TROUBLE EVERY DAY: MONETARY POLICY IN AN OPEN EMERGING ECONOMY

Ekaterina Pirozhkova
Giovanni Ricco
Nicola Viegi

SCIENCES PO OFCE WORKING PAPER n° 01/2025

EDITORIAL BOARD

CONTACT US

OFCE
10 place de Catalogne | 75014 Paris | France
Tél. +33 1 44 18 54 24
www.ofce.fr

WORKING PAPER CITATION

This Working Paper:
Ekaterina Pirozhkova, Giovanni Ricco and Nicola Viegi
Trouble Every Day: Monetary Policy in an Open Emerging Economy
Sciences Po OFCE Working Paper, n° 01/2025.
Downloaded from URL: www.ofce.sciences-po.fr/pdf/dtravail/WP2025-01.pdf
DOI - ISSN

ABOUT THE AUTHORS

Ekaterina Pirozhkova, EM Normandie, Metis Lab, South African Reserve Bank
Email Address: ekaterina.pirozhkova01@gmail.com
Giovanni Ricco, CREST, Ecole Polytechnique, University of Warwick, OFCE, ERSA, CEPR
Email Address: giovanni.ricco@polytechnique.edu
Nicola Viegi, University of Pretoria, ERSA
Email Address: mailto:nicola.viegi@up.ac.za

ABSTRACT

Four factors drive the high-frequency impact of monetary policy announcements in South Africa: affecting short-, mid-, and long-term yield curve, as well as country risk. Controlling for information effects, we build IVs to study the transmission of conventional monetary policy, forward guidance, term premia, country risk and information shocks. Our findings reveal textbook contractionary effects of conventional monetary policy. Policy communication, particularly forward guidance, has persistent effects on output and prices. Country risk is a novel and powerful channel of monetary policy communication in emerging markets. By defending its independence, re-stating its inflation target objective, and addressing external shocks, the central bank can mitigate country risk and generate strong expansionary effects.

KEYWORDS

Monetary policy, Small Open Economy, Inflation Targeting, Exchange Rates.

JEL

E5, F3, F4, C3.

Trouble Every Day: Monetary Policy in an Open Emerging Economy

Ekaterina Pirozhkova*
EM Normandie, Metis Lab,
South African Reserve Bank

Giovanni Ricco†
CREST – École Polytechnique,
University of Warwick, OFCE, ERSA, CEPR

Nicola Viegi‡
University of Pretoria, ERSA

First Version: February 2021
This version: 13 November 2024

Abstract

Four factors drive the high-frequency impact of monetary policy announcements in South Africa: affecting short-, mid-, and long-term yield curve, as well as country risk. Controlling for information effects, we build IVs to study the transmission of conventional monetary policy, forward guidance, term premia, country risk and information shocks. Our findings reveal textbook contractionary effects of conventional monetary policy. Policy communication, particularly forward guidance, has persistent effects on output and prices. Country risk is a novel and powerful channel of monetary policy communication in emerging markets. By defending its independence, re-stating its inflation target objective, and addressing external shocks, the central bank can mitigate country risk and generate strong expansionary effects.

Keywords: Monetary policy, Small Open Economy, Inflation Targeting, Exchange Rates.
JEL Classification: E5, F3, F4, C3.

*EM Normandie, Metis Lab, 9 rue Claude Bloch, 14000 Caen, France. Email: ekaterina.pirozhkova01@gmail.com

†CREST, École Polytechnique, 5 Av. Le Chatelier, 91120 Palaiseau, France. Email: giovanni.ricco@polytechnique.edu Web: www.giovanni-ricco.com

‡Department of Economics, University of Pretoria. Email: nicola.viegi@up.ac.za

The opinions expressed herein solely represent those of the authors and do not necessarily reflect the views of the South African Reserve Bank. We thank Riccardo Degasperi, Anshumaan Tuteja and Charl van Schoor for research assistance. We are grateful to Refet Gürkaynak for sharing the updated daily US monetary surprise series and for his numerous insightful suggestions as a discussant. We are also thankful to Mamokete Lijane for her valuable comments and for sharing the methodology of the forward rates' transformation. We acknowledge Guido Ascari, Romain Houssa, Karel Mertens, and participants of the first CEPR-SARB workshop, as well as attendees of the seminar series at De Nederlandsche Bank, University of Namur, Toulouse School of Economics, University of Alicante, and Armenian Economic Association for their insightful remarks. Lastly, Giovanni Ricco acknowledges financial support from the SARB as an International Research Fellow of the bank.

Introduction

In recent years, significant strides have been made in advancing our understanding of how monetary policy operates. High-frequency and narrative empirical methods have been employed to study how monetary policy announcements affect market expectations (e.g. Kuttner, 2001, Gürkaynak et al., 2005a, Altavilla et al., 2019, Swanson, 2021) and transmit to the economy (e.g., among many others, Gertler and Karadi, 2015, Nakamura and Steinsson, 2018, Jarociński and Karadi, 2020, Lunsford, 2020, Miranda-Agrippino and Ricco, 2021). However, despite the wealth of literature, research on monetary policy transmission has almost exclusively focused on the US, with a secondary role for other advanced economies, such as the Euro Area, the UK, Japan and Canada.

Yet, little is still known about the effectiveness of monetary policy and how it operates in emerging markets, and smaller open economies (see Frankel, 2010 for a classic survey on the topic).[1] This paper tries to make some headway into these questions by applying event study and high-frequency identification techniques to South Africa to study, first, how monetary policy communication affects the yield curve and other assets, and second, how it transmits to the economy. In doing so, we recognise that emerging markets are of great interest due to their growing role in the global economy. This importance highlights the significant gap in the literature. Additionally, emerging markets offer unique policy settings where important but less visible channels, compared to advanced economies, can be studied.

The democratic South Africa that has emerged from the post-apartheid transition has a special position among emerging markets. It shares a large number of institutional characteristics with advanced economies: flexible exchange rates, an open capital account, developed and deep financial markets, central bank's independence, modern central banking and inflation targeting. Yet, it is undoubtedly an emerging economy with the trademark characteristics of developing countries: unsteady growth, greater exposure to supply shocks, spillovers from shocks originating abroad, dependence on and vulnerability

[1] Notable recent exceptions are Checo et al. (2024) that employs analysts' forecasts of policy rate decisions to build measures of conventional policy shocks for a panel of emerging markets, Lakdawala and Sengupta (2021) that studies monetary policy in India using high-frequency identification, and Ho and Karagedikli (2021) that identifies two monetary policy factors driving responses of the yield curve to monetary policy announcements in Malaysia being a non-inflation targeting economy. The earlier studies of Reid (2009) and Larraín (2005) analyse the effect of high-frequency monetary policy surprises on the private sector inflation expectations in South Africa and on the term structure of interest rates in Chile, respectively.

to capital and trade flows, lower credibility with respect to both price stability and default risk, high inequality, and a contested institutional framework. These facts make the country an ideal setting to study the effects of monetary policy in an emerging market, with modern methods.

During the whole period covered by this study, from 2002 to 2020, the monetary policy framework has been relatively stable. The South African Reserve Bank (SARB) adopted inflation targeting in 2000, one of the earliest central banks in emerging markets to do so. The inflation target is defined as the band of 3-6% for the headline consumer price index, with the aim to maintain inflation close to the midpoint of the band. The Monetary Policy Committee (MPC) is responsible for setting the bank's repurchase rate (repo rate) to meet the SARB's price stability objective. The monetary policy decisions are communicated in the form of the MPC statements, while the Governor delivers a press statement at a televised press conference. At the same time as the announcement, the SARB publishes on its website a report containing its forecasts of key macroeconomic variables.

Our analysis proceeds in steps. First, we construct daily measures of how the SARB's monetary policy decision announcements affect the prices of interest rate derivatives – forward agreements and interest rate swaps – and country default swaps.[2] We then extract four principal components from these price revisions that capture meaningful commonalities and rotate them to capture specific dimensions of monetary policy, following the approach of Gürkaynak et al. (2005a). In particular, we identify four factors, which we call monetary policy surprises, affecting respectively the short, the medium, and the long end of the yield curve, and the country risk premium. We analyse the effects of these surprises on financial assets, in an event study approach.

Second, we provide an interpretation of the identified monetary policy factors by examining market expectations, as reported by the Bloomberg market survey, alongside the SARB's communication in the MPC statements, and the business commentary from the local financial press. We analyse these sources both prior to and following MPC meetings to gauge the alignment of market expectations with the policy decisions made, the

[2]The market of derivative instruments in South Africa is well-developed and deep. The daily turnover of the South African rand-denominated interest rate derivatives is more than 27 billion U.S. dollars being the tenth market in the world by volume. Interest rate swaps have a daily turnover of more than 23 billion U.S. dollars, while the forward rate agreements' daily turnover is 3 billion dollars in 2022 (see BIS, 2022).

rationale declared by the SARB, and the market's understanding of the policy decisions. The narrative of the events allows us to interpret (i) the factor affecting the short end of the yield curve as related to conventional monetary policy actions; (ii) the medium-term factor as an implicit forward guidance factor related to shifts in the perceived forward path of the repo rate; (iii) the factor affecting the long end of the yield curve as connected to the perceived economic and policy uncertainty, as communicated by the bank; (iv) the country risk factor communication of the SARB about risks to the economy – either due to critical external events or to internal political and institutional challenges to its mandate. The last factor is of great importance: communications showing careful balancing of risks, or reaffirming the objective of price and macroeconomic stability and the central bank independence reduce the country's risk premium, and vice versa.

Third, we study the informational content of the surprises and create informationally robust IVs to identify policy shocks. We clean the four factors from information effects by regressing them on a measure of the SARB forecasts, as proposed by Miranda-Agrippino and Ricco (2021). This is important in light of the recent literature on information effects in monetary policy (see Nakamura and Steinsson, 2018 and Jarociński and Karadi, 2020), but also because policy announcements coincide with the disclosure of the bank's macroeconomic forecasts and information on its expectations on the path of the policy rate. The procedure delivers four IVs to identify the multidimensional effects of policy actions and policy communication – conventional monetary policy, exogenous forward guidance, term premia and country risk shocks –, plus an IV for the information component of the bank's communication. The intuition for our methodology is supported by an affine model of the yield curve in the spirit of Ang et al. (2007) and Smith and Taylor (2009), that we extend in an imperfect information setting to have persistent inflation, and shocks affecting the curve at different maturities.

Finally, we employ the five IVs as external instruments (see Stock and Watson, 2012 and Mertens and Ravn, 2013) to study the propagation of the different dimensions of monetary policy actions and communication in a medium-scale SVAR setting with standard macroeconomic priors, that incorporates both macroeconomic and financial variables at monthly frequency.

Our analysis delivers a rich set of results and a few key novel findings. Let us summarise them as follows. Policy decisions are often unanticipated and come to market

participants generally as a surprise. This is evident in the high correlation (62%) between repo changes and forecast errors. This is not the case for the Federal Reserve's and the ECB's policy rate announcements. Our narrative analysis and this result point to the difficult nature of central banking in emerging markets where the policymakers have to perform complex balancing acts in controlling inflation while protecting macroeconomic stability, in a vulnerable environment. This interpretation is also supported by a variance decomposition analysis showing that conventional monetary policy shocks explain a smaller share of the variance of prices and industrial production compared to advanced economies. These results indicate that the lower predictability is due to the more volatile environment, and not to the lower quality of policymaking and communication.

Conventional monetary policy shocks affect the economy with conventional contractionary effects, in line with results from advanced economies, and with no evidence of 'perverse transmission' (see Gourinchas, 2018, for a discussion on this). A 100 bps exogenous tightening lifts the short-end of the yield curve more than the longer maturities, stock and house prices fall, bank credit issuance contracts, CDS spread increases, industrial production strongly contracts, and prices fall.

Interestingly, the high-frequency identification of conventional monetary policy shocks yields results indistinguishable from those obtained through traditional recursive identification methods. Unlike advanced economies where recursive and high-frequency identifications offer qualitatively and quantitatively distinct results (see, for example, Gertler and Karadi, 2015 and Miranda-Agrippino and Ricco, 2021), our findings reveal that in South Africa, they coincide due to the lower policy predictability. This suggests that employing more complex techniques may not be necessary, and robust old-style approaches suffice. We conjecture that this practical insight may extend to many other emerging economies where high-frequency identification is not feasible, yet traditional recursive identification can be easily applied.

The macroeconomic effects of the information shock in South Africa are consistent with the central bank responding to supply shocks that depress output and increase prices. This is different from the case of advanced economies where information shocks appear to be related to demand factors (see, Jarociński and Karadi, 2020 and Miranda-Agrippino and Ricco, 2021), and in line with the prevalent role of supply shocks in emerging markets (see Frankel, 2010).

Policy communication delivers significant macroeconomic effects. Forward guidance shocks, unrelated to the economic conditions, lift the medium part of the yield curve with both output and prices persistently negatively affected. This is an interesting result since the SARB does not explicitly use forward guidance as a policy tool. Conversely, pure term premium shocks have subdued macroeconomic effects (see Hansen et al., 2019, on the effects of policy communication and uncertainty on the long end of the yield curve). While they induce a steepening of the yield curve and a contraction of bank lending, the response of macroeconomic variables is largely statistically insignificant.

Country risk shocks have large contractionary effects on the South African economy. They induce a hike of the country's default risk premium, portfolio reallocation by global investors, a contraction of the stock market value. The South African rand depreciates strongly against the U.S. dollar and the euro, industrial production and prices contract. This is a novel and important channel of transmission of monetary policy in emerging markets, that has not been previously reported. It shows that the central bank can effectively modulate risks to the macroeconomic stability of the country and to its independence, thus modifying the expected distribution of future events.

What kind of events are captured by these shocks? Our narrative analysis of business commentaries reveals that spikes in the country risk factor are associated with the perceived credibility (or lack thereof) of the SARB's response to either external shocks that increase economic risk, or internal events that threaten its independence and price stability mandate. An example of the former is the rise in country risk, following the collapse of Lehman Brothers in 2008, caused by the SARB's lack of response and apparent unawareness of the associated risks. An example of the latter is the large reduction in country risk caused by the SARB's unexpected 25 bps rate hike in March 2016. This occurred amid political turmoil sparked by major scandals related to state capture during Zuma's presidency and challenges to the bank's independence. Markets interpreted the SARB's actions as a strong signal of its reaffirmation of independence and commitment to sound macroeconomic policies. The Business Day economic editor wrote:

> This is not the time to take any chances with either policy credibility or the exchange rate. [...] the dramatic disclosures of the Gupta family's influence on ministerial appointments have undermined SA's credibility with investors further and put new downward pressures on the rand. [...] if the committee's

> response was on the hawkish side [...], it cannot be faulted for acting to manage the risks as best as it can.

This channel of monetary policy may seem at first surprising, since central banks in advanced economies are generally not supposed to affect long-run and country risks.[3,4] Yet, Mario Draghi's 'whatever it takes' announcement was possibly an event of this kind, where a central bank communication drastically reduced perceived risks in the form of euro area disintegration, induced repricing of country spreads, and had large macroeconomic effects (see also Leombroni et al., 2021, on this point). In emerging markets, one could say, every day is a whatever it takes day for policymakers.

Moreover, our results contribute to the literature that has examined the role of policy framework credibility in determining the sensitivity of long-term rates to economic news and monetary policy announcements in advanced economies (see, among others, Gürkaynak et al., 2005b, 2010, and Gürkaynak and Wright, 2012 for a review). This literature has pointed to the importance of establishing a credible inflation target and central bank independence in anchoring the long-end of the yield curve and in reducing its sensitivity to news. Notable cases are the independence of Bank of England in 1998, and the formalisation of the Fed 2% target in 2012 exemplify this effect. Similarly, in the context of an emerging market, our results point to the role of independence and credibility in shaping the response of the long-end of the yield curve and the overall market pricing of the country risk.

This paper is organised as follows. Section 1 provides background information on the South African economy and the SARB's monetary policy framework. Section 2 describes an affine model in an imperfect information setting and provides intuition to our approach. The monetary policy surprises are constructed in Section 3 and studied in an event study approach. Their information content is assessed in 4 to build IVs to identify the multiple dimensions of monetary policy. Section 5 provides a narrative that supports our use of these IVs to identify conventional monetary policy, forward guidance, term premium and country risk shocks. Sections 6 and 7 study, respectively, the transmission of conventional

[3]The ability of monetary policy to affect macroeconomic conditions by changing risk-taking and risk premia has been long recognised as the 'risk-taking channel' of monetary transmission (see, among others, Ireland, 2015, Borio and Zhu, 2012 and Bauer et al., 2023). Cieslak and Pang (2021) propose a detailed empirical analysis of the effects of Fed's announcements on risk premia.

[4]Our results are in line with the evidence of Kalemli-Özcan and Unsal (2024) that find that monetary policy credibility is a key factor in emerging markets in reducing the increase in risk spreads, conditional on US monetary policy shocks.

monetary policy and the other three policy shocks onto macro and financial aggregates in an SVAR approach. Section 8 concludes. Additional results, model derivations, and details of our analysis are provided in an Online Appendix.

1 The policy framework in South Africa

South Africa is a small open economy with modern economic institutions: flexible exchange rates, an open capital account, developed and deep financial markets, an independent central bank, and inflation targeting. Yet, it is an emerging economy with high exposure to capital flows and foreign shocks, high wealth and income inequality, and a potentially fragile institutional framework.

Our study covers roughly three periods of the recent economic history of the country, which spans the sample from 2002 to 2020. In the first part of our sample – before the 2008 global financial crisis –, the SARB navigated its inflation target mandate in an economy characterised by booming demand and sustained economic growth, rising inflation and an appreciating currency which was affecting manufacturing and export sectors. External conditions were favourable with high commodity prices, low inflation and low interest rates. The second part of our sample – from January 2008 until September 2014 – starts with the onset of the global financial crisis and ends when the U.S. Federal Reserve began tapering its quantitative easing policies. This period is characterised by a challenging external environment and large shocks that saw the SARB striving to strike a delicate balancing act to maintain price stability while managing macroeconomic risks to the economy. In the final period of our sample, the SARB operated against a backdrop of worsening internal economic conditions and growth prospects, degradation of the country's institutional setting and state capture under Zuma's presidency, and increasing political uncertainty and challenges to the SARB's independence.

1.1 The monetary policy framework

Let us start by illustrating the monetary policy institutional setting that is at the core of this work. The independence of the central bank is enshrined in South Africa's democratic constitution, providing it a stronger foundation than many advanced economies. Article 224 of the constitution defines the objective of the South African Reserve Bank as 'to

protect the value of the currency in the interest of balanced and sustainable economic growth in the Republic', and states that 'the South African Reserve Bank, in pursuit of its primary object, must perform its functions independently and without fear, favour or prejudice'. Indeed, the independence of the Central Bank and its objective of price stability has been regularly reasserted in Monetary Policy Committee (MPC) statements, Governor speeches and in acts of the parliament.[5]

In exercising its independence, the SARB adopted inflation targeting in 2000, being one of the earliest emerging market economies to do so. The target for inflation is defined as the band of 3-6% for the headline consumer price index, as calculated by Stats SA.[6] Since 2017, the MPC has emphasised its aim to maintain inflation close to 4.5%, the midpoint of the inflation target range.

The SARB does not target the exchange rate and does not seek to affect its volatility, leaving the exchange rate free to float. In fact, the SARB's participation in FX markets is limited to the accumulation of foreign reserves, which constitute, alongside with gold, almost the entire asset side of its balance sheet.

The SARB's Monetary Policy Committee (MPC) is responsible for formulating monetary policy to meet the SARB's price stability objective. The MPC meets at least 6 times per year, with meetings held over two days. It sets the repurchase rate (repo rate), which is the main steering tool of monetary policy in South Africa (see Figure 1). Decisions are taken by consensus and the SARB's Financial Markets Department implements the interest rate policy as determined by the MPC.

The monetary policy decisions are communicated by the SARB in the form of MPC statements, while the Governor delivers a press statement at a televised press conference, which includes a question-and-answer session with financial journalists. Usually a statement gives an overview of important domestic and foreign economic developments, informs about the level of the repurchase rate as set by the MPC, and provides reasoning for this choice. An MPC statement is published on the SARB website during the media briefing.[7] At the same time when the MPC statement is published, the SARB releases a report with up to two-year-ahead quarterly forecasts of key macroeconomic variables,

[5]The SARB performs its functions independently, although regular consultation between the Central Bank and the Ministry of Finance happens in the framework of the institutional dialogue.

[6]Before adopting the inflation-targeting framework, the SARB used several different frameworks, including exchange rate targeting and money supply targeting.

[7]Typically, a press statement starts at 15:00 CAT with the reading of the statement, which is then published around 15:10-15:30 CAT, depending on how long the statement is.

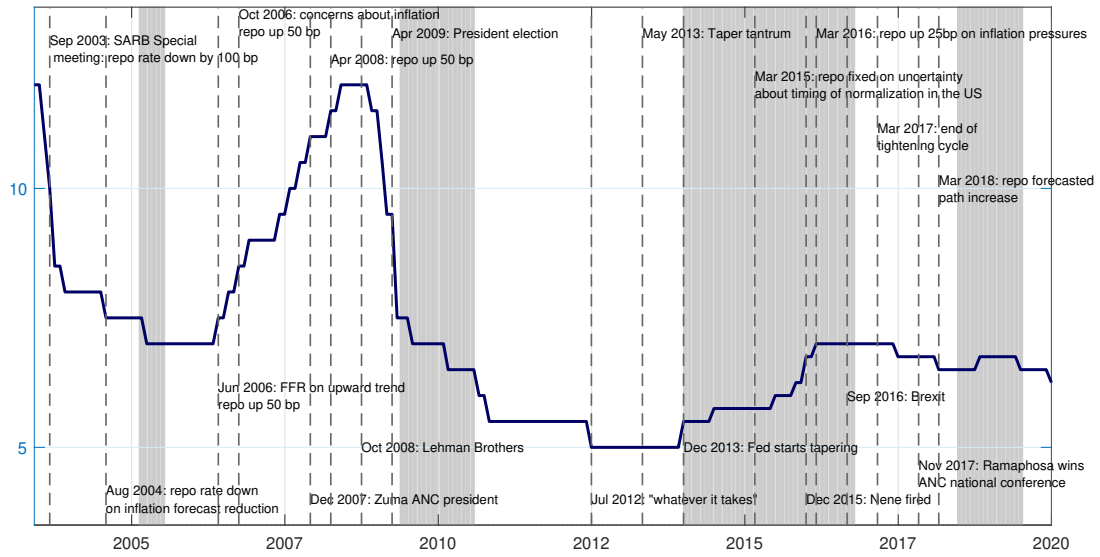


Figure 1: SARB's repurchase rate and important events around the policy decision.

such as GDP growth rate, CPI inflation and the repurchase rate. The SARB also holds post-MPC meetings with domestic and international investors and analysts to further clarify its actions and outlook.

The MPC meeting dates move in the course of the years, and are typically announced for the following year in the last MPC statement of the previous year. Starting from February 2000, when the SARB introduced the inflation targeting framework, the vast majority of MPC meetings have been scheduled – 120 out of 127 in total. Most of unscheduled meetings occurred during the global financial crisis of 2008-2009 – i.e. in March, May, September and November 2009. With the exception of 2020, there have been 6 MPC meetings per year since 2010, which are held every other month.[8]

Until 2022, the period of interest for this work, the SARB operated a classical cash reserve system, whereby a money market shortage was created by levying a cash reserve requirement on banks.[9] In this system, banks refinanced their shortage at the SARB through weekly repo auctions, which were conducted every Wednesday and had a maturity of seven days, at the prevailing repo rate as determined by the MPC.[10] The SARB does not provide unsecured loans, and therefore, participating banks have to provide eligible collateral as security for the funds received.

[8]Starting from 2010, MPC meetings have been held in January, March, May, July, September and November of every year.

[9]In June 2022, the SA Reserve Bank moved away from implementing monetary policy through a classical cash reserve or shortage system, to a surplus or tiered floor system.

[10]During the MPC rate decision week, the main repo auction will be conducted for two days (maturing on a Friday) and then again for five days (maturing on the next Wednesday).

The SARB has not used unconventional monetary policy instruments during our sample period. The SARB intervened to support the secondary government bond market only in the beginning of the COVID-19 pandemic, which is outside of our period of study.[11]

1.2 Financial markets

For its income level, South Africa has a well developed and relatively liquid financial market. The foreign exchange market's turnover is consistently among the top 20 in the world, with a daily average turnover of 73 billion U.S. dollars (in 2022), which is approximately 18% of the annual GDP (see BIS, 2020). The stock market capitalisation is around 300% of GDP and the size of the domestic bond market is around 85% of GDP. The bond market is dominated by the government debt instruments that are mainly domestic currency denominated and have an average maturity of 14.8 years (in 2020) compared to the emerging market average of 8 years. Non-resident trading in domestic securities is substantial, especially in the fixed income market, where foreign holdings of national government bonds had reached a maximum of 43% in 2018 before receding to below 30% in 2022 (see SARB, 2022).

The market of derivative instruments, which is important for this study, is also well-developed. The daily turnover of the South African rand-denominated interest rate derivatives is more than 27 billion U.S. dollars being the tenth market in the world by volume. The bulk of interest rate derivatives are interest rate swaps with a daily turnover of 23 billion U.S. dollars, while the forward rate agreements' daily turnover was 3 billion U.S. dollars in 2022 (see BIS, 2022).

1.3 Emerging or submerging?

South Africa emerged from Apartheid in the early 90's as a young democracy with a modern constitution, a difficult reconciliation, enormous social challenges, the prospect of economic growth and a robust hope in the future. Over the course of the years, its performances have been mixed. Today, it is a small open upper-middle income country

[11] In response to the Covid-19 crisis, the SARB introduced several measures to inject liquidity into the market. These included an intra-day supplementary repo auction, as well as a long-term repo of up to 12 months. These instruments have since been discontinued as of December 2020 and March 2021 respectively, following a gradual return to normal money market conditions.

with a value of income per capita of 7055 U.S. dollars (in 2021).

