t)\varepsilon_{p_{c,t}}}$$

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Taylor Rule

Monetary policy reaction function

- Monetary policy sets policy according to Taylor rule

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_r} \left[\left(\frac{\Pi_t}{\Pi^T}\right)^{\alpha_\pi(t)} \left(\frac{\Delta GDP_t}{\Delta GDP_{t-1}}\right)^{\alpha_y(t)}\right]^{1-\rho_r(t)}$$

- The coefficients $\alpha_\pi(t), \alpha_e(t)$:

$$\begin{aligned} \alpha_\pi(t) &= \alpha_{\pi,c} + \alpha_{\pi,\sigma}.\sigma_{\text{commodity prices},r_{low,t}} \\ \alpha_y(t) &= \alpha_{y,c} + \alpha_{y,\sigma}.\sigma_{\text{commodity prices},r_{high,t}} \end{aligned}$$

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Parameterization Approach
Calibration and estimation

- Calibrated subset of parameters (θ_1)
- Estimation of a subset of parameters using Bayesian techniques to handle complexities and uncertainties in macroeconomic modelling over sample period 2000:Q1 - 2019:Q2 (θ_2)
- Estimation of Taylor rule parameters (trp)

Parameters	Distribution	Init. Value	Mode
ρ_r	*beta*	0.5	0.85566
$\alpha_{\pi,c}$	*gamma*	1	1.8624
$\alpha_{\pi,\sigma}$	*normal*	0	0.060247
$\alpha_{y,c}$	*gamma*	0.2	1.1
$\alpha_{y,\sigma}$	*normal*	0	0.6965
$\sigma_{p_c^*}(r_{low})$	*inv. gamma*	0.01	0.052557
$\sigma_{p_c^*}(r_{high})$	*inv. gamma*	0.01	0.129

Optimization of the Inflation Target

Loss function and Simulation process

- Central Bank loss function:

$$\min_{\rho_r,\alpha_\pi(t),\alpha_y(t),\Pi^T} L = \left(\Pi_t - \Pi^T\right)^2 + w\_dy * \left(\widehat{GDP_t} - \widehat{GDP_{t-1}}\right)^2 + w\_di * \varphi_R \left(\hat{R}_t - \hat{R}_{t-1}\right)^2$$

- Artificial shocks are generated and used to evaluate the loss
- The process is to find the optimal inflation target with the associated policy reaction function

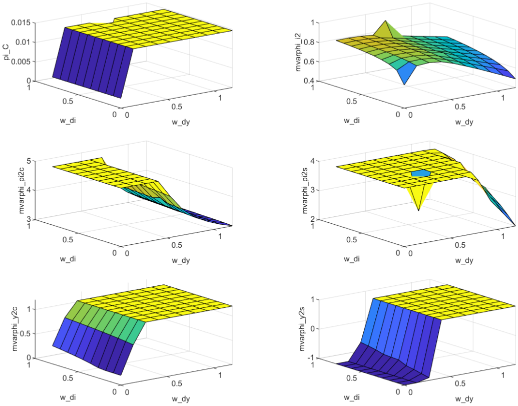
RESULTS

KEY FINDINGS ON OPTIMAL IT

- Discussion of how the central bank's weights on inflation, output and interest rate affect the monetary policy reaction function
- Discussion of how the central bank's weights on inflation, output and interest rate affect Optimal IT

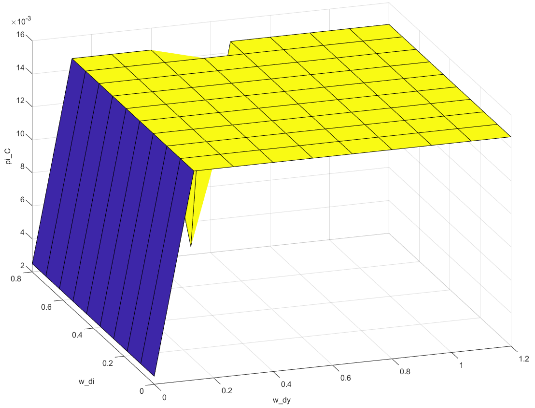
Optimal IT

How variations in MP reaction function affect Optimal IT



Optimal IT

How variation in weights affect Optimal IT



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Results

Comparison of IRFs

- Impulse response functions under optimized monetary policy rules vs estimated monetary policy rule
- Does optimized rules lead to lower fluctuations following shocks to the economy
- Estim: IRFs under estimated model
- Optim1: IRFs under optimized monetary policy rule with strict inflation concern
- Optim2: IRFs under optimized monetary policy rule with output and interest rate stabilization