The openness index of the country fluctuated around the high 50% of GDP, after the country reintegrated in the global economy with the end of apartheid. More than 50% of its exports are stone and minerals, and the mining sector has been traditionally the driver of the country's economic performance. The structure of the economy is dominated by the services sector that contributed 62% of GDP, while agriculture and industry contributed a declining share of 3% and 25%, respectively.

Despite its potential, South Africa has experienced disappointing economic growth, with GDP per capita lower in 2019 than in 2008, even before the COVID-19 pandemic further worsened its economic performances. The country has the highest unemployment rate among nations not at war and the highest income inequality in the world. The economic environment presents significant challenges for macroeconomic policymaking, with intense debate about the roles of fiscal and monetary policy in ensuring economic stability versus providing income and growth support.

2 Surprises, information, risk and monetary shocks

To provide a framework for our empirical approach we move in two steps. First, we write down an affine model of the yield curve in the spirit of Ang et al. (2007) and Smith and Taylor (2009) that we extend to have persistent inflation and a range of shocks. Then, we embed the model in an imperfect information setting and derive the structure of monetary policy surprises.[12] The predictions derived from the model will guide our empirical procedure first to identify meaningful factors from the term structure of the policy surprises, and then to map those factors into exogenous policy shocks.

[12]Details of the derivations are provided in Appendix A.

2.1 A term structure model with shocks

Let us consider an affine model of the yield curve in which the central bank targets inflation, and different types of shocks affect the interest rates:

$$
\begin{aligned}
r_t &= \delta\pi_t + \sigma_{mp}u_t^{mp}, && (1)\\
i_t^{(n)} &= -\frac{1}{n}\log P_t^{(n)}, && (2)\\
P_t^{(n+1)} &= E_t\left[m_{t+1}P_{t+1}^{(n)}\right], && (3)\\
m_{t+1} &= e^{-r_t-\frac{1}{2}\lambda_t^2-\lambda_t u_{t+1}^{\pi}}, && (4)\\
\lambda_t &= -\gamma_t - \psi\pi_t - \xi_t^{\lambda}, && (5)\\
\xi_t &= \rho\xi_{t-1} + \sigma_{\xi}u_t^{\xi}, && (6)\\
\gamma_t &= \gamma_{t-1} + \sigma_{\gamma}u_t^{\gamma}\ , && (7)\\
\pi_t &= \alpha\pi_{t-1} - \phi(r_{t-1}-\pi_{t-1}) + \sigma_{\pi}u_t^{\pi}. && (8)
\end{aligned}
$$

In the model, the four shocks affecting the yield curve – inflation, monetary policy, time-varying and constant risk – are independent and identically distributed normal white noise processes, $u_t^i \sim iidN(0,1)$ for $i \in (\pi, mp, \gamma, \xi)$.

The Taylor rule in Eq. (1) has the short-term nominal interest rate r_t reacting to the inflation rate, with a policy response coefficient $\delta > 0$. Eq. (2) gives the yield to maturity of a zero-coupon bond with a face value of 1 that matures in n periods, where $P_t^{(n)}$ is the price of the bond at time t. Eq. (3) is a no-arbitrage condition showing that the price of an $n+1$ period bond at time t must equal the expected present discounted value of the price of an n-period bond at time $t+1$, where m_t is the stochastic discount factor.

The stochastic discount factor (Eq. 4) is modelled using a functional form that is standard in the affine term structure literature. However, we depart from the standard assumption by considering the risk factor (Eq. 5) as depending on a constant risk premium, γ_t, and a time-varying risk premium, ψ, connected to changes in inflation. The risk factor changes over time due to either temporary disturbances, ξ_t, (Eq. 6), or to permanent changes to the constant risk premium (Eq. 7). We think of the former as capturing transitory increases in the risk at business cycle frequency, while the latter as permanent changes to the perceived country risk. Finally, Eq. (8) is the dynamics of inflation, which is a function of the lagged real interest rate and the past inflation.

The model can be further extended to capture the effects of increases in the policy uncertainty, by considering a time-varying volatility of monetary policy shocks, i.e.

$$\sigma_{mp,t} = \sigma_{mp,t-1} + u_t^{\sigma_{mp}} \ . \tag{9}$$

Lemma 1. *The yield curve described by the model in Eq.s (1-9) is*

$$i_t^{(n)} = a_n + b_n \pi_t + c_n u_t^{mp} + d_n \xi_t + g_n \gamma_t \tag{10}$$

with coefficients of the disturbances given by

$$\begin{aligned} b_n &= \frac{\delta \sum_{i=0}^{n-1} \kappa^i}{n}, & c_n &= \frac{\sigma_{mp}\left(1 - \phi\delta \sum_{i=0}^{n-2} \kappa^i\right)}{n}, \\ d_n &= \frac{\delta\sigma_\pi \sum_{i=1}^{n-1} \rho^i \sum_{j=0}^{i-1} \kappa^j}{n}, & g_n &= \frac{\delta\sigma_\pi \sum_{i=1}^{n-1} \sum_{j=0}^{i-1} \kappa^j}{n}, \end{aligned} \tag{11}$$

$$h_n = \frac{1}{n}\left(\delta\phi \sum_{i=1}^{n-1}\sum_{j=1}^{i-1} \kappa^j + \frac{1}{2}\delta^2\phi^2 \sum_{i=1}^{n-1}\left(\sum_{j=1}^{i-1} \kappa^j\right)^2 + \frac{n-1}{2}\right),$$

for $\kappa = (\alpha + \phi(1-\delta) + \sigma_\pi\psi)$.

Given the structure of the yield curve it is possible to verify analytically the following results on the response of interest rates at different maturities to shocks.[13]

Lemma 2. *The response coefficients of the yield curve*

(i) to inflation and monetary policy shock decrease over the maturities, i.e. $\frac{\partial b_n}{\partial n} < 0$, $\frac{\partial c_n}{\partial n} < 0$;

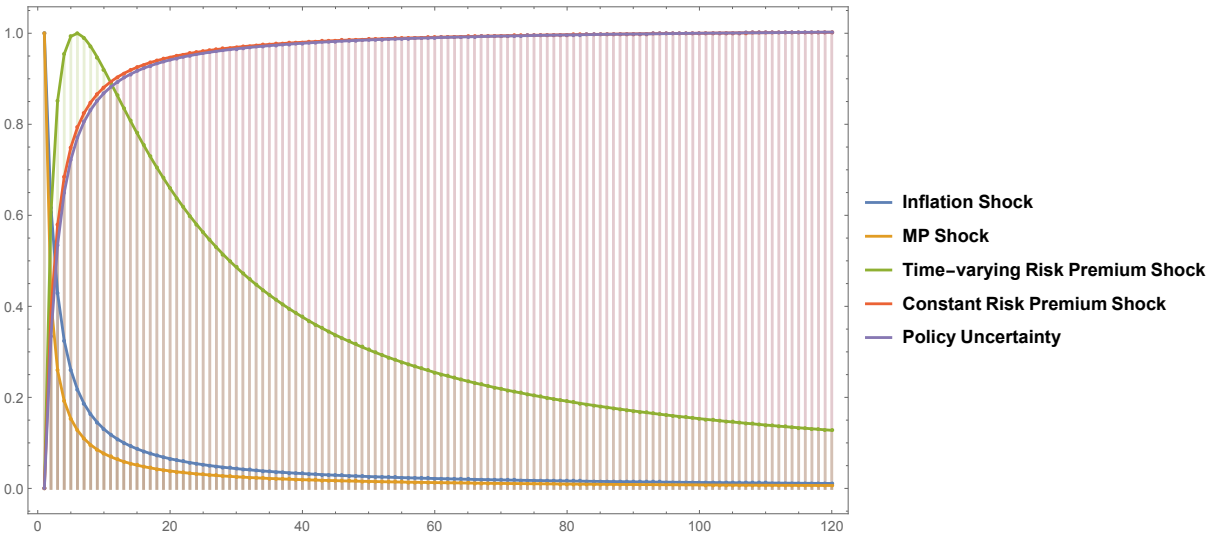
(ii) to the constant risk premium and the monetary policy uncertainty shocks increase over the maturities, i.e. $\frac{\partial g_n}{\partial n} > 0$ *and* $\frac{\partial h_n}{\partial n} > 0$;

(iii) to time-varying risk premium shock first increase and then decrease over the horizon, i.e. there exists n^* *such that* $\frac{\partial d_n}{\partial \delta} > 0$ *for* $n < n^*$, *while* $\frac{\partial d_n}{\partial \delta} < 0$ *for* $n > n^*$.

These results show that different shocks affect the yield curve differentially at various maturities, conditional on their persistence and transmission (Figure 2 plots the responses for a reasonable set of parameters). This potentially allows the use of restrictions on

[13] See Appendix A for details and derivations.

Figure 2: Impact of shocks on the yield curve



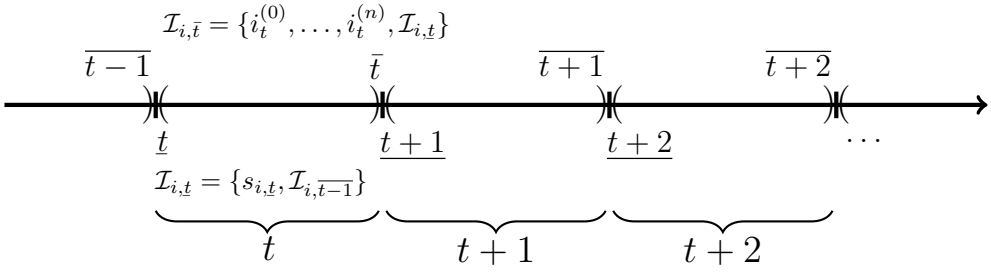
Note. Impact of shocks – inflation, monetary policy, constant risk and time-varying risk – onto the yield curve at maturities between 0 and 120 months. Shocks are normalised to have impact equal to one at peak. The parameters are as follows: $\alpha = 0.2$, $\phi = 0.15$, $\delta = 1.2$, $\rho = 0.9$, $\psi = 0.25$, $\sigma_\pi = 0.25$, $\sigma_{mp} = 0.25$, $\sigma_\xi = 0.25$, $\sigma_\gamma = 0.01$.

the maturity structure to extract meaningful policy surprises. However, the mapping is not unique. Several shocks produce similar effects on the yield curve and hence require additional information to disentangle them, beyond what is contained in the yield curve. A few observations are in order.

First, the monetary policy shocks lift the short end of the yield curve to decline over the term structure. An inflation shock has a similar shape, but – conditional on its persistence – it may have more mass over the medium maturities. This implies that information effects due to the central bank's communication and monetary policy shocks would be 'unspanned' by identifications using only the yield curve, a general insight that underpins different approaches to disentangle information effects from policy shocks using other assets as in Jarociński and Karadi (2020), or forecasts as in Miranda-Agrippino and Ricco (2021).

Second, while for the sake of simplicity we do not model it here, it is easy to recognise that an exogenous forward guidance shock shifting expectations about the forward policy path would affect the medium segment of the yield curve. Information about the expected forward path of inflation or other macro variables to which interest rates may respond (endogenous forward guidance) would have a similar impact. Beyond exogenous and endogenous forward guidance, the mid-segment of the yield curve can also be affected by

Figure 3: The information flow



Note. At the beginning of each period t, agent i receives a private noisy signal of π_t and update their information set $\mathcal{I}_{i,\overline{t-1}}$. Agent observe the policy rate and update again their information set, at the end of the period.

a temporary increase in risk premia, as the one we model. These three types of shocks would be 'unspanned' by identifications using only the yield curve and hence forward guidance policy shocks could be confounded with information and risk shocks.

Third, long-run factors due to debt sustainability, confidence in the policy framework, political factors, etc. affect the country risk and hence the yield curve with an increasing shape over maturities, and larger effects at the long end of the yield curve. Some of these factors may be country-specific, while others may relate to how policy communication shapes the risk attitude of markets conditional on global events. Also, increases in the perceived policy uncertainty – i.e. uncertainty about the policy path – steepen the yield curve by increasing the term premia and have similar effects to country risk shocks.

2.2 Information effects

We now embed the term structure model in an environment characterised by imperfect information, following Miranda-Agrippino and Ricco (2021). Markets are open at beginning, $\underline{t}$, and at the closing, $\bar{t}$, of each period t. Agents form expectations given the signals they receive about the state of the economy and the policy rate that is announced during the period, and trade bonds of different maturities.

In particular, each agent i in the economy does not directly observe π_t, but receives a private noisy signal of π_t at the beginning of the time period $t = [\underline{t}, \bar{t}]$ (see Figure 3): $s_{i,\underline{t}} = \pi_t + \nu_{i,\underline{t}}$, $\nu_{i,\underline{t}} \sim \mathcal{N}(0, \sigma_{n,\nu})$. Given the signal, and conditional on their information set $\mathcal{I}_{\underline{t}} = \{s_{i,\underline{t}}, \mathcal{I}_{\overline{t-1}}\}$, agents update their expectations from the closing time of the previous

period, $F_{i,\underline{t}\overline{t-1}}\pi_t$, and form expectations $F_{i,\underline{t}}\pi_t$ via the Kalman filter:

$$F_{i,\underline{t}}\pi_t = K_1 s_{i,\underline{t}} + (1-K_1)F_{i,\underline{t}\overline{t-1}}\pi_t \ , \tag{12}$$

$$F_{i,\underline{t}}\pi_{t+h} = (\alpha - \phi(\delta-1))^h F_{i,\underline{t}}\pi_t \qquad \forall h > 0 \ , \tag{13}$$

where K_1 is the Kalman gain which represents the relative weight placed on new information relative to previous forecasts.[14] Given their forecasts, at $\underline{t}$, agents trade bonds of different maturities.

At opening time $\underline{t}$ the central bank observes a private noisy signal of the state of the economy in period t, $s_{cb,\underline{t}} = \pi_t + \nu_{cb,\underline{t}}$, $\nu_{cb,\underline{t}} \sim \mathcal{N}(0, \sigma_{cb,\nu})$.[15] Given this signal, the central bank updates its expectations, sets and announces the interest rate, following its policy rule

$$r_t = i_t^{(1)} = \delta F_{cb,\underline{t}}\pi_t + \sigma_{mp} u_t^{mp}. \tag{14}$$

Agents observe the interest rate r_t at closing time $\bar{t}$ and update their expectations and trade bonds at different maturities. The policy rate is a public signal about the state of the economy to the agents. In fact, conditionally, on observing r_t and r_{t-1} (and knowing K_{cb}), agents extract a public signal on π_t, i.e. $\tilde{s}_{cb,t} = \pi_t + \widetilde{\nu}_{cb,\underline{t}}$.[16,17]

At $\bar{t}$, conditional on this public signal, agents update their information set, $\mathcal{I}_{\bar{t}} = \{r_t, p_t, \mathcal{I}_{\underline{t}}\}$, and their forecasts

$$F_{i,\bar{t}}\pi_t = K_2 \tilde{s}_{cb,\bar{t}} + (1-K_2)F_{i,\underline{t}}\pi_t \ , \tag{15}$$

$$F_{i,\bar{t}}\pi_{t+1} = (\alpha+\phi)F_{i,\bar{t}}\pi_t - \phi r_t \ , \tag{16}$$

$$F_{i,\bar{t}}\pi_{t+h} = (\alpha - \phi(\delta-1))^{h-1} F_{i,\bar{t}}\pi_{t+1} \qquad \forall h > 1 \ , \tag{17}$$

where K_2 is the Kalman gain, as given by the noise in the public signal $\tilde{\nu}_{cb,\underline{t}}$.

Observing that from the point of view of the agents, it has to be true that $i_t^{(0)} = r_t =$

[14] If signal were perfectly revealing then $K_1 = 1$, while in the presence of noise $K_1 < 1$. Thus, $(1-K_1)$ can be seen as the degree of information rigidity faced by the agents.

[15] It is generally assumed that the signal observed by the central bank is more precise than the one observed by agents: $\sigma_{cb,\nu} < \sigma_{n,\nu}$, however this is not necessary to our discussion and only the magnitude not the type of the effects would change.

[16] In South Africa, the central bank also discloses its forecasts. To the agents they are a noisy public signal of the state of economy in the same way the interest rate is. This observation does not change the follow up of this discussion.

[17] The noise in the signal $\tilde{s}_t$ is coloured, and not orthogonal to the state. Hence, it does not fulfill the standard conditions under which the Kalman filter is derived. Unmodelled dynamics can degrade the filter performance. We abstract here from these consideration that would require robust control methods.

$\delta F_{i,\bar{t}}\pi_t + \sigma^{mp} F_{i,\bar{t}} u_t^{mp}$, we obtain the following result.

Lemma 3. *The monetary policy surprises and the market revision of expectation, i.e. the information effects, at different maturities are such that:*

$$i_t^{(0)} - F_{\underline{t}} i_t^{(0)} = (1-K_1)(1-K_2)(1+\delta\phi)(i_{t-1}^{(0)} - F_{\underline{t-1}} i_{t-1}^{(0)}) + \upsilon_t. \tag{18}$$

$$i_t^{(n)} - F_{\underline{t}} i_t^{(n)} = b_n(F_{\bar{t}}\pi_t - F_{\underline{t}}\pi_t) + c_n F_{\bar{t}} u_t^{mp} + d_n \xi_t + g_n \gamma_t + h_n u_t^{\sigma^{mp}} \ , \tag{19}$$

$$\begin{aligned} F_{\bar{t}}\pi_t - F_{\underline{t}}\pi_t = {} & (1-K_1)(1-K_2)(F_{\overline{t-1}}\pi_t - F_{\underline{t-1}}\pi_t) \\ & + (1-K_1)(1-K_2)\phi(i_{t-1}^{(0)} - F_{\underline{t-1}} i_{t-1}^{(0)}) \\ & + K_2\left[(1-K_1)\sigma_\pi u_t^\pi - (1-K_1)(\alpha+\phi)\tilde{\nu}_{cb,\overline{t-1}} + \tilde{\nu}_{cb,\bar{t}}\right]. \end{aligned} \tag{20}$$

where υ_t is convolution of past and current shocks.

2.3 The information content of policy surprises

Our results provide insight through the following predictions about the content of monetary policy surprises. First, the presence of information frictions generates autocorrelation in policy surprises and predictability using past information. Second, monetary policy surprises at different horizons result from various combinations of information, monetary policy shocks, and changes to risk premia. Third, and specifically, conventional monetary policy and information shocks dominate the response of the short end of the yield curve. The mid-segment of the yield curve reflects a mix of exogenous forward guidance shocks, information, and possibly transitory increases in risk premia. Changes to country risks and increases in monetary policy uncertainty dominate the long end of the yield curve.

In our empirical analysis, we will apply this insight by first testing our predictions and then disentangling the different types of shocks using additional information from financial markets, policy forecasts, and a narrative of events as communicated by policymakers and perceived by the markets.

3 Monetary Policy Surprises in South Africa

To construct meaningful measures of monetary policy surprises, we proceed in the following steps. First, we build daily price revisions of interest rate derivatives around monetary policy decisions, following Kuttner (2001) and Gürkaynak et al. (2005a). Second, we ex-

tract four principal components from these price revisions that capture meaningful commonalities. Then, following the intuition provided by the model in the previous section, we rotate the principal components to have an interpretation of them as common factors affecting expectations and the yield curve at different maturities and to identify specific dimensions of monetary policy (similarly to Gürkaynak et al., 2005a, Altavilla et al., 2019 and Swanson, 2021). We conclude this section by analysing the effects of these identified common factors on the yield curves, the exchange rate and other financial assets, with an event study approach.

3.1 Market-based policy surprises

To construct measures of the news contained in monetary policy announcements, we study interest rate derivatives' price changes as a proxy for markets' revisions of expectations triggered by the central bank policy communication, at different horizons.[18] In doing so we think of the assets' values before the monetary policy announcement as reflecting the market's expectation about economic conditions and the policy rate decision to be made at the next MPC meeting, and the value after the announcement as capturing the reaction of the market to it, and their updated expectations. The difference between these values captures the 'news' delivered by monetary policy announcements.

We measure the price revisions over daily windows around the MPC. Specifically, we take the difference between the closing value of each asset on the day of an MPC meeting and the closing value on the previous day:[19]

$$mps^{(i)}_{t_{\text{MPC}}} = P^{(i)}_{t_{\text{MPC}}} - P^{(i)}_{t_{\text{MPC}}-1}, \tag{21}$$

where $mps^{(i)}_{t_{\text{MPC}}}$ is the price reaction of asset i to the MPC announcement, $P^{(i)}_{t_{\text{MPC}}}$ is the end-of-day value of an asset i on the day of the MPC, t_{MPC}, and $P^{(i)}_{t_{\text{MPC}}-1}$ is the end-of-day

[18] We obtain the series of the MPC meeting dates as reported on the SARB website, while the exact time of the MPC statements' announcements is retrieved from the Bloomberg macroeconomic news stream database, as it is not reported by the SARB.

[19] We do not use the intraday window, which is a convention in the literature on high-frequency identification of monetary policy shocks, for two reasons. First, the high-frequency (minute- and tick-) data are available to us starting from 2008 only, so resorting to an intraday window would reduce our sample by 8 years. Second, the lower liquidity of the South African market as compared to markets in the U.S. or the E.A. implies that price changes in a narrow window do not necessarily reflect the surprise component induced by policy announcements, since it may take longer for agents to find a transaction counterparty, and accordingly, it takes longer for market values to settle and reflect agents' views on fair asset valuations post-MPC meeting announcements.

value of an asset i on the day before.

We construct daily monetary policy surprises, on the sample 2002M6-2020M1, for the following instruments: 3-month Johannesburg Interbank Average rate (Jibar); Forward Rate Agreements (FRAs) at different horizons – FRA1x4, FRA3x6, FRA6x9, FRA9x12, FRA12x15, FRA15x18, FRA18x21, FRA21x24; Interest Rate Swaps at different maturities – Sw1Y, Sw2Y, Sw3Y, Sw5Y, Sw10Y; and the 5-year country default swap (CDS) spread for South Africa (CDS 5Y).

The 3-month Jibar interbank rate is a widely used and accepted benchmark short-term rate at the South African financial market underlying various contracts and valuations. Jibar is constructed using quoted rates for Negotiable Certificate of Deposits (NCD) by Jibar contributing banks (South African Reserve Bank, 2022). It captures the expected prevailing rate three months ahead.[20]

FRA contracts and interest rate swaps are interest rate derivatives based on the 3-month Jibar rate.[21] The termination date of FRAs in the dataset ranges from 4 to 24 months, while the expiration of interest rate swaps spans from 1 to 10 years.[22] Hence, the maturity structure of the interest rate derivatives we employ can capture expectations about monetary policy and the economy up to a 10 year horizon.

Additionally, we include in the dataset the 5-year CDS spread for South Africa as a proxy of a sovereign risk premium to detect the effect of SARB MPC announcements on the country's risk valuations.[23]

3.2 Factors in Monetary Policy Surprises

We extract common components from the full set of daily price revisions around monetary policy decisions, using principal component analysis. In doing so we consider the surprises

[20]For the 3-month Jibar, we use the difference between the end-of-day value on the day after the MPC meeting and the end-of-day value on the day of the MPC meeting: $\text{mps}^{\text{3M Jibar}}_{t_{\text{MPC}}} = P^{\text{3M Jibar}}_{t_{\text{MPC}}+1} - P^{\text{3M Jibar}}_{t_{\text{MPC}}}$. This is due to 3-month Jibar interbank rate values being updated daily around 10:30 am (South African Reserve Bank, 2022), such that post-MPC announcement values are published only on the next day after the MPC meeting.

[21]FRA1x4 is a 1-month ahead forward contract on the 3-month Jibar rate.

[22]We convert forward rates indicated by FRA contracts to their swap rates' counterparts. This transformation ensures consistency of rates used for the principal components extraction, such that factor loadings are compatible and interpretable. Details of the conversion to swap rates are in Appendix B.

[23]CDS contracts are used by market participants to insure against the event of a sovereign default or a debt restructuring (see, for example, Longstaff et al., 2011).

as having a factor structure of the form

$$X_t = \Lambda F_t + \varepsilon_t, \tag{22}$$

where X_t is the n-dimensional vector of the market-based surprises at time t across all of the asset considered, F_t are is a k-dimensional vector of unobserved factors ($k < n$), Λ are factor-specific loadings, and ε_t captures the idiosyncratic components.

We assess the number of common components in the dataset by testing for the number of unobserved factors, using the procedure proposed by Alessi et al. (2010).[24] The test indicates the presence of four common factors in our dataset that we extract using principal components analysis (PCA). The first four principal components (PCs) explain on average 95.6% of the variation in market-based surprises induced by MPC announcements.[25]

A reading of the correlation between the common components and the individual assets shows raw commonalities that support the intuition proposed by the model and are useful in the identification step of the factors. Specifically, the first PC captures most of the variation in surprises at short and medium horizons. In contrast, the second PC loads on the sovereign risk premium surprises and explains a substantial part of surprises at long and short horizons. The third PC reflects the remaining variation in sovereign risk and long-horizon interest rate surprises that are uncorrelated with surprises in the short-term rate. The fourth PC explains the remaining variation in the 3M Jibar interbank rate surprises.

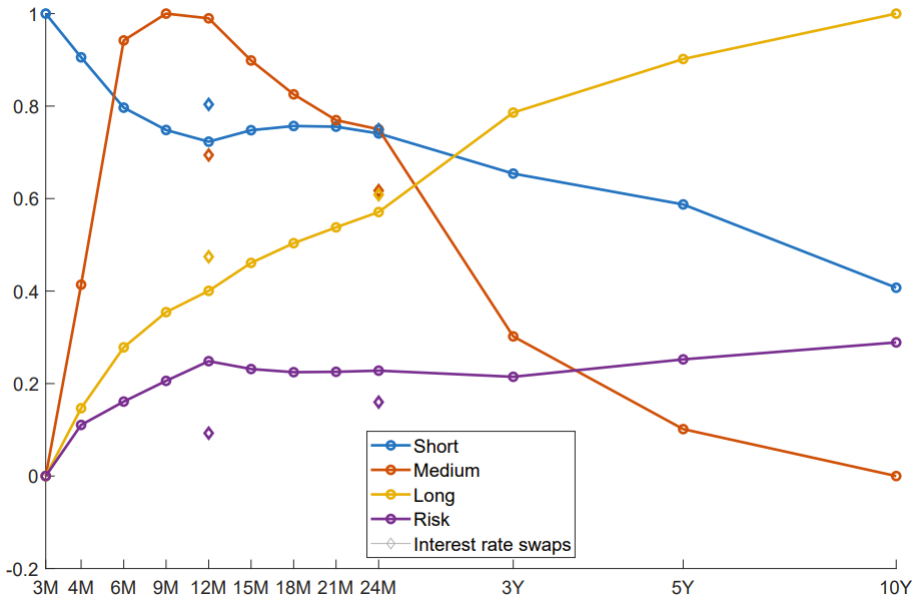
3.3 Identified monetary factors

As discussed in Gürkaynak et al. (2005a), one has to transform the principal components from price revisions at high frequency to identify specific dimensions of monetary policy and allow for economic interpretation. Technically, the issue is that loading and factors in Equation (22) are identified only up to an orthonormal transformation. In fact, for any matrix U such that $UU' = 1$, there exist a transformation $\widetilde{F} = FU$ and $\widetilde{\Lambda} = U'\Lambda$ that leaves X_t and ε_t unchanged. Hence, one has to use economic assumption to provide meaning the the factors.

We identify a unique orthonormal matrix by imposing on it the following restrictions,

[24] Details of the test are provided in Appendix C.
[25] See Table II in the Appendix D.1.

Figure 4: Identified factor loadings



Note. The ticks' location on the x-axis is scaled to improve readability at the short end of the curve. The diamond-shaped marks 'Interest rate swaps' refer to factor loadings on interest rate swaps of respective maturities to distinguish between loadings on forward rate agreements (marked with circles) and interest rate swaps with the same expiration dates: FRA9x12 and Sw1Y with one year expiration, and FRA21x24 and Sw2Y contracts with two years expiration.

motivated by the model in Section 2. First, we assume that the first factor (F1 or 'short-term factor') is the only factor that loads on market surprises at the shortest horizon/3M Jibar interbank rate. This is in line with the assumption proposed by Gürkaynak et al. (2005a) to identify what they call a 'target factor'. Second, we assume that the second factor (F2) doesn't explain variation in surprises on the longest horizon (i.e. the 10Y rate). This characterises it as a 'medium-term factor', affecting the mid part of the term structure, and hence capturing cyclical dynamics. Third, we impose that the third factor (F3) does not explain variation in CDS surprises, hence identifying it as a pure 'term premium factor'. Finally, the fourth factor (F4) is a 'country risk factor' extracted to maximise the share of variation in CDS surprises explained, following the procedure proposed by Swanson (2021) to extract a QE factor. The four factors are assumed to be orthogonal to each other and have unit length.[26]

[26]In the event study analysis, for the sake of interpretability, we rescale the factors, such that the effect of the short-term, medium-term, term premium and country risk factors is unity on surprises in the 3M Jibar, 9M, 10Y rates and the CDS spread, respectively. The choice of the horizon at which factors are rescaled to have a unit effect is given by their importance in explaining respective price revisions.

Table 1: Variance contributions by identified factors

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21
Short-term	**93.9**	**77.0**	**59.6**	**52.6**	**49.1**	**60.7**	**52.5**	**53.8**
Medium-term	0.0	5.5	**28.5**	**32.2**	**31.5**	**15.5**	**26.0**	**21.9**
Term premium	0.0	1.5	5.5	8.9	**11.4**	**16.0**	**15.1**	**18.0**
Country risk	0.0	1.2	2.6	4.2	6.1	0.9	5.3	5.0
Residual	6.1	14.8	3.8	2.1	1.9	7.0	1.1	1.3
	FRA21x24	Sw1Y	Sw2Y	Sw3Y	Sw5Y	Sw10Y		CDS5Y
Short-term	**53.6**	**51.5**	**52.7**	**40.2**	**32.4**	**15.6**		0.2
Medium-term	**19.0**	**18.1**	**12.3**	2.9	0.3	0.0		0.0
Term premium	**20.5**	**23.1**	**26.2**	**43.8**	**57.7**	**70.9**		0.0
Country risk	5.1	5.2	2.5	4.6	6.3	8.3		**99.5**
Residual	1.8	2.1	6.3	8.5	3.2	5.2		0.3

Note: The table reports the fraction of the variance explained by the short-term, medium-term, term premium and country risk factors in daily surprises around MPC announcements of instruments indicated in the first and the seventh rows in percentage points. The row 'Residual' reports the fractions of the variance not explained by the factors.

The identified factor loadings in Figure 4 and their explained variances in Table 1 show that the short-term factor lifts the short end of the yield curve, similarly to conventional monetary policy and short-term information. The medium-term factor is prominent in explaining surprises for horizons from 6M to 24M and plays virtually no role for horizons exceeding 2Y. While there is no explicit forward guidance in South Africa, the SARB disclose its macro forecasts, which include the repo rate projections, at the moment of the MPC announcement and the press conference discloses details on the forward thinking of the bank. This provides a rationale for interpreting this factor as related to changes in the markets' expected policy path, as triggered by communications from the Bank. The importance of the term premium factor increases smoothly over the maturities, in line with its proposed interpretation as a factor connected to risks to the economy and uncertainty in the policy path. Finally, the country risk factor is the sole factor explaining surprises in the sovereign risk premium and has an increasing shape over the maturities, which flattens out roughly after the two-year maturity.

We ensure that effects of identified monetary policy factors are not driven by events outside of MPC meeting announcements by running a falsification or 'placebo' test. In particular, we extract monetary policy factors from daily surprises outside of the SARB MPC meeting dates using our identification approach. We compute daily price changes for the financial market instruments in our dataset (3M Jibar, FRAs, swaps and CDS spread) for 2, 12 and 20 days prior to MPC meetings, and retrieve 'false' monetary policy surprises based on them. Appendix I reports the results on variance contributions and on VAR impulse responses using these 'false' factors. They show that no meaningful

monetary factors are found on days outside of MPC decisions.

3.4 Financial asset responses

How do the monetary policy surprises affect the yield curve and other financial assets? To investigate this question, we run an event study in the spirit of Gürkaynak et al. (2005a), and look at the effects that policy surprises have on changes in money market rates, sovereign bond yields, stock prices, domestic currency exchange rate, sovereign risk premium and capital flows measures around monetary policy announcements. Specifically, we run an OLS regression of daily changes in financial market values around MPC announcements on the identified monetary policy factors (see Table 2).[27,28]

The short-term factor lifts the short end of the yield curve, in line with the positive empirical relationship between the target rate and the long rates established by Cook and Hahn (1989), and the expectations theory of the term structure. We estimate that a 1 percentage point surprise tightening in the short-term 3M Jibar rate leads to increases of 41, 30 and 13 bp in two-, five- and ten-year sovereign bond yields, respectively. The response of the stock market to short-term policy surprises is statistically significant and negative. This negative response to an unanticipated increase in the short-term rate is due to the increase in the discount rates, and its expected contractionary effect on demand yielding lower dividends. A positive short-term policy surprise also induces an appreciation of the South African rand against the U.S. dollar and the euro.[29] This effect is consistent with the uncovered interest parity condition and the widening of the interest rate differential. Finally, a positive short-term policy surprise has a statistically significant, albeit, small in magnitude, negative effect on the sovereign credit risk premium measured by the country's 5Y CDS spread. Put differently, unanticipated short-term rate

[27] Given that MPC decisions and communication are not affected by financial markets' movements within a day, central bank announcements can be seen as having a causal effect for changes in financial markets.

[28] We report results for the informationally-robust factors in Table V in Appendix E.3. Results are overall unchanged by the information correction, indicating that markets in the short-term react to the news but do not fully disentangle the effects.

[29] The currency appreciation effect is found at a 2-day window; at the 1-day window, the effect is not statistically significant. The latter could reflect the fact that trade with South African rand takes place predominantly at international FX market platforms outside of South Africa, including the U.S. with active trading hours after the end of trading day in South Africa. Hence, changes in the nominal exchange rates as a result of FX trade in the U.S. are reflected on the day after the SARB MPC meeting according to the South African trading time. These results are reflected in the '**ZAR/USD**^{2day}' and '**ZAR/USD**^{2day}' rows of the Table 2.

Table 2: Estimated effects of monetary policy surprises on financial markets

	Short-term	Medium-term	Term premium	Country risk	Constant	R^2	Obs
Overnight	0.898***	-0.816*	-0.303*	0.223	-0.028	0.42	81
	(0.25)	(0.47)	(0.18)	(0.33)	(0.02)		
1M Jibar	1.063***	-0.202	-0.165	-0.029	-0.035**	0.79	109
	(0.10)	(0.20)	(0.15)	(0.13)	(0.01)		
3M Jibar	1.000***	0	0	0	-0.026***	0.94	109
	(0.03)	(0.11)	(0.08)	(0.11)	(0.01)		
1Y bond	0.261***	0.313***	0.697***	0.207**	-0.012**	0.66	83
	(0.05)	(0.12)	(0.09)	(0.08)	(0.01)		
2Y bond	0.409***	0.078	0.938***	0.349*	-0.009*	0.86	70
	(0.05)	(0.22)	(0.10)	(0.19)	(0.01)		
3Y bond	0.415***	0.310**	0.957***	0.558***	-0.009**	0.91	79
	(0.04)	(0.12)	(0.06)	(0.08)	(0.00)		
5Y bond	0.303***	0.192***	0.878***	0.526***	-0.014***	0.93	92
	(0.02)	(0.06)	(0.04)	(0.08)	(0.00)		
10Y bond	0.127***	-0.006	0.844***	0.379***	-0.012***	0.79	109
	(0.04)	(0.08)	(0.07)	(0.06)	(0.00)		
20Y bond	0.116***	-0.018	0.863***	0.353***	-0.017***	0.75	105
	(0.03)	(0.08)	(0.06)	(0.07)	(0.00)		
30Y bond	0.119***	-0.038	0.838***	0.319***	-0.016***	0.69	103
	(0.03)	(0.11)	(0.07)	(0.08)	(0.01)		
JSE All shares	-1.944***	2.41	-4.774***	-3.555*	-0.145	0.22	109
	(0.73)	(1.89)	(1.75)	(1.83)	(0.11)		
ZAR/USD^{1day}	1.255	-0.666	-1.056	-3.645	0.101	0.1	109
	(0.82)	(1.98)	(1.80)	(2.30)	(0.11)		
ZAR/USD^{2day}	1.780*	-4.212	-0.081	1.095	0.117	0.1	109
	(0.91)	(2.72)	(2.26)	(2.43)	(0.14)		
ZAR/EUR^{1day}	0.823	-1.785	0.481	-2.951*	0.018	0.08	109
	(0.77)	(1.74)	(1.57)	(1.69)	(0.10)		
ZAR/EUR^{2day}	2.006**	-4.370**	0.567	1.626	0.093	0.11	109
	(0.93)	(2.14)	(2.30)	(1.98)	(0.14)		
CDS 5Y	-0.019***	0	0	1.000***	0.001***	0.99	109
	(0.00)	(0.02)	(0.00)	(0.01)	(0.00)		
EMBI+SA	0.02	-0.088	0.145*	0.922***	0.002	0.52	103
	(0.04)	(0.11)	(0.09)	(0.13)	(0.01)		
NNP	-0.029	0.241	-0.341	-4.409**	0.104	0.07	109
	(0.60)	(1.37)	(1.22)	(1.72)	(0.12)		
NNPshares	-0.251	-0.525	1.108	-2.011*	0.018	0.03	109
	(0.39)	(1.25)	(1.29)	(1.19)	(0.10)		
NNPbonds	0.119	0.61	-1.087	-4.045*	0.114	0.05	109
	(0.65)	(1.86)	(1.26)	(2.12)	(0.13)		

Note. Projections of financial market values on identified monetary policy surprises. Robust standard errors in parentheses. The dependent variable is the daily change in financial market values around the SARB MPC announcements in the sample 2002M6-2020M1. '1M Jibar' and '3M Jibar' are 1-month and 3-month Jibar/interbank rates. '1Y bond', '2Y bond', '3Y bond', '5Y bond', '10Y bond', '20Y bond' and '30Y bond' are the government bond yields of the respective maturities as quoted on Bloomberg. JSE All shares is a stock market index. USD/ZAR and EUR/ZAR are nominal exchange rates of South African rand (ZAR) expressed as ZAR prices in USD and EUR, respectively, i.e. the exchange rate increase is ZAR appreciation. 'CDS 5Y' and 'EMBI+SA' are measures of the country credit risk premium. 'NNP' is non-residents' net purchases of South African shares and bonds, 'NNPshares' is non-residents' net purchases of South African shares, 'NNPbonds' is non-residents' net purchases of South African bonds. Capital flow variables are z-scores of their deflated values (GDP deflator index, 2015 = 100 is used for deflating nominal values). $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

hikes appear to reduce compensation for the country's credit risk, perhaps by signalling the determination of the central bank to control inflation. Overall, the effects of the first factor of monetary policy in South Africa and their magnitudes are similar to what was found for the effect of the target factor in the U.S. and the euro area, as documented in

Gürkaynak et al. (2005a) and Altavilla et al. (2019).

The medium-term component of the policy surprises shifts the middle part of the yield curve, at maturity from one to five years (see Table 2). This is possibly due to the signalling effect of policy communication and the market anticipating the short-term rate to stay higher over the medium term.

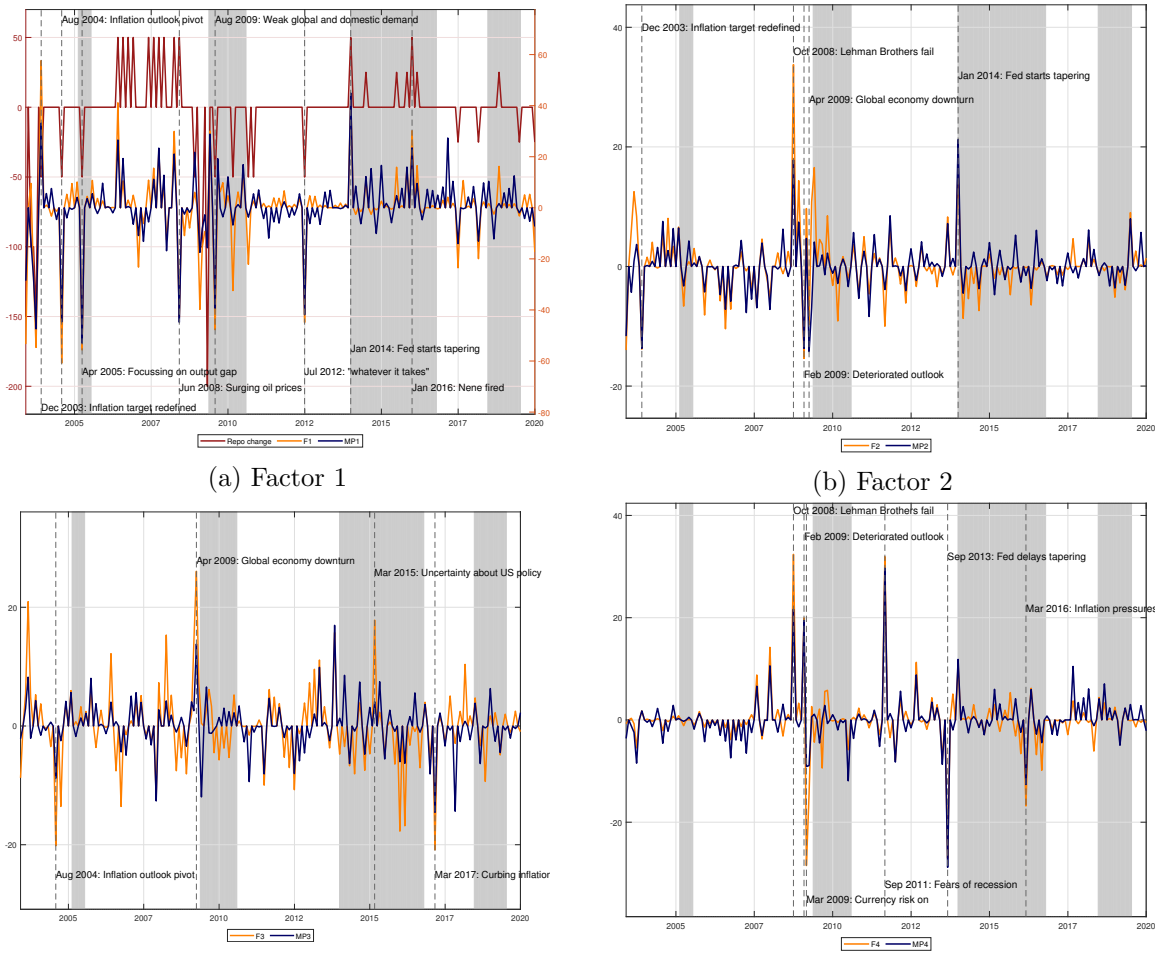
An increase in the term premium and country risk factors both steepens the yield curve and puts downward pressure on stock prices. The country risk factor also affects the country credit risk premium – EMBI+SA index and CDS 5-year spread.[30] In line with the interpretation of this factor as related to country risk, the results point to a portfolio reallocation effect of international investors. Non-residents reduce their net purchases of South African stocks and bonds upon an increase in the country risk factor. This also explains the responses of the stock market and long-term sovereign bond yields that reflect the higher compensation required by investors for holding South African bonds. The statistically significant depreciation of the South African rand against the euro captures the increased country credit risk premium and the reduced demand for domestic financial assets.

4 Informationally-Robust Monetary Policy IVs

We can now build instrumental variables to identify monetary policy and risk shocks by employing the market surprises that we constructed in the previous section. First, we project them onto a set of central bank forecasts and other measures of shocks to assess their information content (see Miranda-Agrippino and Ricco, 2021), and to separate the information disclosed by the central bank from the other shocks. We think of the residuals of these regression exercises as potentially good proxies for different exogenous shocks, since the endogenous component of monetary policy is controlled for. Second, to construct IVs for those shocks at a monthly frequency, we project the residuals of the information regressions on their past to remove any autocorrelation and aggregate them at a monthly frequency.

[30] EMBI+SA index is the JP Morgan Emerging Markets Bond Index Plus spread for South Africa that measures the country-specific sovereign risk premium.

Figure 5: Monetary policy surprise and important events.



(a) Factor 1

(b) Factor 2

(c) Factor 3

(d) Factor 4

Note. The charts report monetary policy surprises - F1, F2, F3 and F4, - together with their informationally robust counterparts - MP1, MP2, MP3 and MP4. Shaded periods indicate recessions, as captured by the OECD recession indicator for South Africa.

4.1 Informationally-Robust Factors

The factors plotted in Figure 5 combine monetary policy and risk shocks, and market revision of expectations about the state of the economy. This is the information channel illustrated in the model in Section 2, which in the case of the SARB is due to both the announcement of the policy rate and the concurrent disclosure of the economic projection.

To control for the information channel in the monetary policy factors, we regress each of the identified factors on the SARB's forecasts and forecast revisions of GDP growth and CPI inflation. These projections are produced for each MPC meeting and are a part of the policymakers' information set during the MPC meetings, which is partially disclosed to

Table 3: Contribution of central bank information to policy surprises

	Short-term	Medium-term	Term premium	Country risk
Adjusted R^2	0.05	0.15	0.41	0.01

Note. Each column shows adjusted R^2 of the regression model in Eq. (23) for the four monetary policy factors.

the public during the policy announcements.[31] Specifically, we run the following regression at the SARB MPC meeting frequency:

$$\mathrm{F}^{i}_{t_{\mathrm{MPC}}} = \alpha_0 + \sum_{j=-1}^{3} \theta_j \mathrm{FC}^{\mathrm{SARB}}_{t_{\mathrm{MPC}}} x_{q+j} + \sum_{j=-1}^{3} \eta_j [\mathrm{FC}^{\mathrm{SARB}}_{t_{\mathrm{MPC}}} x_{q+j} - \mathrm{FC}^{\mathrm{SARB}}_{t_{\mathrm{MPC}}-1} x_{q+j}] + \mathrm{MP}^{i}_{t_{\mathrm{MPC}}}, \quad (23)$$

where $\mathrm{F}^{i}_{t_{\mathrm{MPC}}}$ denotes the monetary policy factor i, while $\mathrm{FC}^{\mathrm{SARB}}_{t_{\mathrm{MPC}}} x_{q+j}$ is the real-time SARB forecast of a variable x – GDP growth or headline CPI inflation –, at horizon j available to the SARB before MPC meeting t_{MPC}. Hence, $(\mathrm{FC}^{\mathrm{SARB}}_{t_{\mathrm{MPC}}} x_{q+j} - \mathrm{FC}^{\mathrm{SARB}}_{t_{\mathrm{MPC}}-1} x_{q+j})$ are the forecast revisions for a variable x at horizon j between two MPC meetings at dates $t_{\mathrm{MPC}} - 1$ and t_{MPC}.

The SARB information disclosure appears to play an important role in explaining monetary policy surprises, especially for the medium-term and term-premium factors (see Table 3). This indicates that SARB's macroeconomic forecasts affect market expectations about the future path of monetary policy at the medium – 6 to 24 months –, and long – 3 to 10 years –, horizons. Interestingly, the country risk factor is not affected by information effects.

4.2 IVs at monthly frequency

The residuals $\mathrm{MP}^{i}_{t_{\mathrm{MPC}}}$ of the regression model in Eq. (23) do not correlate with past and current shocks as captured by the SARB forecasts, by construction. Hence, they are both orthogonal to the SARB reaction function and unexpected by the markets. They can be employed to build IVs to identify different types of policy shocks. To do so, we aggregate them from MPC frequency to monthly frequency and remove any residual autocorrelation.

First, the residuals of the identified monetary policy surprises are transformed from an MPC frequency to a monthly frequency. Specifically, for months with MPC meetings,

[31] Before 2017 the SARB forecasts were produced with the macroeconomic Core model, and after 2017 the projections have been made using the Quarterly Projection Model (see Botha et al., 2017).

$\text{MP}^i_{t_{\text{MPC}}}$ is taken as the value for the respective month; for months without MPC meetings, the factor value MP^i_t is set to zero.[32]

Second, to account for the slow information absorption by market participants, the residuals at monthly frequency are cleaned from an autoregressive component.[33] It is worth observing that the autocorrelation of forecast errors is a trademark of imperfect information models (see Coibion and Gorodnichenko, 2012, 2015), and a key feature of the model in Section 2.

The residuals of this regression at monthly frequency are our informationally-robust monetary policy IVs: MP1_t, MP2_t, MP3_t, and MP4_t. These four instruments, plotted in Figure 5, will be employed in Sections 6 and 7 as external IVs to identify respectively (i) conventional monetary policy shocks, (ii) exogenous forward guidance shocks, (iii) term-premium/policy uncertainty shocks, and (iv) country risk shocks. Before doing so, in Section 5, we will provide a narrative of the events captured by the IVs that supports their proposed use in the identification of shocks.

4.3 Information effects

To study how macroeconomic variables respond to the information component of monetary surprises, we construct an instrument for the information effect. First, we obtain the fitted values from Eq. (23) for each of the four identified monetary policy factors.[34] Next, we extract the first principal component from these values and aggregate it to monthly frequency. Figure 6 reports the resulting IV, capturing the effect of the SARB's disclosure of information.

4.4 Spillover from external shocks

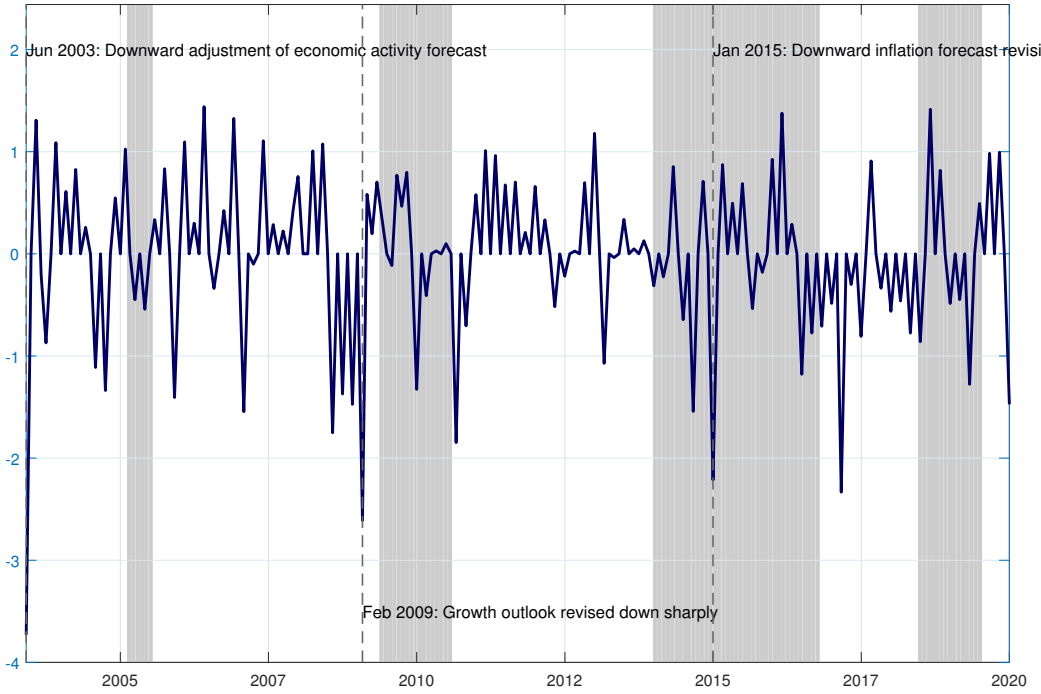
To gauge the role of shocks originating outside of South Africa in the monetary policy surprises, we regress the identified monetary policy surprises onto (i) the high-frequency U.S. monetary policy surprises around FOMC announcements – target, forward guidance,

[32]For the sample period considered, there is at most one MPC meeting held during each month.