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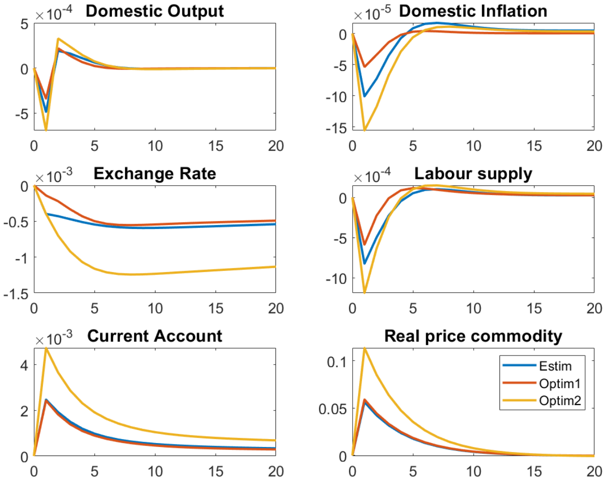
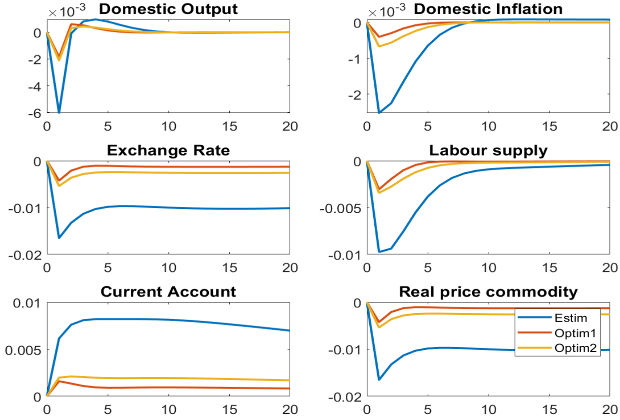
Results

Comparison of IRFs - Commodity price shock



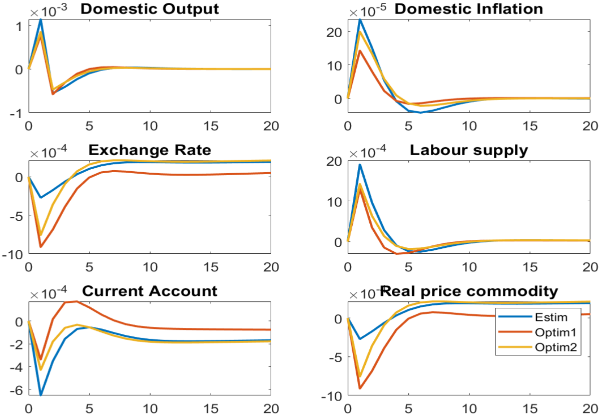
Results

Comparison of IRFs - Monetary shock



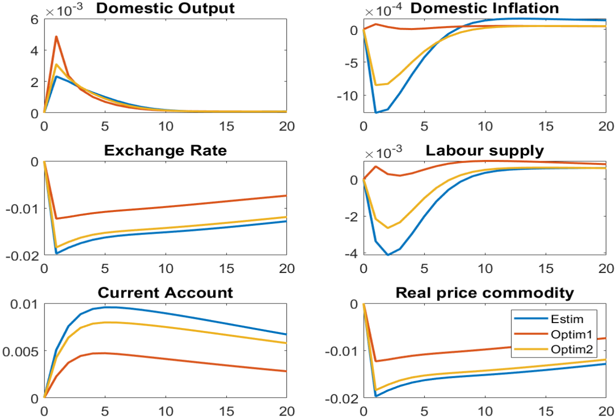
Results

Comparison of IRFs - Demand shock



Results

Comparison of IRFs - Supply shock



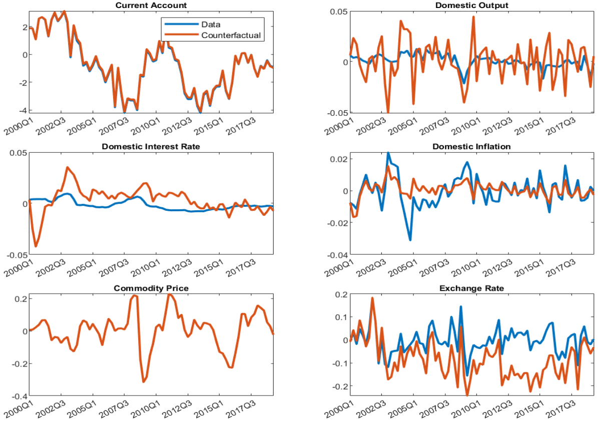
Counterfactual analysis

Comparison

- How did the economy behave with actual monetary policy?
- How would the economy behave had the SARB implemented an optimized rule

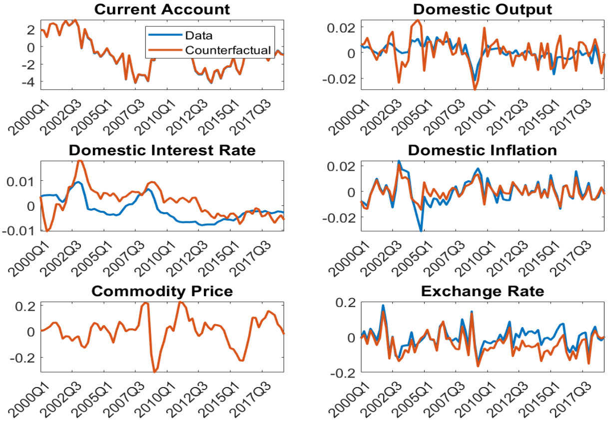
Counterfactual analysis

Data vs Counterfactual under Optim1



Counterfactual analysis

Data vs Counterfactual under Optim2



Results

1. Optimal inflation target depends on the Central Bank's preferences, its reaction function and the economic environment
2. The higher the weight on inflation and the concern of the Central Bank to curb inflation, the lower is inflation
3. Comparison of estimated Taylor rule and optimized policy rule brings better price stability