[33]Results are reported in Table III in Appendix E. The autoregression is run using non-zero monthly observations of the dependent variable. In months without MPC meetings MP^i_t is equal to zero.

[34]The SARB forecasts and forecast revisions for the current quarter and one-quarter-ahead GDP growth and CPI inflation have the largest predictive power for the short-term and medium-term factors, while the three- and four-quarters-ahead forecasts and revisions play a larger role in explaining the term premium factor.

Figure 6: Instrument for the information effect



Note. The information IV is the first principal component of fitted information in Eq. (23) in four monetary policy factors.

and large-scale asset purchases –, as built by Gürkaynak et al. (2005a) and Swanson (2021); and (ii) the high-frequency ECB monetary policy surprises – target, timing, forward guidance, and QE –, as identified in Altavilla et al. (2019).[35] The regressions are run at the SARB MPC meeting frequency on surprises registered between 2002M6 and 2020M1.[36] Results reported in Appendix E.2 show a small but significant role of U.S. and euro area monetary surprises. Overall, these results point to the importance of open market effects for South Africa but also confirm the prediction of the model regarding the surprises being convolutions of past and current shocks, beyond monetary policy, due to information effects.[37]

[35]The most recent values of the U.S. and ECB monetary policy factors before each SARB MPC meeting are used in projections.

[36]In the case of U.S. monetary policy effects, the sample is 2002M6-2019M6 given the availability of the policy surprises of Swanson (2021). The Federal Reserve QE factor of Swanson (2021) is taken with the opposite sign to make its interpretation consistent with other factors in terms of the direction of monetary policy (easing vs. tightening).

[37]We do not directly correct for the external shocks in the construction of the IVs due to the different sample sizes and the relatively small importance, especially post-information correction.

Figure 7: Policy rate changes, policy rate forecast errors, and forecast disagreement.

Note. Forecast errors are defined as the difference between the actual policy rate and the median expected policy rate. Forecast disagreement is defined as the standard deviation of the policy rate forecasts over the surveyed participants in every survey. Short-term policy surprises are the scaled short-term factor that measures market alignment with the expected short-term policy rate path.

5 A narrative of surprising events

In this section, we provide an interpretation of the identified monetary policy factors. We do so by collecting, for each meeting, the market forecasts as represented by the Bloomberg market survey, the text of MPC statements, and the commentary and news appearing in the Business Day, the main local financial journal, the day before and the day after MPC meetings.[38] These materials allow us to assess whether market expectations were in line with the policy stance decided at the meeting; the SARB's declared rationale for the decision taken; the market sentiment before the meetings; and the interpretation that the market gave to the policy decisions, the MPC statements, and the MPC press conferences that followed the policy meetings.

[38]In Section J, in the Online Appendix, we report all the episodes of large surprises (larger than two standard deviations for the short-term factor and one standard deviation for medium-term, term premium and country risk factors) and the corresponding MPC and business commentary narrative.

In assessing the narrative of the events, we refer to monetary policy decisions on the repo rate as 'anticipated' when the Bloomberg market surveys median forecast was correctly projecting the stance taken by the SARB at the meeting (see Figure 7). We refer to the decision that surprised the median professional forecaster as 'unanticipated', instead.

Our analysis points to the following narrative of the identified factors:

- The largest short-term surprises (F1) are related to unanticipated repo rate changes. This allows us to interpret the first factor as an instrument for unexpected changes to the policy stance, i.e. conventional monetary policy shocks.

- The medium-term factor (F2) relates to MPC communication about the central bank's policy path, with large revisions associated with the market perceiving large policy shifts in the future policy stance. Hence, the medium-term factor can be seen as an implicit forward guidance factor, although the central bank's signal may be unintentional.

- The factor affecting the term premium (F3) relates to the perceived uncertainty about the bank's assessment of the economy and hence its policy path. It shows downward movement when the SARB clarifies its view and vice versa.

- The country risk factor (F4) relates to communication of the SARB about risks to the economy – either due to critical external events or to internal political and institutional events that challenge its mandate. The way markets perceive the central bank's response to these risks determines the response of the country risk. In other words, the central bank with its actions and words shapes the perceived distribution of risky events for the country. Communications showing a careful balance of risks, reaffirming the objective of price and macroeconomic stability, or of the central bank independence reduce the country risk premium.

5.1 Conventional monetary policy and forward guidance

A few episodes of large surprises are particularly illustrative of these patterns. Let us start with the short-term factor (F1) which we connect to conventional monetary policy shocks:

Dec-03 *MP Decision -50 bps; unanticipated; F1 57.68 bps, F2 -13.82 bps.* The SARB is on a path of policy normalisation and suddenly slows down the pace of the interest rate reduction, surprising the markets that were expecting a larger cut. However, the unexpected break is read by markets as leading to further rate reductions in the following meetings: "the Reserve Bank has created opportunity for future cuts" is the title given by Business Day to the news.

Aug-04 *MP Decision -50 bps; unanticipated; F1 -60.82 bps, F3 -20.19 bps.* The Bank makes an unanticipated cut in the policy rate, given a more favourable inflation outcome, induced by significant appreciation of the domestic currency. The markets read the surprise move as a dovish shift of the bank due to political pressure: "The Reserve Bank's monetary policy committee took a shock decision yesterday to cut interest rates, reversing its previous cautious tone on inflation in a move interpreted by some as bowing to pressure to weaken the rand" (Business Day).

Apr-05 *MP Decision -50 bps; unanticipated; F1 -55.68 bps.* The repo rate cut surprises the market with a dovish shift. Given muted inflation expectations and some slack in economic activity, the SARB presents the move as consistent with the inflation targeting objective. The market is of a different opinion. The financial commentators read it as due to the bank heeding the labour union 'cry' against a too-strong rand. "Blinkered attention to inflation eschewed for welcome focus on rand and jobs" is the Business Day's title.

Jun-08 *MP Decision 50 bps; unanticipated; F1 -42.87 bps.* Another dovish surprise from the SARB. "Markets were caught off guard yesterday when Bank Governor Tito Mboweni announced a decision to raise the repo rate by half a percentage point to 12%, after a stream of hawkish rhetoric – mainly from him – had prompted them to price in a full percentage-point increase" (Business Day).

Aug-09 *MP Decision -50 bps; unanticipated; F1 -47.73 bps.* Dovish surprise with a shift of attention to growth. "The Reserve Bank took markets and analysts by surprise yesterday, cutting lending rates despite stubborn price pressures in a bid to help jolt the economy out of recession" (Business Day).

Jul-12 *MP Decision -50 bps; unanticipated; F1 -44.88 bps, F3 -10.74 bps.* Unanticip-

ated reduction in the policy rate. The MPC statement states that "the MPC is concerned about the increased downside risk posed to the domestic economy from global developments". The Business Day titles "Rate cut 'bid to shield SA' from global downturn."

Jan-14 *MP Decision 50 bps; unanticipated; F1 44.53 bps, F2 16.93 bps, F4 10.85 bps.* A hawkish shift from the SARB. "It was a credible move from a credible Bank – even if nobody in the market had seen it coming" (Business Day).

This narrative evidence strongly supports the view that unexpected repo rate changes, perceived as shifts to a more dovish or hawkish stance generate short-term monetary policy surprises and allow us to identify the first factor as related to conventional monetary policy shocks (after the removal of the information component).

Similarly, F2 is shaped by shifts in the SARB communication about the future path of rates. This allows to think of it as a forward guidance factor, albeit possibly not intentional. This interpretation is supported by the reading of the financial newspapers, as is the case for the Dec-03 surprise ("the Reserve Bank has created opportunity for future cuts"), discussed above. It is also evidenced in the following events:

Oct-08 *MP Decision 0 bps; anticipated; F2 33.79 bps, F4 32.39 bps.* After the Lehman Brothers bankruptcy, the Bank appears uncertain about the correct policy path but signals a rather hawkish stance. Markets anticipate the hold decision but are disappointed by the tone and revise up the expected policy path. "Bank governor Tito Mboweni said that [...] 'The MPC is of the view that an unchanged monetary policy stance is appropriate at this stage.' Interest rate cuts had not even been considered at the two-day policy meeting, he told reporters later. The Bank's decision to keep rates steady was not a surprise, but disappointed local markets" (Business Day).

May-09 *MP Decision -100 bps; anticipated; F2 -9.67 bps, F3 26.06 bps, F4 -14.48 bps.* The MPC statement observes that "the adverse economic conditions continue to tilt the balance of risks to the inflation outlook to the downside over the medium term." The Business Day titles "Another sharp rate cut looks likely."

It is interesting to observe that this account of events does not led support to a

narrative compatible with temporary changes to risk premia, as per our model, albeit we cannot fully rule it out.

5.2 Term premium and country risk

The last two factors connect to communicated and perceived risk to the economy and the policy path. F3 appears to be related to uncertainty about the communicated forecasts of inflation and growth for South Africa and of the policy path. F4 is instead more clearly linked to the credibility of the response of the central bank to either large external shocks that put at peril the rand and the macroeconomic stability of South Africa, or to challenges to the central bank's independence and its mandate in terms of price stability and sound macroeconomic policy. Our reading of the narrative is also in line with the evidence of Kalemli-Özcan and Unsal (2024) that find that monetary policy credibility is a key factor in emerging markets in reducing the increase in risk spreads, conditional on external shocks.

Let us start from F3. A first interesting episode is the Aug-04, discussed above, when a surprise rate cut was combined with a strong signal about reduced risks on inflation and potentially softening growth. This clarification of the policy stance delivered a sharp reduction in F3. Other decisions where F3 responds strongly and negatively are the following occasions in which the bank reduced uncertainty around its policy path:

Jul-12 *MP Decision -50 bps; unanticipated; F1 -44.88 bps, F3 -10.74 bps.* Unanticipated reduction in the policy rate. The MPC statement states that "the MPC is concerned about the increased downside risk posed to the domestic economy from global developments." The Business Day editorial is titled "Rate cut 'bid to shield SA' from global downturn."

Jan-16 *MP Decision 50 bps; anticipated; F1 30.17 bps, F3 -17.71 bps.* The surprise dismissal of the Finance Minister in December 2015 started a period of economic policy uncertainty and rapid exchange rate devaluation, to which the Bank responded as strongly as it was hoped by the markets reducing the uncertainty regarding its policy path. The following day, the Business Day's comment reads: "[...] with the market widely predicting 50 basis points, the committee would have had to do a lot of explaining had it taken any other decision."

Mar-17 *MP Decision 0 bps; anticipated; F3 -10.87 bps.* The Bank follows the anticipated policy and signals that it is at the end of the tightening cycle. The comment from the Business Day reads: "The only surprise, in a week of such intense political uncertainty, was that one committee member voted for an interest rate cut."

The last factor is possibly the most interesting one and shows the ability of the bank to effectively modulate risks to the country. One remarkable event happened in March 2016 with a surprise hike of 25-basis points that took place in the middle of political turmoil, the disclosure of high-profile scandals related to the state capture during Zuma's presidency, and challenges to the bank's independence. Markets read into the hike and the MPC communication as a strong signal that the SARB was reaffirming its independence and commitment to sound macroeconomic policies. The factor reading is F1 16.49 bps, F3 -16.81 bps, F4 -16.82 bps. A very revealing quote is from the Business Day economic editor:

> It is hard not to wonder whether the events of the past few days were the factor that tipped the monetary policy committee into opting for a 25-basis point hike rather than a hold. And rightly so. This is not the time to take any chances with either policy credibility or the exchange rate. But the battle lines that have been drawn between Finance Minister Pravin Gordhan and the Hawks, and the dramatic disclosures of the Gupta family's influence on ministerial appointments have undermined SA's credibility with investors further and put new downward pressures on the rand. [...] if the committee's response was on the hawkish side (in the monetary policy sense), it cannot be faulted for acting to manage the risks as best as it can.

The credibility of the bank (or the lack thereof) in responding to external critical conditions shapes other large movements in F4:

Oct-08 *MP Decision 0 bps; anticipated; F2 33.79 bps, F4 32.39 bps.* In the immediate aftermath of Lehman Brothers' bankruptcy and at the onset of the financial crisis, the SARB appears to underestimate risks. "SA did not need to join a round of rate cuts by central banks globally as its financial system remained stable in the face of global turmoil, said Bank governor Tito Mboweni." Markets disagree. The Business Day titles "Disappointment at Mboweni's decision to buck global trend."

Feb-09 *MP Decision -100 bps; anticipated; F1 60.82 bps, F2 -15.37 bps, F4 19.95 bps.* The SARB reduces the policy rate as anticipated by 100 basis points. Markets get a clear message about the policy path ("Mboweni guns blazing for an even bigger cut") but also large and increased risks. "Growth [...] is a real concern. And from the Bank's point of view, given its mandate of price stability, the output gap suggests it should be worrying less about inflation and more about growth" (Business Day).

Sep-11 *MP Decision 0 bps; anticipated; F4 31.93 bps.* As anticipated, the MPC doesn't change the policy rate. However, the deepening of the European debt crisis makes the bank sharply reduce the growth projection and highlights several risk factors in the statement. The market hears the risks but does not see action. "The Bank revised its growth forecasts sharply down, and warned that they were still at risk from the global downturn. It was concerned about the potential impact of global turmoil" (Business Day).

Sep-13 *MP Decision 0 bps; anticipated; F4 -27.03 bps.* Markets reel while the Fed pauses its tapering. The SARB responds by reaffirming its focus on macro stability and does not change rates. "Markets might have been a little euphoric yesterday after the US Federal Reserve pulled back from the 'tapering' [...]. But the Reserve Bank's monetary policy committee was definitely not about to be carried away. Its tone yesterday [...] was anything but euphoric" (Business Day).

We close this section by stressing the crucial role of the SARB communication in conjunction with its actions in shaping market expectations about the policy path, the risks to inflation and growth, and in modulating the perceived threats to the country's macroeconomic stability.

6 The transmission of monetary policy

It is time to explore the transmission of conventional monetary policy shocks using the IV we built in the previous sections. We first show that policy changes strongly correlate with the short-term surprises – indicating that they were unexpected. Then we use the informationally robust IV derived from short-term surprises to identify conventional

monetary policy shocks. Finally, we compare the high frequency identification with an old style recursive identification of conventional policy shocks to show that they essentially coincide. This is a novel and important finding potentially allowing for the use of less advanced techniques to gauge monetary policy effects in emerging markets, where liquid derivative markets are not present.

6.1 (Almost) every change is a surprise

Table 4: Co-movement of short-term policy surprises with changes in policy rate.

	United States	Euro area	South Africa
2002M6-2008M12	0.15	0.42	0.56
Full sample	0.22	0.35	0.62

Note. Correlation of changes in the policy rate in the U.S., E.A. and South Africa with identified short-term monetary policy surprise component in each column. For the U.S., the Target factor is from Swanson (2021) and changes in the effective federal funds rate data are used; the full sample is 1991M5-2019M6, which is limited by the Target factor series availability. For the E.A., the Target factor is from Altavilla et al. (2019) and changes in the main refinancing operations rate data are used; the full sample is 2002M6-2019M12. For South Africa, the full sample is 2002M6-2020M1.

A cursory examination of the plot of the short-term factor, which captures surprise movements in the policy rate, shows a high degree of correlation between the first factor and the changes in the SARB repurchase policy rate (plot 5a in Figure 5). Coefficients of correlation, presented in Table 4, indicate a 62% correlation of the policy changes with F1. This points to the fact that policy decisions are largely unanticipated and come to market participants generally as a surprise.[39] This is not the case for the Federal Reserve's and the ECB's policy rate announcements (and, for the latter, especially after it established its credibility). In fact, for these central banks, their respective short-term surprises have a lower correlation with the policy changes (Table 4).

Figure 7 plots the policy changes, along with the short-term factor and the Bloomberg market surveys median forecasts errors for the policy rate. It shows a large degree of

[39]This result contrasts with the earlier evidence suggesting insensitivity of inflation expectations to monetary policy surprises in South Africa (Reid, 2009). This is likely due to a different measure of surprises used in the latter study. Specifically, daily changes in the 3-month bankers acceptance (BA) rate around MPC announcements are employed as a surprise proxy. While the BA rate tracks the current short-term rate conditions, it has a limited capacity to reflect market expectations, especially at longer horizons, unlike the range of interest rate derivative instruments across maturities employed here.

correlation between forecast errors and policy changes (coefficient of correlation 0.42), and between forecast errors and the short-term factor (coefficient of correlation 0.86).

Why are the markets often surprised? We conjecture that in an emerging market and small open economy, monetary policy must react to both internal and external shocks while balancing sharp trade-offs. This inherent instability makes the policy decisions less predictable, even when taken within a well-defined policy framework, as in South Africa. This is a key fact with both analytical and practical implications for the study of monetary policy in emerging markets.[40]

6.2 Conventional instruments, standard effects

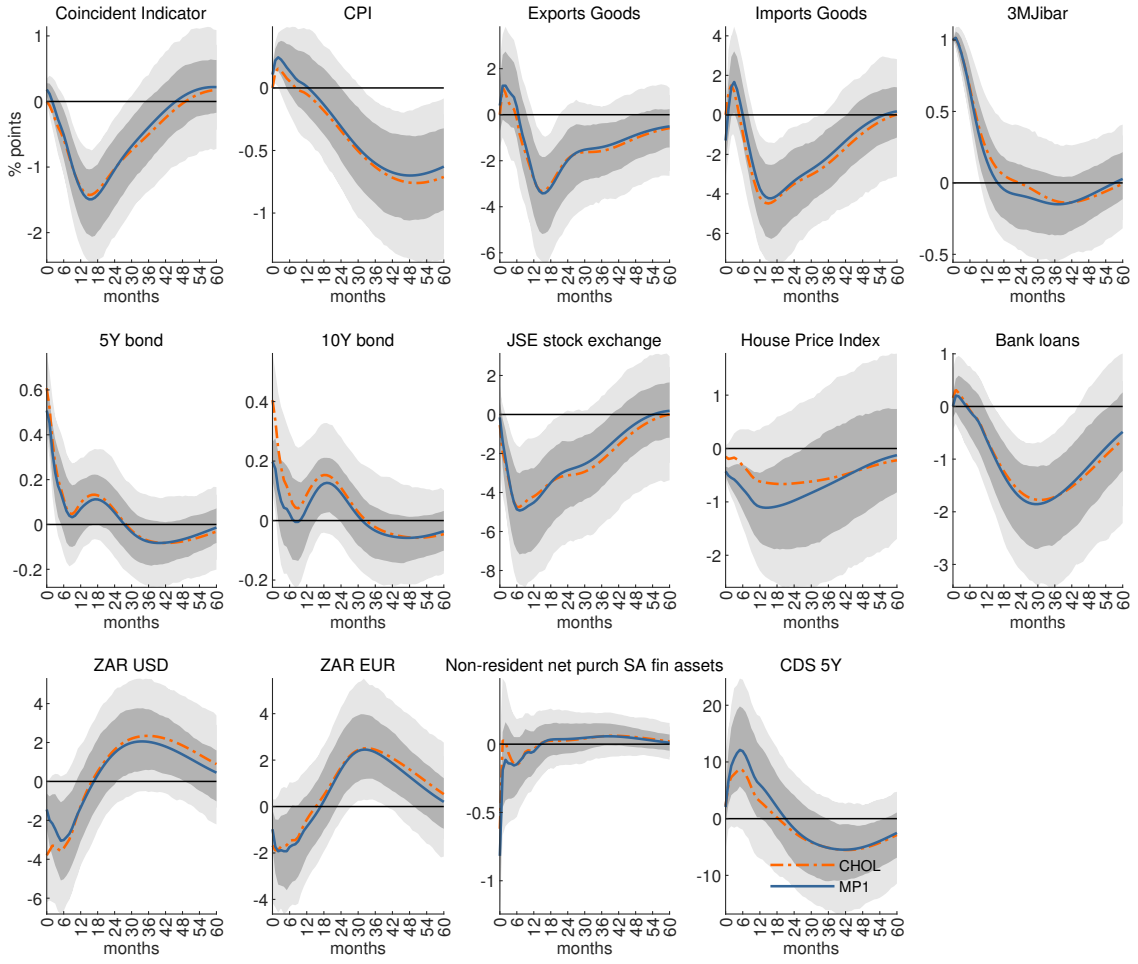
We now study the transmission of conventional monetary policy shocks in the South African economy, employing a medium-sized VAR model estimated on a monthly dataset of macroeconomic and financial indicators, over the period 2003M6-2020M1. The vector of endogenous variables in the model includes a coincident indicator for industrial production, the commodity price index, the value of good exports and imports in domestic currency, the 3-month Jibar interbank rate, the 2-, 5- and 10-year sovereign bond yields, the JSE stock market index, the house price index, the volume of bank loans outstanding, the nominal exchange rate of South African rand to U.S. dollar and euro, the non-residents' net purchases of South African financial assets as a ratio to GDP and 5-year CDS spread (see Table I in the Appendix for details on the dataset).[41] The model incorporates 12 lags of the endogenous variables and a constant term.

The VAR impulse response functions to a monetary policy shock are reported in Figure 8, where the impact of the shock is normalised to induce a 100 basis points increase in the 3M Jibar interbank rate. The blue lines are responses to a monetary policy shock identified using the informationally robust IV – i.e. MP1, which is derived from the short-term policy surprises –, with a Proxy-SVAR/SVAR-IV approach (see Stock and Watson, 2012 and Mertens and Ravn, 2013). The orange (dashed) lines report the responses to a monetary policy shock identified using a traditional recursive identification of monetary

[40] This interpretation is also supported by the variance decomposition results presented later. They show that the variance explained by conventional monetary policy shocks for key variables is lower than in advanced economies. This result points to the larger volatility caused by other shocks in the South African economy, rather than a a lower quality of policymaking and communication.

[41] The VAR is estimated with Bayesian techniques and standard macro Normal-Inverse Wishart priors, whose informativeness is set with the approach proposed by Giannone et al. (2015).

Figure 8: Conventional monetary policy shock



Note. Responses to a conventional monetary policy shock. The shock is identified either with recursive restrictions (orange, dashed) or with the informationally robust instrument for conventional monetary policy shocks 'MP1' (dark blue line). The shock is normalised to induce a 100 basis point increase in the 3M Jibar rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands for the shock identified with informationally robust instrument (MP1). 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'CDS 5Y' is a 5-year CDS spread for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 155.21. Reliability of the instrument is 0.651. For details on variables used, see Table I in the Appendix.

policy shocks (see, for example, Christiano et al., 1999). Specifically, aggregate demand as measured by the coincident indicator, the consumer price index, and the trade balance variables are assumed to be 'slow variables', featuring sluggish responses to the policy shocks, and hence not responding to the monetary policy shock within a month.

Two very broad results are worth highlighting. First, the effects of conventional monetary policy shocks in an emerging market with open capital flows and flexible exchange rates are indeed conventional, in the textbook sense. Second, a state-of-the-art identification of monetary policy derives almost indistinguishable results from an old-style recursive identification.

Let us first analyse how conventional monetary policy shocks transmit. The exogenous increase in the short-term rate affects the yield curve lifting the short-end more than the longer maturities. Bank credit issuance falls by around 2pp and is depressed persistently following the shock, indicating that the credit channel of monetary policy is operative. Asset prices fall – stocks and house prices –, possibly putting downward pressure both on the value of collaterals of the borrowers and on the balance sheets of lenders. The shock is persistently contractionary with falling aggregate activity (coincident indicator) and prices (CPI).[42] The ZAR/USD and ZAR/EUR nominal exchange rates respond negatively on impact to slowly recover, while the CDS spread increases. The FX market response is possibly due to macroeconomic channels dominating the direct effect of the higher rates. Overall, these effects are in line with what has been reported for advanced economies, and consistent with responses to a conventional monetary policy shock as predicted by standard macroeconomic theory. We believe that this is an important result both for the implication for the modelling of a small open economy and for its policy implications since no 'perverse effect' of monetary policy is apparent (see, for example, Gourinchas, 2018) in the case of South Africa.

Let us now discuss the question of identification. South Africa is one of the few emerging markets where it is possible to build modern IVs for the identification of monetary policy shocks due to the presence of a well-defined policy framework, deep financial markets, and a well-developed economic infrastructure that includes economic professional forecasters. In advanced economies, recursive identification and high-frequency identification provide results that are both qualitatively and quantitatively different (see, for

[42]The response of the CPI is subject to a small price puzzle upon impact, which may be due to the imperfect way we control for information and external shocks.

Table 5: Variance decomposition

	Conventional policy shock			**Forward guidance shock**		
Waves periodicity	1M-2Y	2Y-5Y	5Y+	1M-2Y	2Y-5Y	5Y+
Coincident indicator	0.6	1.3	1.9	1.6	1.6	0.5
	(0.3–1.1)	(0.4–1.6)	(0.5–2.1)	(0.7–2.3)	(0.5–2.5)	(0.3–1.3)
CPI	0.8	0.7	1.6	1	0.9	2.5
	(0.3–1.2)	(0.3–1.2)	(0.3–1.9)	(0.5–1.6)	(0.4–1.7)	(0.8–3.5)
JSE stock exchange	0.8	1.1	1.7	1.2	0.8	0.2
	(0.3–1.2)	(0.3–1.4)	(0.5–2.1)	(0.5–2.2)	(0.3–1.9)	(0.1–1.0)
Non-resident net purch	0.4	0.9	1.6	2.2	2.5	0.6
	(0.3–0.9)	(0.2–1.4)	(0.2–1.6)	(1.0–3.3)	(0.5–3.1)	(0.3–1.8)
CDS 5Y	0.2	0.7	1.4	0.8	1.4	0.2
	(0.1–0.6)	(0.2–1.3)	(0.3–1.7)	(0.4–1.6)	(0.4–2.5)	(0.2–1.3)
	Term premia shock			**Country risk shock**		
Waves periodicity	1M-2Y	2Y-5Y	5Y+	1M-2Y	2Y-5Y	5Y+
Coincident indicator	0.1	0.9	0.6	2	4	1.2
	(0.2–1.2)	(0.3–1.9)	(0.2–1.5)	(0.7–2.7)	(1.0–4.1)	(0.3–1.9)
CPI	0.1	0.4	0.1	0.3	0.7	0.8
	(0.1–0.7)	(0.2–1.2)	(0.1–1.1)	(0.2–0.9)	(0.3–1.5)	(0.2–1.6)
JSE stock exchange	0.3	1.5	0.6	16.5	9.6	2
	(0.3–1.5)	(0.3–2.4)	(0.1–1.4)	(5.3–12.7)	(2.0–6.9)	(0.6–2.5)
Non-resident net purch	1.3	2.2	1.1	6.5	7.6	2
	(0.5–2.5)	(0.4–2.6)	(0.2–1.8)	(3.8–7.6)	(1.5–5.3)	(0.3–2.2)
CDS 5Y	1.5	2.1	0.9	4.7	5.6	2.8
	(0.7–2.4)	(0.4–3.1)	(0.2–1.8)	(3.1–6.1)	(1.7–5.6)	(0.6–2.9)

Note: The table reports the fraction of the total variance of variables in the left column explained by the conventional monetary policy shock (top left panel), forward guidance shock (top right panel), term premia shock (bottom left panel) and country risk shock (bottom right panel) for waves of periodicity 1 month - 2 years (short run), 2-5 years (business cycle) and 5+ years (long run). 68% confidence bands in the brackets. The details of methodology used to compute the variance decomposition and the results for all the variables in the VAR are shown in Section H of the Appendix.

example, Gertler and Karadi, 2015 and Miranda-Agrippino and Ricco, 2021). Our results show that, in the case of South Africa, instead, the results coincide and one could dispense from more complex techniques and use robust old-style approaches. This is a result that has practical relevance and that we conjecture to apply to many other emerging economies for which high-frequency identification is not possible, while a traditional recursive identification could be easily employed.

We conclude this section by gauging the importance of monetary shocks. We do so by computing the share of the observed variance of the variables in the VAR that is explained by conventional policy shocks (Table 5).[43] In particular, we follow Forni et al. (2023) and compute the contribution of the identified shocks to the observed variance of

[43]The details of the methodology used for computation and results of variance decomposition for all the variables in the VAR are shown in Section H of the Appendix.

the indicators in the VAR, at different frequencies.

Results indicate that monetary policy shocks explain up to 1.9% of the variance of economic activity as measured by the coincident indicator, 1.6% of the variance of the CPI inflation, and 1.7% of the stock market. Overall, conventional monetary policy accounts for a low share of the observed variance of the South African economy, and less than what is generally found for advanced economies. This indicates the prevalence of other shocks in the economy compared to conventional monetary policy.

7 Forward guidance, term premia and country risk

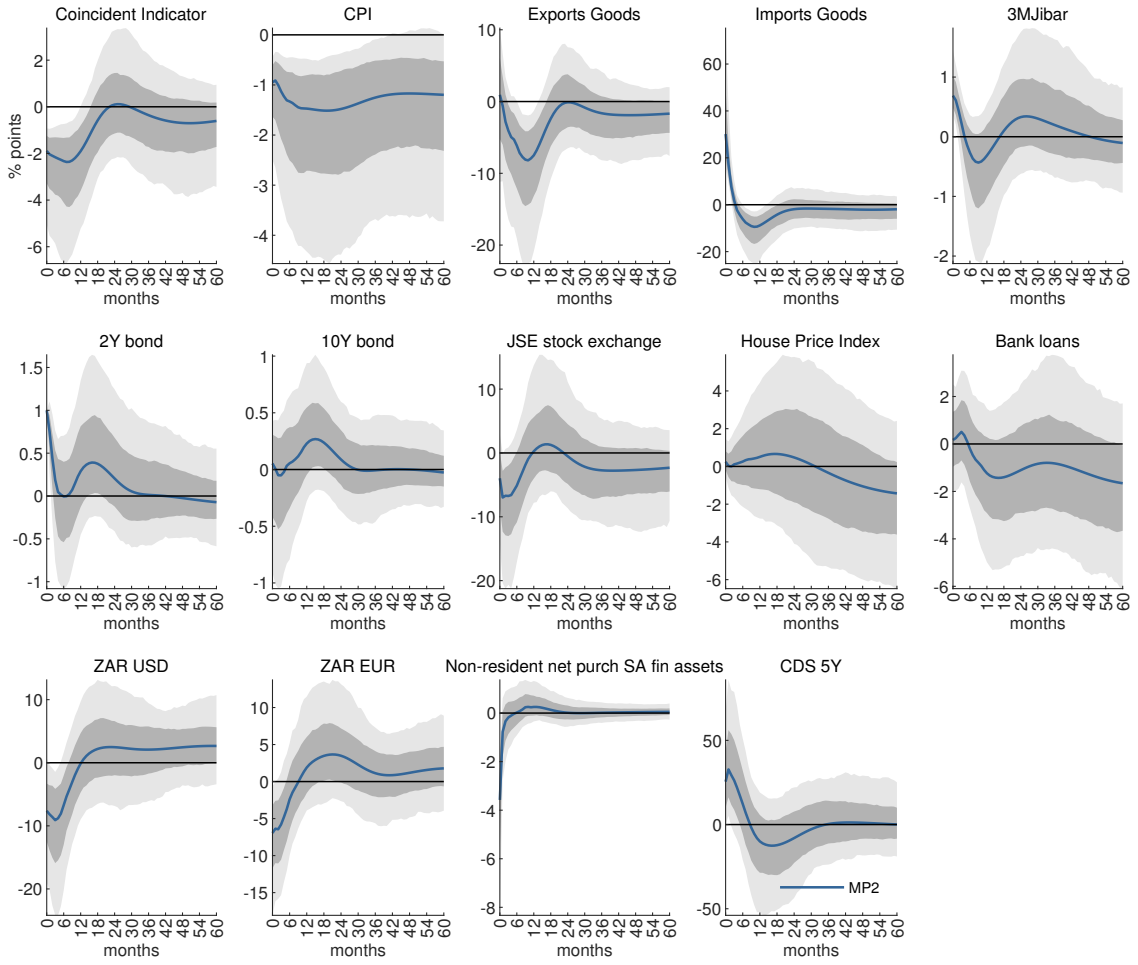
Medium and long-term yields, as well as country risk, are strongly affected by policy announcements, which shows that policy communication has a major role in shaping rates beyond the direct effects of short-term rates and conventional monetary policy. This is a largely unexplored channel of monetary policy, especially in the case of emerging markets. In advanced economies, these movements are possibly due to the way the central bank communication can affect expectation over the medium term (as is the case for the 'path factor' of Gürkaynak et al., 2005a) and, after the 2008 financial crisis, to the effect of unconventional monetary policy in the form of forward guidance or quantitative easing. However, the SARB, like most central banks in emerging economies, has not adopted unconventional monetary policies.

In this section, we study the macroeconomic effect of shocks to medium and long-term rates that we interpret, after having controlled for the information about the expected path of monetary policy, as (implicit) forward guidance shocks, term premium shocks related to the uncertainty about the policy path, and country risk shocks. Lastly, we analyse the SARB information effects on macroeconomic and financial variables, using the instrument as outlined in Section 4.3.

7.1 Forward guidance shocks

Forward guidance shocks, unrelated to the economic conditions, lift the medium part of the yield curve with both output and prices persistently negatively affected (see Figure 9). The coincident indicator and CPI fall on impact to stay below equilibrium over several years. The reduced growth prospects seem to dominate in the response of financial

Figure 9: Forward guidance shock.

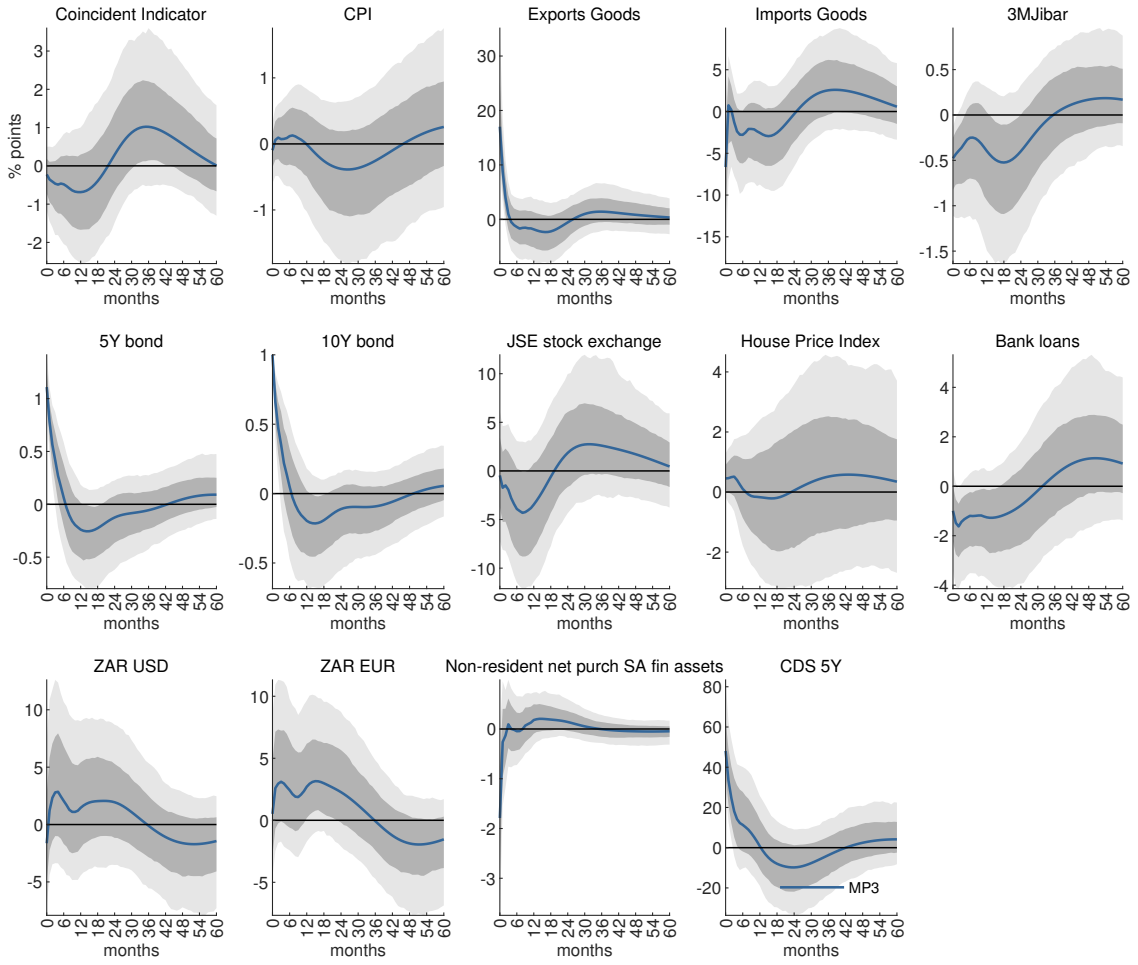


Note. Responses to a monetary policy shock identified with 'MP2' – the medium-term/F2 factor series corrected for the central bank's economic projections (see Section 4 for details). The shock is normalised to induce a 100 basis point increase in the 2Y rate. Sample 2003:06-2020:01. Light and dark grey shaded areas are, respectively, 90% and 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. F statistic of the first stage regression of the reduced-form innovations on the instrument is 1.545. Reliability of the instrument is 0.436. For details on variables used, see Table I in the Appendix.

assets. The domestic currency depreciates against the U.S. dollar and the euro. There is portfolio reallocation, a reduction of non-residents' net purchases of South African shares and bonds, and a repricing of the sovereign risk premium.

The variance decomposition indicates that the forward guidance shock explains around 1.6% of the observed variance of the coincident indicator, 2.5% of the CPI, and 2.5% of the variation in capital flows due to non-residents' net purchases of South African financial assets (see Table 5).

Figure 10: Term premia shock.



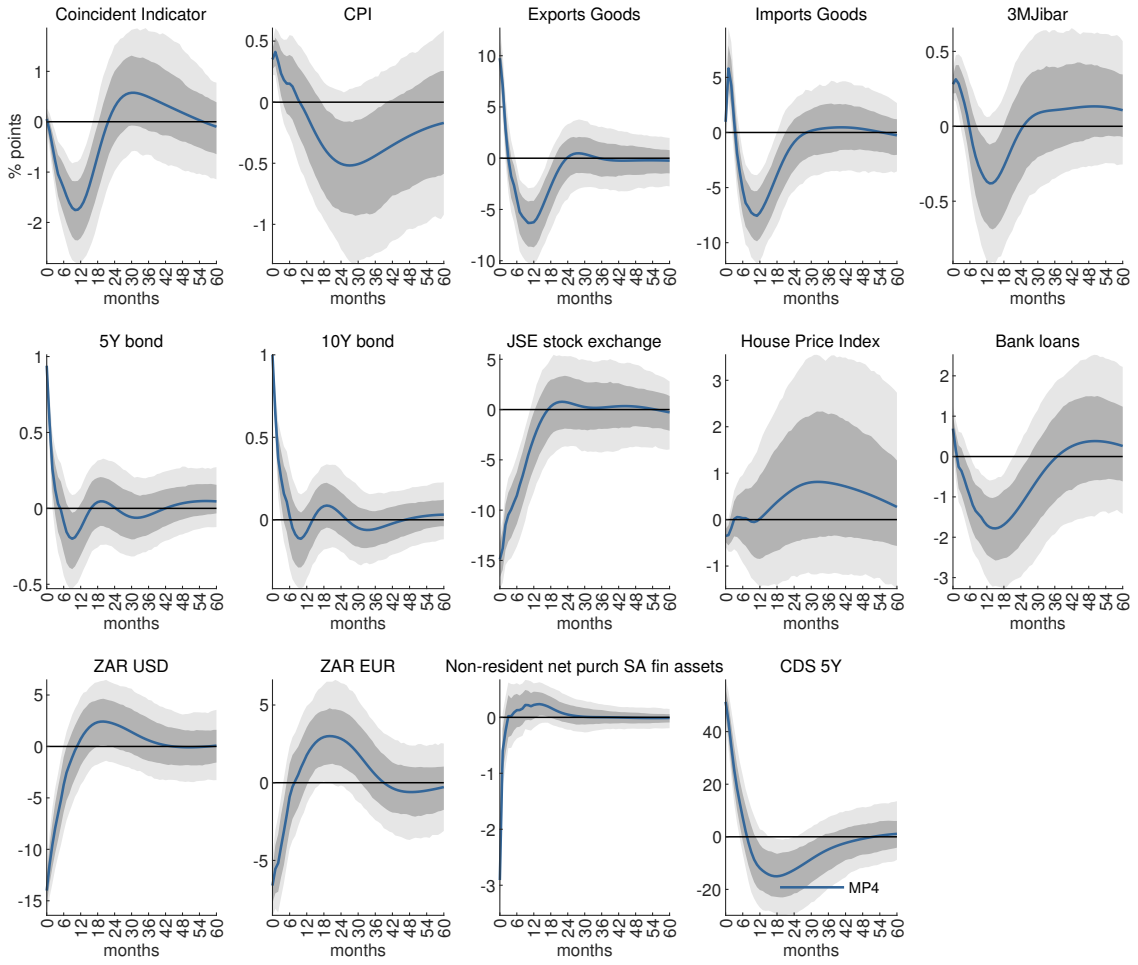
Note. Responses to a monetary policy shock identified with 'MP3' – the term premium/F3 factor series corrected for the central bank's economic projections (see Section 4 for details). The shock is normalised to induce a 100 basis point increase in the 10Y rate. Sample 2003:06-2020:01. Light and dark grey shaded areas are, respectively, 90% and 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. F statistic of the first stage regression of the reduced-form innovations on the instrument is 1.862. Reliability of the instrument is 0.262. For details on variables used, see Table I in the Appendix.

7.2 Term premia shocks

Pure term premium shocks have subdued macroeconomic effects. While they induce a steepening of the yield curve and a contraction of bank lending, the response of macroeconomic variables is largely statistically insignificant (see Figure 10). The exchange rate marginally appreciates and induces an improvement in the trade balance.

In line with the overall picture provided by the impulse response functions, the variance decomposition also points to a small contribution of the term premia shocks in explaining

Figure 11: Country risk shock.



Note. Responses to a monetary policy shock identified with 'MP4' – the country risk/F4 factor series corrected for the central bank's economic projections (see Section 4 for details). The shock is normalised to induce a 100 basis point increase in the 10Y rate. Sample 2003:06-2020:01. Light and dark grey shaded areas are, respectively, 90% and 68% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. F statistic of the first stage regression of the reduced-form innovations on the instrument is 17.468. Reliability of the instrument is 0.605. For details on variables used, see Table I in the Appendix.

the observed variance of macroeconomic and financial variables (see Table 5).

7.3 Country risk shocks

Country risk shocks have large contractionary effects on the South African economy (Figure 11). The shock induces a hike of the country default risk premium and a repricing of the CDS spread. The portfolio reallocation by global investors is evident in the movement of capital flow, with non-residents reducing their net purchases of South African shares and bonds upon the shock impact. The stock market value is negatively affected, while

interest rates increase, especially for medium and long-maturity instruments. Demand for domestic currency falls, and the South African rand depreciates strongly against the U.S. dollar and the euro. The pattern of responses is compatible with domestic assets becoming less attractive, and international investors demanding higher compensation to risk for holding South African bonds and equities.

Low financial assets' values and reduced external positions underlie the weakening of creditors' and borrowers' balance sheets, while increased interest rates make borrowing more expensive. These factors contribute to depressed credit issuance by domestic banks.

Weakened aggregate demand appears to put downward pressure on output and prices, inducing a deflationary environment. However, a weaker currency stimulates domestic export: the trade balance-to-GDP ratio features a positive impact response to shock.

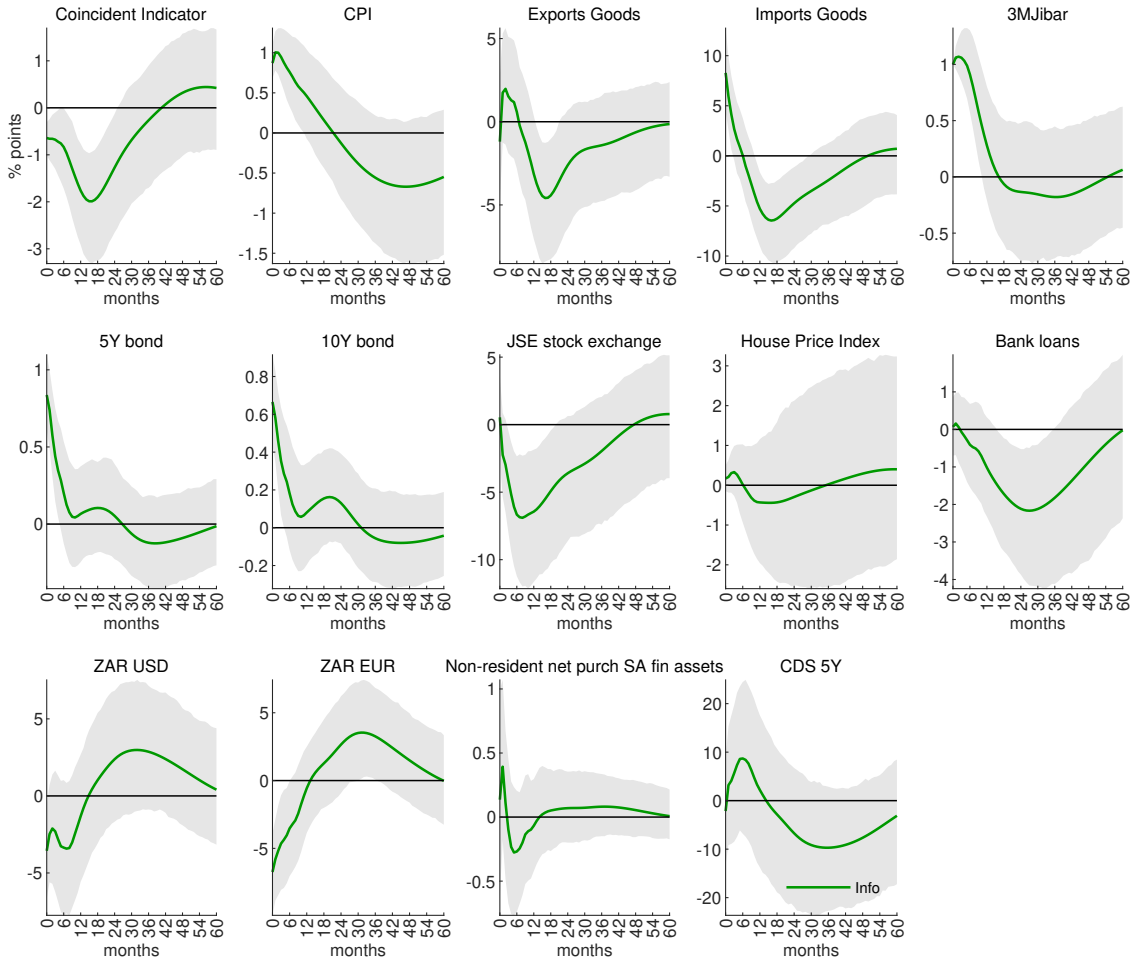
The variance decomposition shows that the country risk shock plays an important role in the macroeconomic fluctuations in South Africa by explaining 4% of the variance of production at the business cycle horizon. Country risk appears also to be a prominent driver of the financial market, explaining 16.5% of the variation of the stock market index in the short run, and 9.6% of its variation at the business cycle frequency. It also accounts for 7.6% of total variance in capital flows, and 5.6% of CDS spread at the business cycle frequency.

7.4 Information effects

To study the SARB information effects, we use a VAR with the same composition, sample, lags and estimation procedure as for the other monetary policy shocks discussed above. The IV for the information component (see 4.3 for details) is used to identify the information shock, and responses reflect the effect of the information released by the central bank via its forecasts and communication about the macroeconomic outlook, at the time of MPC announcements (Figure 12).

The macroeconomic effects of the information shock are consistent with the propagation of a supply shock, at business cycle frequency. Specifically, the information shock is followed by a significant reduction of growth and an increase in CPI inflation on impact. The relative yield curve steepening reflects the response of interest rates to inflation. The stock market and credit volumes fall, the sovereign risk premium goes up, and the exchange rate depreciates, consistently with the effects of a supply shock.

Figure 12: SARB information shock.



Note. Responses to a SARB information shock identified with the information IV series, 'Info' (see Section 4.3 for details). The shock is normalised to induce a 100 basis point increase in the 3M Jibar rate. Sample 2003:06-2020:01. Light and dark grey shaded areas are, respectively, 90% and 68% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. For details on variables used, see Table I in the Appendix.

These results indicate that information effects are driven by the endogenous response of the central bank to supply shocks. It is worth stressing that the prevalence of supply shocks is one of the important characteristics of emerging markets, as opposed to advanced economies where central banks mainly respond to and signal demand shocks (see results on the information effects in Jarociński and Karadi, 2020 and Miranda-Agrippino and Ricco, 2021).

8 Conclusion

Monetary policy practice in many emerging markets has progressively converged to a common standard of inflation targeting, flexible exchange rates, and credible monetary policy institutions. This modern framework has often had to contend with an economic environment dominated by external shocks and internal tensions. Despite the highly interesting macroeconomic and policy features of such an environment, too little research has been dedicated to studying it. This paper is an effort to address this gap by providing an analysis of how monetary policy operates in South Africa.

The SARB's monetary policy is a typical example of the trend towards best practices and its challenges. It was in the first wave of inflation-targeting adopters in 2000; it purposefully does not intervene in the exchange rate market; its independence and its mandate of price stability are enshrined in the constitution; and it has adopted a very transparent form of communication, with macro forecasts and the interest rate path published after each monetary policy committee meeting. However, it found itself a bulwark of sound macroeconomic policy amidst a deteriorating economic and institutional environment, confronted with significant shocks and tested in its independence. Indeed, many years of low growth, high unemployment, and extreme inequality can put monetary policy under pressure to adopt a less orthodox approach, with calls for monetary policy to assume a variably defined role of the creditor of last resort. On the other hand, a continuum of global shocks has reinforced the need for monetary policy as a stabilising force against global uncertainty.

Employing state-of-the-art high-frequency techniques, this paper unveils a few novel facts. First, conventional monetary policy works with conventional effects, with tightenings generating recessionary impacts. However, it is less predictable than in an advanced economy due to the higher volatility of the economic environment, which poses a challenge to the implementation of price stability and forces the central bank into a complex balancing act. Second, conventional monetary policy generally responds to shocks causing effects similar to supply shocks, with prices and output moving in opposite directions. This is different from what happens in advanced economies, where information effects signal demand shocks. Third, policy communication guides market expectations and has persistent macroeconomic effects, even in an emerging market. Finally, the main channel through which monetary policy operates in South Africa is by modulating the perceived

risks to the country's macroeconomic stability, either responding to and absorbing the risks posed by large external shocks or by offering a guarantee of sound macroeconomic policy against internal challenges.

References

Alessi, Lucia, Matteo Barigozzi, and Marco Capasso, "Improved penalization for determining the number of factors in approximate factor models," *Statistics & Probability Letters*, December 2010, *80* (23-24), 1806–1813.

Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Ragusa, "Measuring euro area monetary policy," *Journal of Monetary Economics*, 2019, *108* (C), 162–179.

Ang, Andrew, Sen Dong, and Monika Piazzesi, "No-Arbitrage Taylor Rules," Working Paper 13448, National Bureau of Economic Research September 2007.

Bauer, Michael D., Ben S. Bernanke, and Eric Milstein, "Risk Appetite and the Risk-Taking Channel of Monetary Policy," *Journal of Economic Perspectives*, February 2023, *37* (1), 77–100.

BIS, "Financial market development, monetary policy and financial stability in emerging market economies," in "in," Vol. 113 of *BIS Papers chapters*, Bank for International Settlements, 2020, pp. 293–305.

_ , "Triennial Central Bank Survey," 2022.

Borio, Claudio and Haibin Zhu, "Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism?," *Journal of Financial Stability*, 2012, *8* (4), 236–251.

Botha, Byron, Shaun de Jager, Franz Ruch, and Rudi Steinbach, "Working Paper WP1701 The Quarterly Projection Model of the SARB," Working Papers 8000, South African Reserve Bank September 2017.

Checo, Ariadne, Francesco Grigoli, and Damiano Sandri, "Monetary Policy Transmission in Emerging Markets: Proverbial Concerns, Novel Evidence," BIS Working Papers 1170, Bank for International Settlements March 2024.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans, "Monetary policy shocks: What have we learned and to what end?," in J. B. Taylor and M. Woodford, eds., *Handbook of Macroeconomics*, Vol. 1 of *Handbook of Macroeconomics*, Elsevier, 1999, chapter 2, pp. 65–148.

Cieslak, Anna and Hao Pang, "Common shocks in stocks and bonds," *Journal of Financial Economics*, 2021, *142* (2), 880–904.

Coibion, Olivier and Yuriy Gorodnichenko, "What Can Survey Forecasts Tell Us about Information Rigidities?," *Journal of Political Economy*, 2012, *120* (1), 116 – 159.

_ **and** _ , "Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts," *American Economic Review*, 2015, *105* (8), 2644–78.

Cook, Timothy and Thomas Hahn, "The effect of changes in the federal funds rate target on market interest rates in the 1970s," *Journal of Monetary Economics*, 1989, *24* (3), 331–351.

Forni, Mario, Luca Gambetti, and Giovanni Ricco, "External Instrument SVAR Analysis for Noninvertible Shocks," CEPR Discussion Papers 17886, C.E.P.R. Discussion Papers February 2023.

Frankel, Jeffrey, "Chapter 25 - Monetary Policy in Emerging Markets," in Benjamin M. Friedman and Michael Woodford, eds., *Benjamin M. Friedman and Michael Woodford, eds.*, Vol. 3 of *Handbook of Monetary Economics*, Elsevier, 2010, pp. 1439–1520.

Gertler, Mark and Peter Karadi, "Monetary Policy Surprises, Credit Costs, and Economic Activity," *American Economic Journal: Macroeconomics*, 2015, *7* (1), 44–76.

Giannone, Domenico, Michele Lenza, and Giorgio E. Primiceri, "Prior Selection for Vector Autoregressions," *The Review of Economics and Statistics*, May 2015, *2* (97), 436–451.

Gourinchas, Pierre-Olivier, "Monetary Policy Transmission in Emerging Markets: An Application to Chile," in Enrique G. Mendoza, Ernesto Pastén, and Diego Saravia, eds., *Monetary Policy and Global Spillovers: Mechanisms, Effects and Policy Measures*, Vol. 25 of *Central Banking, Analysis, and Economic Policies Book Series*, Central Bank of Chile, August 2018, chapter 8, pp. 279–324.

Gürkaynak, Refet S. and Jonathan H. Wright, "Macroeconomics and the Term Structure," *Journal of Economic Literature*, June 2012, *50* (2), 331?67.

_ , Andrew Levin, and Eric Swanson, "Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence from the U.S., UK, and Sweden," *Journal of the European Economic Association*, 12 2010, *8* (6), 1208–1242.

Gürkaynak, Refet S, Brian Sack, and Eric Swanson, "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements," *International Journal of Central Banking*, May 2005, *1* (1).

Gürkaynak, Refet S., Brian Sack, and Eric Swanson, "The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models," *American Economic Review*, March 2005, *95* (1), 425?436.

Hansen, Stephen, Michael McMahon, and Matthew Tong, "The long-run information effect of central bank communication," *Journal of Monetary Economics*, 2019, *108* (C), 185–202.

Ho, Sui-Jade and Ozer Karagedikli, "Effects of monetary policy communication in emerging market economies: Evidence from Malaysia," CAMA Working Papers 2021-67, Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, The Australian National University July 2021.

Ireland, Peter N., "Monetary policy, bond risk premia, and the economy," *Journal of Monetary Economics*, 2015, *76*, 124–140.

Jarociński, Marek and Peter Karadi, "Deconstructing Monetary Policy Surprises? The Role of Information Shocks," *American Economic Journal: Macroeconomics*, April 2020, *12* (2), 1–43.

Kalemli-Özcan, Sebnem and Filiz D. Unsal, "Global Transmission of FED Hikes: The Role of Policy Credibility and Balance Sheets," NBER Working Papers 32329, National Bureau of Economic Research, Inc April 2024.

Kuttner, Kenneth N., "Monetary policy surprises and interest rates: Evidence from the Fed funds futures market," *Journal of Monetary Economics*, June 2001, *47* (3), 523–544.

Lakdawala, Aeimit and Rajeswari Sengupta, "Measuring monetary policy shocks in India," Indira Gandhi Institute of Development Research, Mumbai Working Papers 2021-021, Indira Gandhi Institute of Development Research, Mumbai, India August 2021.

Larraín, Mauricio, "Monetary Policy and Long-Term Interest Rates in Chile," Working Papers Central Bank of Chile 335, Central Bank of Chile November 2005.

Leombroni, Matteo, Andrea Vedolin, Gyuri Venter, and Paul Whelan, "Central bank communication and the yield curve," *Journal of Financial Economics*, 2021, *141* (3), 860–880.

Longstaff, Francis A., Jun Pan, Lasse H. Pedersen, and Kenneth J. Singleton, "How Sovereign Is Sovereign Credit Risk?," *American Economic Journal: Macroeconomics*, April 2011, *3* (2), 75–103.

Lunsford, Kurt G., "Policy Language and Information Effects in the Early Days of Federal Reserve Forward Guidance," *American Economic Review*, September 2020, *110* (9), 2899–2934.

Mertens, Karel and Morten O. Ravn, "The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States," *American Economic Review*, 2013, *103* (4), 1212–47.

Miranda-Agrippino, Silvia and Giovanni Ricco, "The Transmission of Monetary Policy Shocks," *American Economic Journal: Macroeconomics*, July 2021, *13* (3), 74–107.

Nakamura, Emi and Jón Steinsson, "High-Frequency Identification of Monetary Non-Neutrality: The Information Effect," *The Quarterly Journal of Economics*, 01 2018, *133* (3), 1283–1330.

Reid, Monique, "The Sensitivity Of South African Inflation Expectations To Surprises," *South African Journal of Economics*, September 2009, *77* (3), 414–429.

SARB, *Quarterly Bulletin* number 306, South African Reserve Bank, December 2022.

Smith, Josephine M. and John B. Taylor, "The term structure of policy rules," *Journal of Monetary Economics*, October 2009, *56* (7), 907–917.

South African Reserve Bank, "Money Market Reference Rates. Jibar: Code of Conduct, Governance Process and Operating Rules," Technical Report, South African Reserve Bank November 2022.

Stock, James H. and Mark W. Watson, "Disentangling the Channels of the 2007-09 Recession," *Brookings Papers on Economic Activity*, 2012, *44* (1 (Spring), 81–156.

Swanson, Eric T., "Measuring the effects of federal reserve forward guidance and asset purchases on financial markets," *Journal of Monetary Economics*, 2021, *118* (C), 32–53.

Online Appendix to Trouble Every Day: Monetary Policy in an Open Emerging Market

Ekaterina Pirozhkova*
University of Pretoria,
South African Reserve Bank

Giovanni Ricco†
École Polytechnique,
University of Warwick, ERSA, CEPR

Nicola Viegi‡
University of Pretoria, ERSA

First Version: July 2021
This version: 25 October 2024

Abstract

This online appendix contains model derivations, details on the data used, a detailed narrative of the monetary policy events, and additional results for the paper 'Trouble Every Day: Monetary Policy in an Open Emerging Market'.

Keywords: Monetary policy, Small Open Economy, Trilemma, Exchange Rates.
JEL Classification: E5, F3, F4, C3.

*Department of Economics, University of Pretoria. Email: ekaterina.pirozhkova01@gmail.com

†CREST, École Polytechnique, 5 Av. Le Chatelier, 91120 Palaiseau, France. Email: giovanni.ricco@polytechnique.edu Web: www.giovanni-ricco.com

‡Department of Economics, University of Pretoria. Email: nicola.viegi@up.ac.za

Contents

A Model Derivations

A term structure with monetary and risk shocks

Let us consider an extension of the model of Smith and Taylor (2009), for an inflation targeting central bank

$$
\begin{aligned}
r_t &= \delta\pi_t + \sigma_{mp} u_t^{mp}, && (1)\\
i_t^{(n)} &= -\frac{1}{n}\log P_t^{(n)}, && (2)\\
P_t^{(n+1)} &= E_t\left[m_{t+1} P_{t+1}^{(n)}\right], && (3)\\
m_{t+1} &= e^{-r_t - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi}}, && (4)\\
\lambda_t &= -\gamma - \psi\pi_t - \sigma_\lambda u_t^{\lambda}, && (5)\\
\pi_t &= \alpha\pi_{t-1} - \phi(r_{t-1} - \pi_{t-1}) + \sigma_\pi u_t^{\pi}, && (6)
\end{aligned}
$$

where the three shocks – inflation, monetary policy, and risk – are independent and identically distributed normal white noise processes, $u_t^i \sim iidN(0,1)$ for $i \in (\pi, mp, \lambda)$. Eq. (1) is the monetary policy rule in which the short-term nominal interest rate r_t depends on the inflation rate with a policy response coefficient $\delta > 0$. Eq. (2) gives the yield to maturity of a zero-coupon bond with a face value of 1 that matures in n periods, where $P_t^{(n)}$ is the price of the bond at time t. Eq. (3) is a no-arbitrage condition showing that the price of an $n+1$ period bond at time t must equal the expected present discounted value of the price of an n-period bond at time $t+1$, where m_t is the stochastic discount factor. Eq. (4) describes this stochastic discount factor, whose functional form is borrowed from the affine term structure literature. Eq. (5) model the risk factor as depending on a constant risk premium, γ, and the time-varying risk premium, ψ, connected to changes in inflation. Finally, Eq. (59) the dynamics inflation that is function of the lagged real interest rate and past inflation.

This modellisation allows for an affine structure of the yield curve of the form

$$
i_t^{(n)} = a_n + b_n\pi_t + c_n u_t^{mp} + d_n u_t^{\lambda}\ , \tag{7}
$$

and hence

$$
P_t^{(n)} = e^{A_n + B_n\pi_t + C_n u_t^{mp} + D_n u_t^{\lambda}}\ , \tag{8}
$$

with the map between the coefficients of the two equations as per Eq. (2):

$$a_n = -\frac{A_n}{n}, \qquad b_n = -\frac{B_n}{n}, \qquad c_n = -\frac{C_n}{n}, \qquad d_n = -\frac{D_n}{n}. \tag{9}$$

Let us find a solution by the method of undetermined coefficients For $n = 1$, $i_t^{(1)} = r_t$, one obtains from Eq. (1)

$$a_1 = 0, \qquad A_1 = 0, \tag{10}$$

$$b_1 = \delta, \qquad B_1 = -\delta, \tag{11}$$

$$c_1 = \sigma_{mp}, \qquad C_1 = -\sigma_{mp}, \tag{12}$$

$$d_1 = 0, \qquad D_1 = 0. \tag{13}$$

From Eq. (3) one obtains

$$\begin{aligned}
P_t^{(n+1)} &= E_t\left[m_{t+1} P_{t+1}^{(n)}\right] \\
&= E_t\left[e^{-r_t - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi}} e^{A_n + B_n \pi_{t+1} + C_n u_{t+1}^{mp} + D_n u_{t+1}^{\lambda}}\right] \\
&= E_t\left[e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi} + A_n + B_n \pi_{t+1} + C_n u_{t+1}^{mp} + D_n u_{t+1}^{\lambda}}\right] \\
&= E_t\left[e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi} + A_n + B_n\left(\alpha\pi_t - \phi(\delta\pi_t + \sigma_{mp} u_t^{mp} - \pi_t) + \sigma_\pi u_{t+1}^{\pi}\right) + C_n u_{t+1}^{mp} + D_n u_{t+1}^{\lambda}}\right] \\
&= e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 + A_n + B_n\left((\alpha + \phi - \phi\delta)\pi_t - \phi\sigma_{mp} u_t^{mp}\right)} E_t\left[e^{-\lambda_t u_{t+1}^{\pi} + B_n\sigma_\pi u_{t+1}^{\pi} + C_n u_{t+1}^{mp} + D_n u_{t+1}^{\lambda}}\right] \\
&= e^{-\delta\pi_t - \frac{1}{2}\lambda_t^2 + A_n - \sigma_{mp}(1 + \phi B_n) u_t^{mp} + B_n(\alpha + \phi(1-\delta))\pi_t + \frac{1}{2}\left(B_n^2\sigma_\pi^2 + \lambda_t^2 + C_n^2 + D_n^2\right) - B_n\sigma_\pi\lambda_t} \\
&= e^{-\delta\pi_t - \frac{1}{2}\lambda_t^2 + A_n - \sigma_{mp}(1 + \phi B_n) u_t^{mp} + B_n(\alpha + \phi(1-\delta))\pi_t + \frac{1}{2}\left(B_n^2\sigma_\pi^2 + \lambda_t^2 + C_n^2 + D_n^2\right) + B_n\sigma_\pi\left(\gamma + \psi\pi_t + \sigma_\lambda u_t^{\lambda}\right)} \\
&= e^{A_n + B_n\sigma_\pi\gamma + \frac{1}{2}\left(B_n^2\sigma_\pi^2 + C_n^2 + D_n^2\right) + (B_n(\alpha + \phi(1-\delta) + \sigma_\pi\psi) - \delta)\pi_t - \sigma_{mp}(1 + \phi B_n) u_t^{mp} + B_n\sigma_\pi\sigma_\lambda u_t^{\lambda}}
\end{aligned}$$

where the equalities are derived by substituting in the no arbitrage condition in order, Eq. (4), Eq. (8), Eq. (1), Eq. (59), taking the expected value of the exponential of a normally distributed variable, and using Eq. (5) before simplifying the expression and factorising.

Matching coefficients with Eq. (8), one obtains the following set of recursive equations:

$$
\begin{aligned}
A_{n+1} &= A_n + \sigma_\pi \gamma B_n + \frac{1}{2}\left(\sigma_\pi^2 B_n^2 + C_n^2 + D_n^2\right), && (14)\\
B_{n+1} &= \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right) B_n - \delta, && (15)\\
C_{n+1} &= -\sigma_{mp}(1 + \phi B_n), && (16)\\
D_{n+1} &= \sigma_\pi \sigma_\lambda B_n, && (17)
\end{aligned}
$$

that can be solved recursively using the initial conditions in Eq. (10-13).

Solving the recursion in Eq. (15), one obtains

$$
\begin{aligned}
B_n &= -\delta \sum_{i=0}^{n-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i, && (18)\\
b_n &= \frac{\delta \sum_{i=0}^{n-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i}{n}. && (19)
\end{aligned}
$$

Hence, substituting in the expressions for the other coefficients

$$
\begin{aligned}
C_n &= -\sigma_{mp}\left(1 - \phi\delta \sum_{i=0}^{n-2} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i\right), && (20)\\
c_n &= \frac{\sigma_{mp}\left(1 - \phi\delta \sum_{i=0}^{n-2} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i\right)}{n}, && (21)\\
& && (22)
\end{aligned}
$$

and

$$
\begin{aligned}
D_n &= -\sigma_\pi \sigma_\lambda \delta \sum_{i=0}^{n-2} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i, && (23)\\
d_n &= \frac{\sigma_\pi \sigma_\lambda \delta \sum_{i=0}^{n-2} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i}{n}. && (24)
\end{aligned}
$$

Substituting in Eq. (14)

$$
\begin{aligned}
A_{n+1} &= A_n + \sigma_\pi \gamma B_n + \frac{1}{2}\left(\sigma_\pi^2 B_n^2 + \sigma_{mp}^2 (1 + \phi B_n)^2 + \sigma_\pi^2 \sigma_\lambda^2 B_n^2\right)\\
&= A_n + \left(\sigma_\pi \gamma + \sigma_{mp}^2 \phi\right) B_n + \frac{1}{2}\left(\sigma_\pi^2 + \phi^2 \sigma_{mp}^2 + \sigma_\pi^2 \sigma_\lambda^2\right) B_n^2 + \frac{1}{2}\sigma_{mp}^2, && (25)
\end{aligned}
$$

and iterating

$$A_n = \left(\sigma_\pi \gamma + \sigma_{mp}^2 \phi\right) \sum_{i=1}^{n-1} B_i + \frac{1}{2}\left(\sigma_\pi^2 + \phi^2 \sigma_{mp}^2 + \sigma_\pi^2 \sigma_\lambda^2\right) \sum_{i=1}^{n-1} B_i^2 + \frac{n-1}{2}\sigma_{mp}^2. \quad (26)$$

As before

$$a_n = -\frac{1}{n}\left(\sigma_\pi \gamma + \sigma_{mp}^2 \phi\right) \sum_{i=1}^{n-1} B_i - \frac{1}{2n}\left(\sigma_\pi^2 + \phi^2 \sigma_{mp}^2 + \sigma_\pi^2 \sigma_\lambda^2\right) \sum_{i=1}^{n-1} B_i^2 - \frac{n-1}{2n}\sigma_{mp}^2. \quad (27)$$

For the geometric sum in b_n not to be explosive in n, we have to assume that

$$|\alpha + \phi(1-\delta) + \sigma_\pi \psi| < 1$$

Restricting the space of the parameters to $\delta > 0$ and $\kappa \equiv \alpha + \phi(1-\delta) + \sigma_\pi \psi > 0$, the condition is

$$\delta > 1 + \frac{\alpha - 1 + \sigma_\pi \psi}{\phi}\ . \quad (28)$$

Under this condition, b_n has a numerator that grows as a geometric series with parameter smaller than one, and a numerator that grows with n.

The derivative of b_n in n is

$$\frac{\partial b_n}{\partial n} = \frac{\partial}{\partial n}\left(\frac{\delta}{n}\frac{1-\kappa^n}{1-\kappa}\right) = -\frac{1}{n}\frac{\delta}{1-\kappa}\left(\frac{1-\kappa^n}{n} + \kappa^n \log \kappa\right) < 0,$$

hence the response coefficient on inflation decrease over the horizons, as also shown in Smith and Taylor (2009).

We can also look at the derivative of b_n in δ:

$$\begin{aligned}
\frac{\partial b_n}{\partial \delta} &= \frac{\partial}{\partial \delta}\left(\frac{\delta}{n}\frac{1-\kappa^n}{1-\kappa}\right) = \frac{1}{n}\frac{1-\kappa^n}{1-\kappa} + \frac{\delta}{n}\frac{(1-\kappa)(-n\kappa^{n-1}) - (1-\kappa^n)(-1)}{(1-\kappa)^2}\frac{\partial \kappa}{\partial \delta} \\
&= \frac{1}{n}\frac{1-\kappa^n}{1-\kappa} + \frac{\delta}{n}\frac{(1-\kappa)(-n\kappa^{n-1}) - (1-\kappa^n)(-1)}{(1-\kappa)^2}(-\phi) \\
&= \frac{1}{n}\frac{1}{(1-\kappa)^2}\left[n\phi\delta\kappa^{n-1}(1-\kappa) - (1-\kappa^n)(\phi\delta - 1)\right], \quad (29)
\end{aligned}$$

if $\delta > 1/\phi$, then the first term in parenthesis is positive, while the second is negative. Since κ^{n-1} goes to zero for $n \to \infty$, while the second term goes to a constant, there will exist n^* such that $\frac{\partial b_n}{\partial \delta} > 0$ for $n < n^*$, while $\frac{\partial b_n}{\partial \delta} < 0$ for $n > n^*$.

The derivative of c_n in n is:

$$\begin{aligned}
\frac{\partial c_n}{\partial n} &= \frac{\partial}{\partial n}\left(\frac{\sigma_{mp}\left(1-\phi\delta\sum_{i=0}^{n-2}\kappa^i\right)}{n}\right) \\
&= \frac{\partial}{\partial n}\left(\frac{\sigma_{mp}\left(1-\phi\delta\left[\sum_{i=0}^{n-1}\kappa^i-\kappa^{n-1}\right]\right)}{n}\right) \\
&= \frac{\partial}{\partial n}\left(\frac{\sigma_{mp}\left(1-\phi\delta\left[\frac{1-\kappa^n}{1-\kappa}-\kappa^{n-1}\right]\right)}{n}\right) \\
&= \frac{\partial}{\partial n}\left(\frac{\sigma_{mp}}{n}-\sigma_{mp}\frac{\phi\delta}{n}\frac{1-\kappa^n}{1-\kappa}+\frac{\sigma_{mp}\phi\delta\kappa^{n-1}}{n}\right) \\
&= \frac{\partial}{\partial n}\left(\frac{\sigma_{mp}}{n}-\frac{\sigma_{mp}\phi\delta}{n(1-\kappa)}+\frac{\sigma_{mp}\phi\delta\kappa^n}{n(1-\kappa)}+\frac{\sigma_{mp}\phi\delta\kappa^{n-1}}{n}\right) \\
&= -\frac{\sigma_{mp}}{n^2}+\frac{\sigma_{mp}\phi\delta}{n^2(1-\kappa)}-\frac{\sigma_{mp}\phi\delta\kappa^n}{n^2(1-\kappa)}+\frac{\sigma_{mp}\phi\delta\kappa^n\log\kappa}{n(1-\kappa)}-\frac{\sigma_{mp}\phi\delta\kappa^{n-1}}{n^2}+\frac{\sigma_{mp}\phi\delta\kappa^{n-1}\log\kappa}{n} \\
&= -\frac{\sigma_{mp}}{n^2}\left(1-\frac{\phi\delta}{1-\kappa}+\frac{\phi\delta\kappa^n}{1-\kappa}-\frac{\phi\delta\kappa^n n\log\kappa}{1-\kappa}+\phi\delta\kappa^{n-1}-\phi\delta\kappa^{n-1}n\log\kappa\right) \\
&= -\frac{\sigma_{mp}}{n^2}\left(1-\frac{\phi\delta}{1-\kappa}+\delta\phi\kappa^{n-1}\left(\frac{\kappa}{1-\kappa}+1\right)-\phi\delta\kappa^{n-1}n\log\kappa\left(\frac{\kappa}{1-\kappa}+1\right)\right) \\
&= -\frac{\sigma_{mp}}{n^2}\left(1-\frac{\phi\delta}{1-\kappa}+\left(\frac{\kappa}{1-\kappa}+1\right)\left(\delta\phi\kappa^{n-1}-\phi\delta\kappa^{n-1}n\log\kappa\right)\right) \\
&= -\frac{\sigma_{mp}}{n^2}\left(1-\frac{\phi\delta}{1-\kappa}+\delta\phi\kappa^{n-1}\left(\frac{\kappa}{1-\kappa}+1\right)(1-n\log\kappa)\right),
\end{aligned}$$

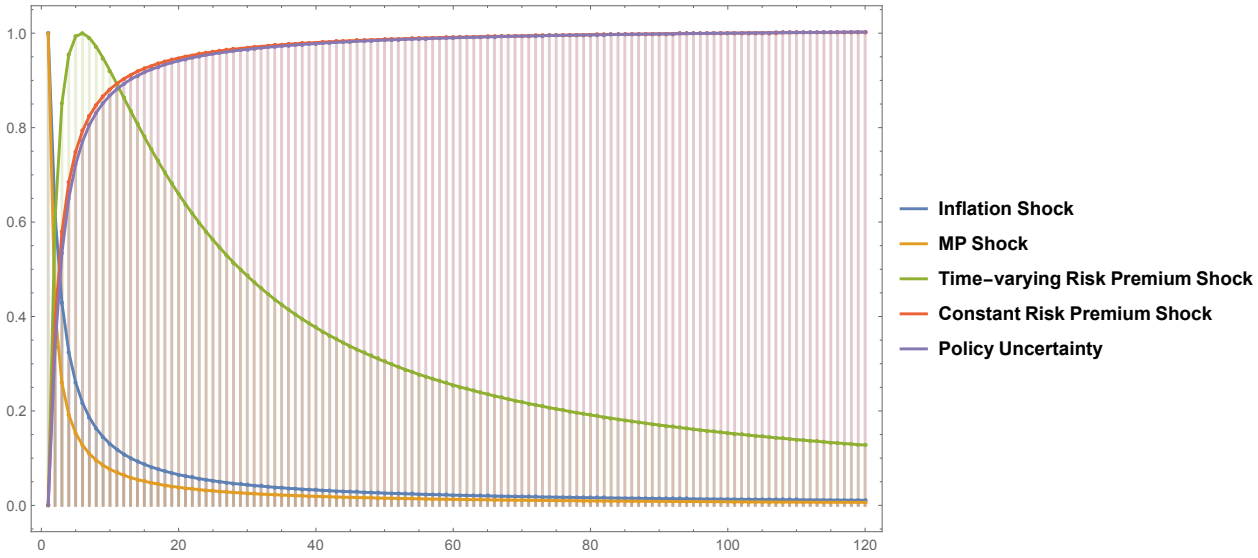
with expression in the brackets being positive, assuming $\kappa < 1-\phi\delta$, or equivalently, for $\alpha+\phi+\sigma_\pi\psi<1$. This implies $\frac{\partial c_n}{\partial n}<0$, meaning that the effect of monetary policy shock is smaller at long maturities.

The derivative of d_n in n is:

$$\begin{aligned}
\frac{\partial d_n}{\partial n} &= \frac{\partial}{\partial n}\left(\frac{\sigma_\pi\sigma_\lambda\delta}{n}\left[\sum_{i=0}^{n-1}\kappa^i-\kappa^{n-1}\right]\right) \\
&= \frac{\partial}{\partial n}\left(\frac{\sigma_\pi\sigma_\lambda\delta}{n}\left[\frac{1-\kappa^n}{1-\kappa}-\kappa^{n-1}\right]\right) \\
&= -\frac{\sigma_\pi\sigma_\lambda\delta}{n^2}+\frac{\sigma_\pi\sigma_\lambda\delta\kappa^n}{n^2(1-\kappa)}-\frac{\sigma_\pi\sigma_\lambda\delta\kappa^n\log\kappa}{n(1-\kappa)}+\frac{\sigma_\pi\sigma_\lambda\delta\kappa^{n-1}}{n^2}-\frac{\sigma_\pi\sigma_\lambda\delta\kappa^{n-1}\log\kappa}{n} \\
&= -\frac{\sigma_\pi\sigma_\lambda\delta}{n^2}\left(1-\kappa^{n-1}(1-n\log\kappa)(\frac{\kappa}{1-\kappa}+1)\right).
\end{aligned}$$

The impact of shocks is plotted in Figure I.

FIGURE I: Impact of shocks on the yield curve



Note. Impact of the inflation, monetary policy, constant risk and time-varying risk shocks onto the yield curve at maturities between 0 and 120 months. Shocks are normalised to have impact equal to one at peak. The parameters are as follows: $\alpha = 0.2$, $\phi = 0.15$, $\delta = 1.2$, $\rho = 0.8$, $\psi = 0.25$, $\sigma_\pi = 0.25$, $\sigma_{mp} = 0.25$, $\sigma_\xi = 0.25$, $\sigma_\gamma = 0.01$.

Temporary and Permanent Risk shocks

We now add to the model two shocks to the risk factor a temporary and a permanent one. We think of the former as capturing increases in the risk as due to temporary events, possibly due to external factors, and of the latter as permanent changes due either to term risk, not necessarily country specific, or country risk, and possibly due to internal developments. The two different mechanisms would affect the yield curve in a similar manner and would be distinguished only by the response of the country specific risk premium. In particular, we modify Eq. (5)

$$\lambda_t = -\gamma_t - \psi\pi_t - \xi_t^\lambda, \tag{30}$$

and we model the permanent shock to the constant risk premium by considering a random walk process

$$\gamma_t = \gamma_{t-1} + \sigma_\gamma u_t^\gamma \ , \tag{31}$$

while the temporary changes to λ_t are captured as

$$\xi_t = \rho\xi_{t-1} + \sigma_\xi u_t^\xi, \tag{32}$$

where $0 < \rho < 1$.

The affine structure of the yield curve takes the form

$$i_t^{(n)} = a_n + b_n \pi_t + c_n u_t^{mp} + d_n \xi_t + g_n \gamma_t \ , \tag{33}$$

and hence

$$P_t^{(n)} = e^{A_n + B_n \pi_t + C_n u_t^{mp} + D_n \xi_t + G_n \gamma_t} \ , \tag{34}$$

and initial conditions as in Eq.s (10-13), and $G_1 = 0$.

Following the same steps as before, we derive

$$\begin{aligned}
P_t^{(n+1)} &= e^{A_{n+1} + B_{n+1}\pi_t + C_{n+1} u_t^{mp} + D_{n+1}\xi_t + G_{n+1}\gamma_t} \\
&= E_t \left[e^{-r_t - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi}} e^{A_n + B_n \pi_{t+1} + C_n u_{t+1}^{mp} + D_n \xi_{t+1} + G_n \gamma_{t+1}} \right] \\
&= E_t \left[e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi} + A_n + B_n \pi_{t+1} + C_n u_{t+1}^{mp} + D_n \xi_{t+1} + G_n \gamma_{t+1}} \right] \\
&= E_t \left[e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi} + A_n + B_n \left(\alpha\pi_t - \phi(\delta\pi_t + \sigma_{mp} u_t^{mp} - \pi_t) + \sigma_\pi u_{t+1}^{\pi} \right) + C_n u_{t+1}^{mp} + D_n \xi_{t+1} + G_n \gamma_{t+1}} \right] \\
&= E_t \Big[e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 - \lambda_t u_{t+1}^{\pi} + A_n} \\
&\qquad e^{B_n \left(\alpha\pi_t - \phi(\delta\pi_t + \sigma_{mp} u_t^{mp} - \pi_t) + \sigma_\pi u_{t+1}^{\pi} \right) + C_n u_{t+1}^{mp} + D_n(\rho\xi_t + \sigma_\xi u_{t+1}^{\xi}) + G_n(\gamma_t + \sigma_\gamma u_{t+1}^{\gamma})} \Big] \\
&= e^{-\delta\pi_t - \sigma_{mp} u_t^{mp} - \frac{1}{2}\lambda_t^2 + A_n + B_n \left((\alpha + \phi - \phi\delta)\pi_t - \phi\sigma_{mp} u_t^{mp} \right) + \rho D_n \xi_t + G_n \gamma_t} \\
&\qquad E_t \left[e^{-\lambda_t u_{t+1}^{\pi} + B_n \sigma_\pi u_{t+1}^{\pi} + C_n u_{t+1}^{mp} + D_n \sigma_\xi u_{t+1}^{\xi} + G_n \sigma_\gamma u_{t+1}^{\gamma}} \right] \\
&= e^{-\delta\pi_t - \frac{1}{2}\lambda_t^2 + A_n - \sigma_{mp}(1 + \phi B_n) u_t^{mp} + B_n(\alpha + \phi(1-\delta))\pi_t + \rho D_n \xi_t + G_n \gamma_t + \frac{1}{2}\left(B_n^2 \sigma_\pi^2 + \lambda_t^2 + C_n^2 + D_n^2 \sigma_\xi^2 + G_n^2 \sigma_\gamma^2 \right) - B_n \sigma_\pi \lambda_t} \\
&= e^{-\delta\pi_t - \frac{1}{2}\lambda_t^2 + A_n - \sigma_{mp}(1 + \phi B_n) u_t^{mp} + B_n(\alpha + \phi(1-\delta))\pi_t + \rho D_n \xi_t + G_n \gamma_t} \\
&\qquad e^{\frac{1}{2}\left(B_n^2 \sigma_\pi^2 + \lambda_t^2 + C_n^2 + D_n^2 \sigma_\xi^2 + G_n^2 \sigma_\gamma^2 \right) + B_n \sigma_\pi (\gamma_t + \psi\pi_t + \xi_t)} \\
&= e^{A_n + \frac{1}{2}\left(B_n^2 \sigma_\pi^2 + C_n^2 + D_n^2 \sigma_\xi^2 + G_n^2 \sigma_\gamma^2 \right) + (B_n(\alpha + \phi(1-\delta) + \sigma_\pi\psi) - \delta)\pi_t - \sigma_{mp}(1 + \phi B_n) u_t^{mp} + (B_n \sigma_\pi + \rho D_n)\xi_t + (B_n \sigma_\pi + G_n)\gamma_t}
\end{aligned}$$

From which we obtain the system of recursive equations

$$\begin{aligned}
A_{n+1} &= A_n + \frac{1}{2}\left(\sigma_\pi^2 B_n^2 + C_n^2 + D_n^2 \sigma_\xi^2 + G_n^2 \sigma_\gamma^2 \right), && (35) \\
B_{n+1} &= (\alpha + \phi(1-\delta) + \sigma_\pi \psi) B_n - \delta, && (36) \\
C_{n+1} &= -\sigma_{mp}(1 + \phi B_n), && (37) \\
D_{n+1} &= \rho D_n + B_n \sigma_\pi, && (38) \\
G_{n+1} &= G_n + B_n \sigma_\pi && (39)
\end{aligned}$$

Solving the recursion in Eq. (36), one obtains

$$B_n = -\delta \sum_{i=0}^{n-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i, \tag{40}$$

$$b_n = \frac{\delta \sum_{i=0}^{n-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i}{n}. \tag{41}$$

Hence, substituting in the expressions (37) and (38)

$$C_n = -\sigma_{mp} \left(1 - \phi\delta \sum_{i=0}^{n-2} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i\right), \tag{42}$$

$$c_n = \frac{\sigma_{mp} \left(1 - \phi\delta \sum_{i=0}^{n-2} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^i\right)}{n}. \tag{43}$$

$$\tag{44}$$

The recursions for D_n and G_n deliver

$$D_n = \sigma_\pi \sum_{i=1}^{n-1} \rho^i B_i = -\delta\sigma_\pi \sum_{i=1}^{n-1} \rho^i \sum_{j=0}^{i-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^j, \tag{45}$$

$$d_n = \frac{\delta\sigma_\pi \sum_{i=1}^{n-1} \rho^i \sum_{j=0}^{i-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^j}{n}. \tag{46}$$

and

$$G_n = \sigma_\pi \sum_{i=1}^{n-1} B_i = -\delta\sigma_\pi \sum_{i=1}^{n-1} \sum_{j=0}^{i-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^j, \tag{47}$$

$$g_n = \frac{\delta\sigma_\pi \sum_{i=1}^{n-1} \sum_{j=0}^{i-1} \left(\alpha + \phi(1-\delta) + \sigma_\pi \psi\right)^j}{n}. \tag{48}$$

To compute the impact of a temporary risk shock across the yield curve, we look at the sign of $\frac{\partial d_n}{\partial n}$:

$$d_n = \frac{\delta\sigma_\pi}{n} \sum_{i=1}^{n-1} \rho^i \sum_{j=0}^{i-1} \kappa^j = \frac{\delta\sigma_\pi}{n} \sum_{i=1}^{n-1} \rho^i \frac{1-\kappa^i}{1-\kappa} = \frac{\delta\sigma_\pi}{n(1-\kappa)} \left[\sum_{i=1}^{n-1} \rho^i - \sum_{i=1}^{n-1} \rho^i \kappa^i\right] \tag{49}$$

$$= \frac{\delta\sigma_\pi}{n(1-\kappa)} \left[\frac{1-\rho^n}{1-\rho} - \frac{1-\rho^n\kappa^n}{1-\rho\kappa}\right] \tag{50}$$

so that

$$\frac{\partial d_n}{\partial n} = \frac{\delta\sigma_\pi}{n(1-\kappa)}\left[\frac{1}{1-\rho\kappa}\left((\kappa\rho)^n\log(\kappa\rho)+\frac{1-(\rho\kappa)^n}{n}\right)-\frac{1}{1-\rho}\left(\rho^n\log\rho+\frac{1-\rho^n}{n}\right)\right]. \quad (51)$$

As both $0<\rho<1$ and $0<\kappa<1$, one can notice that smaller values n ($n<n^*$) yield the first component in the square brackets being greater than the second one, what results in the positive value of the expression in square brackets. On the other hand, larger values of n ($n>n^*$) yield the value of the second component in the square brackets exceeding the first one, resulting in the negative value of $\frac{\partial d_n}{\partial n}$. Therefore, the effect of a temporary risk shock is increasing for maturities up to n^* and becomes decreasing for maturities beyond n^*. In case of parametrization used for illustrating the impact of shocks in Figure I, n^* is 4.198 month.

What is the impact of a permanent risk shock onto the yield curve? To compute it, let us first observe that

$$g_n = \frac{\delta\sigma_\pi}{n}\sum_{i=1}^{n-1}\sum_{j=0}^{i-1}k^j = \frac{\delta\sigma_\pi}{n}\sum_{i=1}^{n-1}\frac{1-\kappa^i}{1-\kappa} = \frac{\delta\sigma_\pi}{n(1-\kappa)}\left[(n-1)-\sum_{i=1}^{n-1}\kappa^i\right] \quad (52)$$

$$= \frac{\delta\sigma_\pi}{n(1-\kappa)}\left[n-\sum_{i=0}^{n-1}\kappa^i\right] = \frac{\delta\sigma_\pi}{(1-\kappa)}\left[1-\frac{1}{n}\frac{1-\kappa^n}{1-\kappa}\right]. \quad (53)$$

Hence, we get

$$\frac{\partial g_n}{\partial n} = \frac{\delta\sigma_\pi}{n(1-\kappa)^2}\left(\frac{1-\kappa^n}{n}+\kappa^n\log\kappa\right)>0, \quad (54)$$

which shows that the impact is increasing over the yield curve maturities.

Substituting Eq.s (37-38) and (48) in Eq. (35)

$$A_{n+1} = A_n+\frac{1}{2}\left(\sigma_\pi^2B_n^2+\sigma_{mp}^2(1+\phi B_n)^2+\sigma_\xi^2\sigma_\pi^2\left(\sum_{i=1}^{n-1}\rho^iB_i\right)^2+\sigma_\gamma^2\sigma_\pi^2\left(\sum_{i=1}^{n-1}B_i\right)^2\right)$$

$$= A_n+\sigma_{mp}^2\phi B_n+\frac{1}{2}\left(\sigma_\pi^2+\phi^2\sigma_{mp}^2\right)B_n^2\frac{1}{2}\sigma_\xi^2\sigma_\pi^2\left(\sum_{i=1}^{n-1}\rho^iB_i\right)^2+\frac{1}{2}\sigma_\gamma^2\sigma_\pi^2\left(\sum_{i=1}^{n-1}B_i\right)^2+\frac{1}{2}\sigma_{mp}^2,$$

and iterating

$$A_n = \left(\sigma_\pi \gamma + \sigma_{mp}^2 \phi\right) \sum_{i=1}^{n-1} B_i + \frac{1}{2}\left(\sigma_\pi^2 + \phi^2 \sigma_{mp}^2\right) \sum_{i=1}^{n-1} B_i^2 + \frac{1}{2}\sigma_\xi^2 \sigma_\pi^2 \sum_{k=1}^{n-1} \left(\sum_{i=1}^{k-1} \rho^i B_i\right)^2 + \frac{1}{2}\sigma_\gamma^2 \sigma_\pi^2 \sum_{k=1}^{n-1} \left(\sum_{i=1}^{k-1} B_i\right)^2 + \frac{n-1}{2}\sigma_{mp}^2.$$

The impact of the risk shocks are plotted in Figure I.

A.1 Monetary Policy Uncertainty Shocks

Without affecting the results on the affine structure of the yield curve, the model can be further extended to capture the effects of increases in the policy uncertainty, by considering a time-varying volatility of monetary policy shocks, i.e.

$$\sigma_{mp,t} = \sigma_{mp,t-1} + u_t^{\sigma_{mp}} \ . \tag{55}$$

To understand the impact of such a shock on the yield curve – assuming that all other shocks are zero –, one has to consider its impact on a_n. By factoring out the terms in a_n that contain $\sigma_{mp,t}$:

$$a_n = -\left(\frac{1}{n}\phi \sum_{i=1}^{n-1} B_i + \frac{1}{2n}\phi^2 \sum_{i=1}^{n-1} B_i^2 + \frac{n-1}{2n}\right) u_t^{\sigma_{mp}} + (\dots) \tag{56}$$

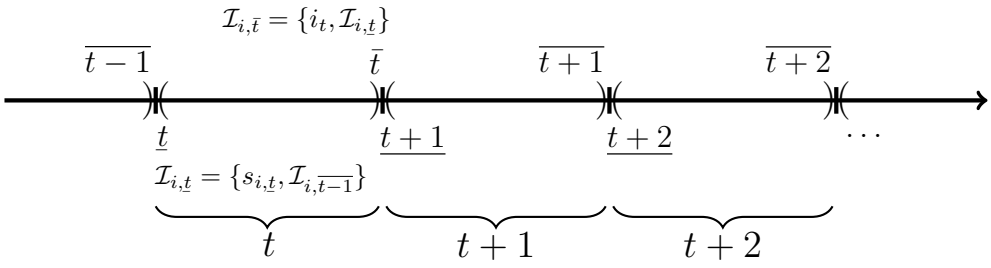
Let's call h_n the term in parentheses, it is straightforward to realise that the affine structure of the yield curve now takes the form

$$i_t^{(n)} = a_n + b_n \pi_t + c_n u_t^{mp} + d_n \xi_t + g_n \gamma_t + h_n u_t^{\sigma_{mp}} \ . \tag{57}$$

Let now consider the coefficient h_n

$$\begin{aligned} h_n &= \frac{1}{n}\left(\delta\phi \sum_{i=1}^{n-1}\sum_{j=1}^{i-1} \kappa^j + \frac{1}{2}\delta^2\phi^2 \sum_{i=1}^{n-1}\left(\sum_{j=1}^{i-1}\kappa^j\right)^2 + \frac{n-1}{2}\right) \\ &= \frac{1}{n}\left(\delta\phi \sum_{i=1}^{n-1} \frac{1-\kappa^i}{1-\kappa} + \frac{1}{2}\delta^2\phi^2 \sum_{i=1}^{n-1}\left(\frac{1-\kappa^i}{1-\kappa}\right)^2 + \frac{n-1}{2}\right) \\ &= \frac{1}{n}\left(\delta\phi \sum_{i=1}^{n-1} \frac{1-\kappa^i}{1-\kappa} + \frac{1}{2}\delta^2\phi^2 \sum_{i=1}^{n-1} \frac{1-2\kappa^i+\kappa^{2i}}{(1-\kappa)^2} + \frac{n-1}{2}\right) \\ &= \delta\phi \frac{1}{1-\kappa}\left(1 - \frac{1}{n}\frac{1-\kappa^n}{1-\kappa}\right) + \frac{1}{2}\delta^2\phi^2 \frac{1}{(1-\kappa)^2}\left(1 - \frac{2}{n}\frac{1-\kappa^n}{1-\kappa} + \frac{1}{n}\frac{1-\kappa^{2n}}{1-\kappa^2}\right) + \frac{n-1}{2n}. \end{aligned} \tag{58}$$

FIGURE II: The information flow.



Following the same derivations for g_n, it is easy to realise that $\frac{\partial h_n}{\partial n} > 0$ and hence the effects of monetary policy uncertainty are increasing at longer maturities. The impact of the monetary policy uncertainty shock is plotted in Figure I.

Imperfect Information

We now embed the term structure model in an environment characterised by imperfect information, following Miranda-Agrippino and Ricco (2021).

The inflation process in the model is:

$$\begin{aligned} \pi_t &= \alpha\pi_{t-1} - \phi(r_{t-1} - \pi_{t-1}) + \sigma_\pi u_t^\pi, \\ &= \alpha\pi_{t-1} - \phi(\delta\pi_{t-1} + \sigma_{mp} u_{t-1}^{mp} - \pi_{t-1}) + \sigma_\pi u_t^\pi, \\ &= (\alpha - \phi(\delta - 1))\pi_{t-1} - \phi\sigma_{mp} u_{t-1}^{mp} + \sigma_\pi u_t^\pi \end{aligned} \tag{59}$$

Each agent i in the economy do not directly observe π_t, but receives a private noisy signal of π_t at the beginning of the time period $t = [\underline{t}, \bar{t}]$ (see Figure II):

$$s_{i,\underline{t}} = \pi_t + \nu_{i,\underline{t}} \ , \qquad \nu_{i,\underline{t}} \sim \mathcal{N}(0, \sigma_{n,\nu}) \ . \tag{60}$$

Given the signal, and conditional on their information set $\mathcal{I}_{\underline{t}} = \{s_{i,\underline{t}}, \mathcal{I}_{\overline{t-1}}\}$, agents update their expectations from closing time of the previous period, $F_{i,\overline{t-1}}\pi_t$, and form expectations $F_{i,\underline{t}}\pi_t$ given their information set via the Kalman filter

$$F_{i,\underline{t}}\pi_t = K_1 s_{i,\underline{t}} + (1 - K_1) F_{i,\overline{t-1}}\pi_t \ , \tag{61}$$

$$F_{i,\underline{t}}\pi_{t+h} = (\alpha - \phi(\delta - 1))^h F_{i,\underline{t}}\pi_t \qquad \forall h > 0 \ , \tag{62}$$

where K_1 is the Kalman gain which represent the relative weight placed on new information relative to previous forecasts. When the signal is perfectly revealing $K_1 = 1$, while in the presence of noise $K_1 < 1$. Thus $(1 - K_1)$ is the degree of information rigidity faced by the agents.

Given their forecasts, at $\underline{t}$, agents trade bonds of different maturities with the following interest rates

$$i_{\underline{t}}^{(n)} = a_n + b_n F_{i,\underline{t}} \pi_t + d_n F_{i,\underline{t}} \xi_t + g_n \gamma_{t-1} \ , \tag{63}$$

and prices

$$P_{\underline{t}}^{(n)} = e^{A_n + B_n F_{i,\underline{t}} \pi_t + D_n F_{i,\underline{t}} \xi_+ G_n \gamma_{t-1}} \ . \tag{64}$$

At opening time $\underline{t}$ the central bank observes a private noisy signal of the state of the economy in period t

$$s_{cb,\underline{t}} = \pi_t + \nu_{cb,\underline{t}} \ , \qquad\qquad \nu_{cb,\underline{t}} \sim \mathcal{N}(0, \sigma_{cb,\nu}) \ . \tag{65}$$

We can assume without loss of generality that the signal observed by the central bank is more precise than the one observed by agents: $\sigma_{cb,\nu} < \sigma_{n,\nu}$. Given the signal, the central bank updates its expectations from closing time of the previous period given its information set via the Kalman filter

$$F_{cb,\underline{t}} \pi_t = K_{cb} s_{cb,\underline{t}} + (1 - K_{cb}) F_{cb,\overline{t-1}} \pi_t \ , \tag{66}$$

$$F_{cb,\underline{t}} \pi_{t+h} = (\alpha - \phi(\delta - 1))^h F_{cb,\underline{t}} \pi_t \qquad \forall h > 0 \ , \tag{67}$$

where K_{cb} is the bank's Kalman gain. Given its nowcast for inflation, the central bank sets and announces the interest rate, by following its policy rule:

$$i_t^{(1)} = r_t = \delta F_{cb,\underline{t}} \pi_t + \sigma_{mp} u_t^{mp} \tag{68}$$

Agents observe the interest rate r_t at closing time $\bar{t}$ and update their expectations and trade bonds at different maturities. The policy rate is to the agents a public signal about

the state of the economy. In fact, the policy rate depends on the value of inflation at t as[1]

$$
\begin{aligned}
r_t &= \delta F_{cb,\underline{t}}\pi_t + \sigma_{mp}u_t^{mp} \\
&= \delta(K_{cb}s_{cb,\underline{t}} + (1-K_{cb})F_{cb,\overline{t-1}}\pi_t) + \sigma_{mp}u_t^{mp} \\
&= \delta(K_{cb}\pi_t + K_{cb}\nu_{cb,\underline{t}} + (1-K_{cb})F_{cb,\overline{t-1}}\pi_t) + \sigma_{mp}u_t^{mp} \\
&= \delta(K_{cb}\pi_t + K_{cb}\nu_{cb,\underline{t}} + (1-K_{cb})((\alpha-\phi(\delta-1))F_{cb,\underline{t}}\pi_{t-1} - \phi\sigma_{mp}u_{t-1}^{mp}) + \sigma_{mp}u_t^{mp} \\
&= \delta(K_{cb}\pi_t + K_{cb}\nu_{cb,\underline{t}} + \\
&\qquad (1-K_{cb})((\alpha-\phi(\delta-1))(\frac{r_{t-1}-\sigma_{mp}u_{t-1}^{mp}}{\delta}) - \phi\sigma_{mp}u_{t-1}^{mp})) + \sigma_{mp}u_t^{mp}.
\end{aligned}
$$

Hence, conditionally, on observing r_t and r_{t-1} (and knowing K_{cb}), agents extract a public signal on π_t[2]

$$
\begin{aligned}
\tilde{s}_t &= \pi_t + \nu_{cb,\underline{t}} - K_{cb}^{-1}(1-K_{cb})((\alpha-\phi(\delta-1))\delta^{-1}+\phi))u_{t-1}^{mp} + \delta^{-1}K_{cb}^{-1}\sigma_{mp}u_t^{mp} \\
&= \pi_t + \widetilde{\nu}_{cb,\underline{t}} \qquad (69)
\end{aligned}
$$

At $\bar{t}$, conditional on this public signal, agents update their information set, $\mathcal{I}_{\bar{t}} = \{i_t, p_t, \mathcal{I}_{\underline{t}}\}$, and their forecasts

$$
\begin{aligned}
F_{i,\bar{t}}\pi_t &= K_2\tilde{s}_{cb,\bar{t}} + (1-K_2)F_{i,\underline{t}}\pi_t \ , &(70)\\
F_{i,\bar{t}}\pi_{t+1} &= (\alpha+\phi)F_{i,\bar{t}}\pi_t - \phi r_t \ , &(71)\\
F_{i,\bar{t}}\pi_{t+h} &= (\alpha-\phi(\delta-1))^{h-1}F_{i,\bar{t}}\pi_{t+1} \qquad \forall h>1 \ , &(72)
\end{aligned}
$$

where K_2 is the Kalman gain, as given by the noise in the public signal $\tilde{\nu}_{cb,\underline{t}}$.

[1] We assume that the central bank does not update its nowcast between $\underline{t}$ and $\bar{t}$, i.e. $F_{cb,\underline{t}}\pi_{t-1} = F_{cb,\bar{t}}\pi_{t-1}$.

[2] The noise in the signal $\tilde{s}_t$ is coloured, and not orthogonal to the state. Hence it does not fulfils the standard conditions under which the Kalman filter is derived. Unmodelled dynamics can seriously degrade the filter performance, we abstract here from these consideration that would require robust control methods.

We can obtain an expression for the revision of expectations, from Eq. (70)

$$\begin{aligned}
F_{i,\bar{t}}\pi_t - F_{i,\underline{t}}\pi_t &= K_2\left[\tilde{s}_{cb,\bar{t}} - F_{i,\underline{t}}\pi_t\right] \\
&= K_2(\pi_t + \tilde{\nu}_{cb,\bar{t}}) - K_2\left[K_1(\pi_t + \nu_{i,\underline{t}}) + (1-K_1)F_{i,\overline{t-1}}\pi_t\right] \\
&= K_2(1-K_1)\pi_t + K_2\tilde{\nu}_{cb,\bar{t}} - K_2K_1\nu_{i,\underline{t}} - K_2(1-K_1)F_{i,\overline{t-1}}\pi_t \\
&= K_2(1-K_1)\pi_t + K_2\tilde{\nu}_{cb,\bar{t}} - K_2K_1\nu_{i,\underline{t}} \\
&\qquad - K_2(1-K_1)((\alpha+\phi)F_{i,\overline{t-1}}\pi_{t-1} - \phi r_{t-1}) \\
&= K_2(1-K_1)((\alpha+\phi)\pi_{t-1} - \phi r_{t-1} + \sigma_\pi u_t^\pi) + K_2\tilde{\nu}_{cb,\bar{t}} - K_2K_1\nu_{i,\underline{t}} \\
&\qquad - K_2(1-K_1)((\alpha+\phi)F_{i,\overline{t-1}}\pi_{t-1} - \phi r_{t-1}) \\
&= K_2(1-K_1)(\alpha+\phi)\left[\pi_{t-1} - F_{i,\overline{t-1}}\pi_{t-1}\right] \\
&\qquad + K_2\left[(1-K_1)\sigma_\pi u_t^\pi + \tilde{\nu}_{cb,\bar{t}} - K_1\nu_{i,\underline{t}}\right].
\end{aligned} \tag{73}$$

The expression is obtained by employing in order (i) Eq. (69), (61), and (60); (ii) Eq. (71); and (iii) the dynamic equation for inflation $\pi_t = (\alpha+\phi)\pi_{t-1} - \phi r_{t-1} + \sigma_\pi u_t^\pi$. To find an expression for the forecast error $\left(\pi_{t-1} - F_{i,\overline{t-1}}\pi_{t-1}\right)$ in Eq. (73), first note that Eq. (70) implies

$$\pi_t - F_{i,\bar{t}}\pi_t = K_2^{-1}(1-K_2)\left(F_{i,\bar{t}}\pi_t - F_{i,\underline{t}}\pi_t\right) - \tilde{\nu}_{cb,\bar{t}}. \tag{74}$$

Then Eq. (74) one period earlier can be written as

$$\begin{aligned}
\pi_{t-1} - F_{i,\overline{t-1}}\pi_{t-1} &= K_2^{-1}(1-K_2)\left[F_{i,\overline{t-1}}\pi_{t-1} - F_{i,\underline{t-1}}\pi_{t-1}\right] - \tilde{\nu}_{cb,\overline{t-1}} \\
&= K_2^{-1}(1-K_2)(\alpha+\phi)^{-1}\left[(F_{i,\overline{t-1}}\pi_t - F_{i,\underline{t-1}}\pi_t)\right. \\
&\qquad \left. + \phi\left(r_{t-1} - F_{i,\underline{t-1}}r_{t-1}\right)\right] - \tilde{\nu}_{cb,\overline{t-1}}\,.
\end{aligned} \tag{75}$$

Substituting Eq. (75) into Eq. (73) yields

$$\begin{aligned}
F_{i,\bar{t}}\pi_t - F_{i,\underline{t}}\pi_t &= (1-K_1)(1-K_2)\left[(F_{i,\overline{t-1}}\pi_t - F_{i,\underline{t-1}}\pi_t) + \phi(r_{t-1} - F_{i,\underline{t-1}}r_{t-1})\right] \\
&\qquad + K_2\left[(1-K_1)(\sigma_\pi u_t^\pi - (\alpha+\phi)\tilde{\nu}_{cb,\overline{t-1}}) + \tilde{\nu}_{cb,\bar{t}} - K_1\nu_{i,\underline{t}}\right].
\end{aligned} \tag{76}$$

Taking the average over the market of agents i one gets

$$\begin{aligned}
F_{\bar{t}}\pi_t - F_{\underline{t}}\pi_t &= (1-K_1)(1-K_2)(F_{\overline{t-1}}\pi_t - F_{\underline{t-1}}\pi_t) \\
&\qquad + (1-K_1)(1-K_2)\phi(r_{t-1} - F_{\underline{t-1}}r_{t-1}) \\
&\qquad + K_2\left[(1-K_1)\sigma_\pi u_t^\pi - (1-K_1)(\alpha+\phi)\tilde{\nu}_{cb,\overline{t-1}} + \tilde{\nu}_{cb,\bar{t}}\right].
\end{aligned} \tag{77}$$

From the point of view of the agents, it has to be true that

$$r_t = \delta F_{i,\bar{t}} \pi_t + \sigma^{mp} F_{i,\bar{t}} u_t^{mp}, \tag{78}$$

i.e. the agents decompose the rate observed into their updated expectations of inflation and their guess of the value of the monetary policy shock. Using this equation, we can rewrite Eq. 77 as:

$$\begin{aligned} r_t - F_{\underline{t}} r_t = (1-K_1)(1-K_2)(1+\delta\phi)(r_{t-1} - F_{\underline{t-1}} r_{t-1}) \\ + \delta K_2 \left[(1-K_1)\sigma_\pi u_t^\pi - (1-K_1)(\alpha+\phi)\tilde{\nu}_{cb,\overline{t-1}} + \tilde{\nu}_{cb,\bar{t}} \right] + \sigma^{mp} F_{i,\bar{t}} u_t^{mp}. \end{aligned} \tag{79}$$

The equation shows that monetary policy surprises in a model with imperfect information are autocorrelated and depends on a convolution of past and current shocks υ_t

$$r_t - F_{\underline{t}} r_t = (1-K_1)(1-K_2)(1+\delta\phi)(r_{t-1} - F_{\underline{t-1}} r_{t-1}) + \upsilon_t. \tag{80}$$

To understand the structure of surprises along the yield curve, we need to consider Eq. (57). Central bank communication affects the yield curve via the announcements of the new rates (and the signalling of its view of the state of the economy) and also by affecting risk premia.[3] The affine structure of the revisions along the yield curve takes the form

$$i_t^{(n)} - F_{\underline{t}} i_t^{(n)} = b_n (F_{\bar{t}} \pi_t - F_{\underline{t}} \pi_t) + c_n F_{\bar{t}} u_t^{mp} + d_n \xi_t + g_n \gamma_t + h_n u_t^{\sigma^{mp}} \ . \tag{81}$$

Eq. (81) provides insight into the term structure of revisions along the yield curve. First, revisions are autocorrelated, as due to Eq. (77). Second, revisions are due to a combination of information shocks, monetary policy shocks and changes to risk premia related to different types of shocks. Third, the different types of shocks affect the yield curve differentially, at different maturities.

[3] We think of shocks to risk premia as possibly capturing increases or decreases in tail risk – the skewness of or kurtosis of the distribution –, as due to the central bank statements and actions, in a simplified mean-variance model with fixed standard deviations.

B Data Appendix

B.1 Transformation of the FRA forward rates

The following formula is used for the FRA forward rates transformation to swap rates:

$$S_t^{t_n} = \left(\left[\prod_{i=2}^{n} \left(1 + \frac{J_t^{t_1}}{400}\right) \left(1 + \frac{F_t^{t_{i-1},t_i}}{400}\right) \right]^{1/n} - 1 \right) 400, \tag{82}$$

where t_n is the swap rate tenor, $J_t^{t_1}$ is a spot JIBAR/interbank rate of maturity t_1, $F_t^{t_{i-1},t_i}$ is a FRA forward rate with tenor t_{i-1}/t_i, and n is the number of rate components in Eq. (82). To illustrate, for conversion of the FRA1x4 forward rate of the 1x4 tenor to 4M swap rate, the 1M JIBAR/interbank is used:

$$S_t^{4M} = \left(\left[\left(1 + \frac{J_t^{1M}}{400}\right) \left(1 + \frac{F_t^{1,4}}{400}\right) \right]^{1/2} - 1 \right) 400.$$

Starting from the FRA3x6 forward contract with 3x6 tenor and for longer tenors, the 3M JIBAR rate is used:

$$S_t^{6M} = \left(\left[\left(1 + \frac{J_t^{3M}}{400}\right) \left(1 + \frac{F_t^{3,6}}{400}\right) \right]^{1/2} - 1 \right) 400,$$

$$S_t^{9M} = \left(\left[\left(1 + \frac{J_t^{3M}}{400}\right) \left(1 + \frac{F_t^{3,6}}{400}\right) \left(1 + \frac{F_t^{6,9}}{400}\right) \right]^{1/3} - 1 \right) 400,$$

etc.

B.2 VAR data

TABLE I: Variables used in the VAR model

Variable	Source	Label
Coincident Indicator	SARB	Coincident Indicator
CPI	SARB	CPI
3-month Jibar interbank rate	SARB	3MJibar
2-year sovereign bond yield	Bloomberg	2Y bond
5-year sovereign bond yield	Bloomberg	5Y bond
10-year sovereign bond yield	Bloomberg	10Y bond
Johannesburg stock exchange index	SARB	JSE stock exchange
Aggregated house price index	Standard Bank of South Africa	House Price Index
Assets of banking institutions: total deposits, loans and advances	SARB	Bank loans
Nominal bilateral U.S. dollar-rand exchange rate[4]	Bloomberg	USD ZAR
Nominal bilateral euro-rand exchange rate[5]	Bloomberg	EUR ZAR
Non-residents' net purchases of South African shares and bonds as a share of GDP	Authors' calculations based on SARB data	Non-residents' net purch SA fin assets
South Africa's 5Y CDS spread	Bloomberg	CDS 5Y
ZAR value of exported goods	OECD	Exports Goods
ZAR value of imported goods	OECD	Imports Goods

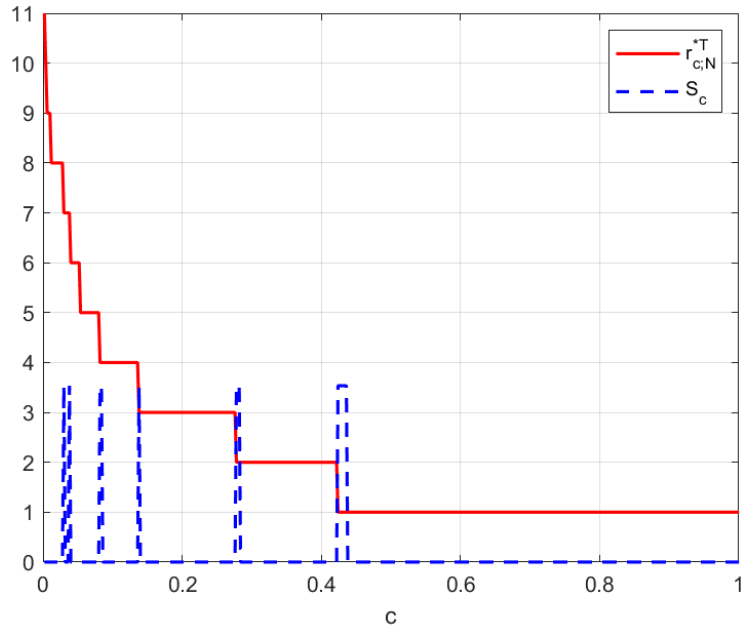
Note. The end of month values are used for series available at daily (or higher) frequency – for example, for 3M Jibar interbank rate, JSE stock exchange index, nominal exchange rates, etc.

C Identifying the number of factors

We estimate the number of factors in the factor model in the main text in Eq. (22) using the procedure suggested by Alessi et al. (2010). This method is an extension of a Bai and Ng (2002) reference criterion identifying a number of factors in a model r such that all eigenvalues of the idiosyncratic covariance matrix are bounded for the cross-section dimension of the dataset. While the framework of Bai and Ng (2002) yields a consistent estimator of the number of common factors for the case when both the cross-section dimension of the dataset and the time diverge, it often delivers results that are not robust, as the number of factors can be overestimated and underestimated (Forni et al., 2009). Thus, we resort to the test by Alessi et al. (2010) that proposes an improved penalisation in the criterion of Bai and Ng (2002) shown to deliver more reliable estimates.

Figure III shows the estimated number of factors $\mathrm{r}^{*\mathrm{T}}_{c;N}$ and stability $\mathrm{S_c}$ as functions of the penalty constraint c. The number of factors $\hat{\mathrm{r}}^{*\mathrm{T}}_{\hat{c};N}$ is determined as the second stability interval of $\mathrm{r}^{*\mathrm{T}}_{c;N}$, i.e. corresponding to the interval $\hat{c}$ that implies $\mathrm{S_c} = 0$, where the latter ensures that the detected number of factors is a stable function of the subsample size (n, T). The second stability interval is chosen, as the first one corresponds to the boundary solution $\mathrm{r}^{*\mathrm{T}}_{c;N} = \mathrm{r_{max}}$, while other stability intervals result in overpenalising, see Alessi et al. (2010). In our case the second stability interval corresponds to $\hat{\mathrm{r}}^{*\mathrm{T}}_{\hat{c};N} = 4$, see Figure III, thereby indicating the presence of four common factors in our dataset.

FIGURE III: The estimated number of factors in the factor model



Note. The Alessi et al. (2010) information criterion for the dataset of daily market surprises around MPC meetings (see section 3.1 for details of the dataset). The chart shows estimated number of factors (solid line) and stability (dashed line) as functions of a penalty constant c.

D Additional results on factors

D.1 Variance contributions

TABLE II: Variance contributions by latent factors

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21
PComp1	**56.4**	**72.2**	**88.9**	**91.8**	**92.9**	**91.2**	**96.5**	**97.7**
PComp2	**15.3**	6.6	3.3	1.1	0.2	1.6	0.1	0.0
PComp3	0.5	1.6	3.1	2.8	2.6	0.1	0.9	0.3
PComp4	**21.7**	4.9	0.9	2.2	2.4	0.0	1.3	0.7
Residual	6.1	14.8	3.8	2.1	1.9	7.0	1.1	1.3
	FRA21x24	Sw1Y	Sw2Y	Sw3Y	Sw5Y	Sw10Y		CDS5Y
PComp1	**97.7**	**97.3**	**92.9**	**81.8**	**74.7**	**56.7**		3.3
PComp2	0.0	0.1	0.0	3.7	**10.1**	**21.8**		**58.9**
PComp3	0.0	0.0	0.8	5.6	**10.8**	**16.0**		**35.0**
PComp4	0.4	0.5	0.1	0.3	1.2	0.4		2.5
Residual	1.8	2.1	6.3	8.5	3.2	5.2		0.3

Note: The table reports the fraction of the variance explained by four principal components in daily surprises around MPC announcements of instruments indicated in the first and the seventh rows in percentage points. The row 'Residual' reports the fractions of the variance not explained by four principal components.

E Additional Results on the IVs

E.1 Serial correlation in monetary policy factors

TABLE III: Serial correlation in monetary policy surprises

	Short-term	Medium-term	Term premium	Country risk
factor_{t-1}	0.160	-0.093	0.172	-0.133
	(0.475)	(0.376)	(0.147)	(0.274)
factor_{t-2}	-0.256**	-0.029	0.070	-0.152
	(0.097)	(0.103)	(0.116)	(0.094)
factor_{t-3}	-0.117	-0.365	-0.308	0.089
	(0.329)	(0.346)	(0.330)	(0.157)
factor_{t-4}	-0.103*	-0.225	-0.173*	-0.008
	(0.062)	(0.138)	(0.096)	(0.166)
factor_{t-5}	0.128	0.055	-0.075	-0.393
	(0.345)	(0.220)	(0.230)	(0.256)
factor_{t-6}	0.005	-0.029	0.059	-0.064
	(0.089)	(0.119)	(0.122)	(0.097)
factor_{t-7}	0.496**	-0.061	-0.096	-0.193
	(0.246)	(0.285)	(0.171)	(0.144)
factor_{t-8}	-0.051	-0.028	-0.248*	0.008
	(0.163)	(0.112)	(0.137)	(0.058)
factor_{t-9}	0.197	-0.163	-0.097	0.072
	(0.238)	(0.182)	(0.155)	(0.472)
factor_{t-10}	0.122	-0.144	-0.089	-0.097
	(0.103)	(0.102)	(0.121)	(0.069)
factor_{t-11}	0.159	0.117	0.065	-0.322
	(0.243)	(0.202)	(0.199)	(0.212)
factor_{t-12}	0.047	0.023	0.040	0.021
	(0.095)	(0.108)	(0.108)	(0.116)
constant	0.619	0.102	-0.096	0.137
	(1.816)	(0.557)	(0.612)	(0.667)
R^2	0.116	0.112	0.108	0.097
F	1.002	0.965	0.926	0.823
p	0.454	0.488	0.525	0.627
Obs	105	105	105	105

Note. AR(12) for identified factors corrected for the central bank information in each column. The sample is 2003M6-2020M1. Robust standard errors in parentheses. *$p < 0.1$, *$p < 0.05$, *$p < 0.01$.

E.2 Spillover from external shocks

TABLE IV: External effects on monetary policy factors in South Africa.

	Short-term	Medium-term	Term premium	Country risk	Short-term	Medium-term	Term premium	Country risk
Target Fed	0	-0.009	0.011	-0.013				
	(0.048)	(0.029)	(0.016)	(0.023)				
Forward Guidance Fed	0.004	0.001	0	0.01				
	(0.025)	(0.006)	(0.008)	(0.008)				
QE Fed	0.017	-0.01	-0.01	0.029*				
	(0.021)	(0.008)	(0.010)	(0.015)				
Target ECB					0.266*	-0.061	0.107	-0.391
					(0.137)	(0.103)	(0.136)	(0.243)
Timing ECB					-0.044	-0.085***	0.037	-0.004
					(0.042)	(0.032)	(0.028)	(0.053)
Forward Guidance ECB					0.005	0.044**	0.003	-0.044
					(0.033)	(0.018)	(0.023)	(0.029)
QE ECB					-0.036	0.011	0.006	0.019
					(0.031)	(0.031)	(0.047)	(0.063)
constant	0.001	0	-0.001	0.001	0.016	0.01	0.003	-0.011
	(0.019)	(0.008)	(0.009)	(0.008)	(0.083)	(0.057)	(0.085)	(0.097))
R^2	0.006	0.016	0.011	0.123	0.054	0.169	0.019	0.108
N	105	105	105	105	108	108	108	108
	Short-term	Medium-term	Term premium	Country risk	Short-term	Medium-term	Term premium	Country risk
Oil supply	-0.007	0.003	0.003	-0.003				
	(0.008)	(0.004)	(0.004)	(0.003)				
VIX					-0.001	0.001	0.001	0
					(0.002)	(0.001)	(0.001)	(0.002)
constant	-0.018	0.001	-0.004	0.01	0.025	-0.021	-0.028	-0.008
	(0.028)	(0.011)	(0.009)	(0.008)	(0.039)	(0.019)	(0.023)	(0.025)
R^2	0.006	0.006	0.014	0.017	0.003	0.017	0.024	0.002
N	55	55	55	55	109	109	109	109

Note. Regressions are run at the SARB MPC frequency. The sample is 2002M6-2020M1. Construction of the SARB monetary policy factors is discussed in section 3. The Federal Reserve monetary policy surprises are from Swanson (2021), the ECB monetary policy factors are from Altavilla et al. (2019), and oil supply shocks are from Känzig (2021). The most recent values of the U.S. and ECB monetary policy factors before each SARB MPC meetings are used in projections. SARB MPC meetings with no oil shock preceding to them are excluded from regressions. The mean of daily VIX index between two consecutive SARB MPC meetings at dates t-1 and t is used as a proxy of global uncertainty outlook prevalent at MPC meeting at date t. The end-of-day value of VIX index at day t is not included in calculation of the mean, as it is not yet available on the day t MPC meeting. Robust standard errors in parentheses, $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

E.3 Event Study Additional Results

TABLE V: Estimated effects of monetary policy surprises corrected for the SARB macroeconomic forecasts on financial markets

	MP1	MP2	MP3	MP4	Constant	R^2	Obs
Overnight	0.584**	-0.019	-0.206	0.122	-0.036	0.15	81
	(0.26)	(0.53)	(0.25)	(0.30)	(0.03)		
1M Jibar	1.071***	0.078	-0.01	0.167	-0.042**	0.58	105
	(0.14)	(0.35)	(0.23)	(0.21)	(0.02)		
3M Jibar	1.020***	-0.039	0.045	0.138	-0.032***	0.71	105
	(0.07)	(0.20)	(0.21)	(0.15)	(0.01)		
1Y bond	0.237***	0.027	0.452**	0.191*	-0.014*	0.24	83
	(0.08)	(0.17)	(0.18)	(0.11)	(0.01)		
2Y bond	0.370***	-0.135	1.192***	0.737***	-0.007	0.57	69
	(0.07)	(0.38)	(0.22)	(0.21)	(0.01)		
3Y bond	0.364***	0.018	1.079***	0.834***	-0.009	0.6	75
	(0.09)	(0.31)	(0.22)	(0.15)	(0.01)		
5Y bond	0.261***	0.036	0.856***	0.657***	-0.018**	0.58	88
	(0.06)	(0.15)	(0.16)	(0.10)	(0.01)		
10Y bond	0.115**	-0.114	0.761***	0.456***	-0.013*	0.41	105
	(0.05)	(0.14)	(0.16)	(0.12)	(0.01)		
20Y bond	0.097*	-0.109	0.724***	0.415***	-0.018**	0.36	101
	(0.05)	(0.16)	(0.17)	(0.12)	(0.01)		
30Y bond	0.104*	-0.135	0.668***	0.382***	-0.017**	0.34	99
	(0.06)	(0.16)	(0.19)	(0.13)	(0.01)		
JSE All shares	-1.741*	3.528	-3.488*	-5.755***	-0.114	0.18	105
	(0.91)	(2.38)	(2.04)	(1.84)	(0.12)		
ZAR/USD^{1day}	1.166	-3.656	-0.353	-3.343	0.111	0.09	105
	(0.90)	(2.58)	(2.36)	(2.51)	(0.11)		
ZAR/USD^{2day}	1.851**	-8.343***	0.307	2.82	0.155	0.15	105
	(0.90)	(2.98)	(3.35)	(2.54)	(0.13)		
ZAR/EUR^{1day}	0.555	-5.259**	0.795	-1.939	0.036	0.09	105
	(0.81)	(2.17)	(1.91)	(2.00)	(0.10)		
ZAR/EUR^{2day}	1.701*	-7.285***	2.801	4.156**	0.13	0.15	105
	(1.00)	(2.40)	(3.25)	(1.95)	(0.14)		
CDS 5Y	-0.033	-0.066	0.053	0.992***	0.002	0.74	105
	(0.029)	(0.076)	(0.084)	(0.088)	(0.004)		
EMBI+SA	-0.016	-0.237*	0.224	1.054***	0	0.54	100
	(0.04)	(0.14)	(0.17)	(0.12)	(0.01)		
NNPtot	0.106	-0.82	-1.917	-4.451**	0.1	0.06	105
	(0.72)	(2.49)	(2.10)	(1.92)	(0.13)		
NNPshares	0.159	0.472	1.95	-2.021	0.002	0.03	105
	-0.432	-1.584	-1.447	-1.516	-0.098		
NNPbonds	0.03	-1.271	-3.49	-4.089*	0.118	0.06	105
	-0.822	-3.054	-2.285	-2.325	-0.13		

Note. Projection of financial market values on identified monetary policy surprises corrected for the SARB macroeconomic forecasts. Robust standard errors in parentheses. Dependent variable is the daily change in financial market value around SARB MPC announcements in the sample 2002M6-2020M1. '1M Jibar' and '3M Jibar' are 1-month and 3-month Jibar/interbank rates. '1Y bond', '2Y bond', '3Y bond', '5Y bond', '10Y bond', '20Y bond' and '30Y bond' government bond yields of respective maturities as quoted on Bloomberg. JSE All shares is a stock market index. ZAR/USD and ZAR/EUR are nominal exchange rates of South African rand (ZAR) expressed as ZAR prices in USD and EUR, respectively, i.e. the exchange rate increase is ZAR appreciation. 'CDS 5Y' and 'EMBI+SA' are measures of the country credit risk premium. 'NNP' is non-residents' net purchases of South African shares and bonds, 'NNPshares' is non-residents' net purchases of South African shares, 'NNPbonds' is non-residents' net purchases of South African bonds. Capital flow variables are z-scores of their deflated values (GDP deflator index, 2015 = 100 is used for deflating nominal values). $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

F Additional results on correlations

TABLE VI: Policy surprises' co-movement with changes in the SARB repurchase rate.

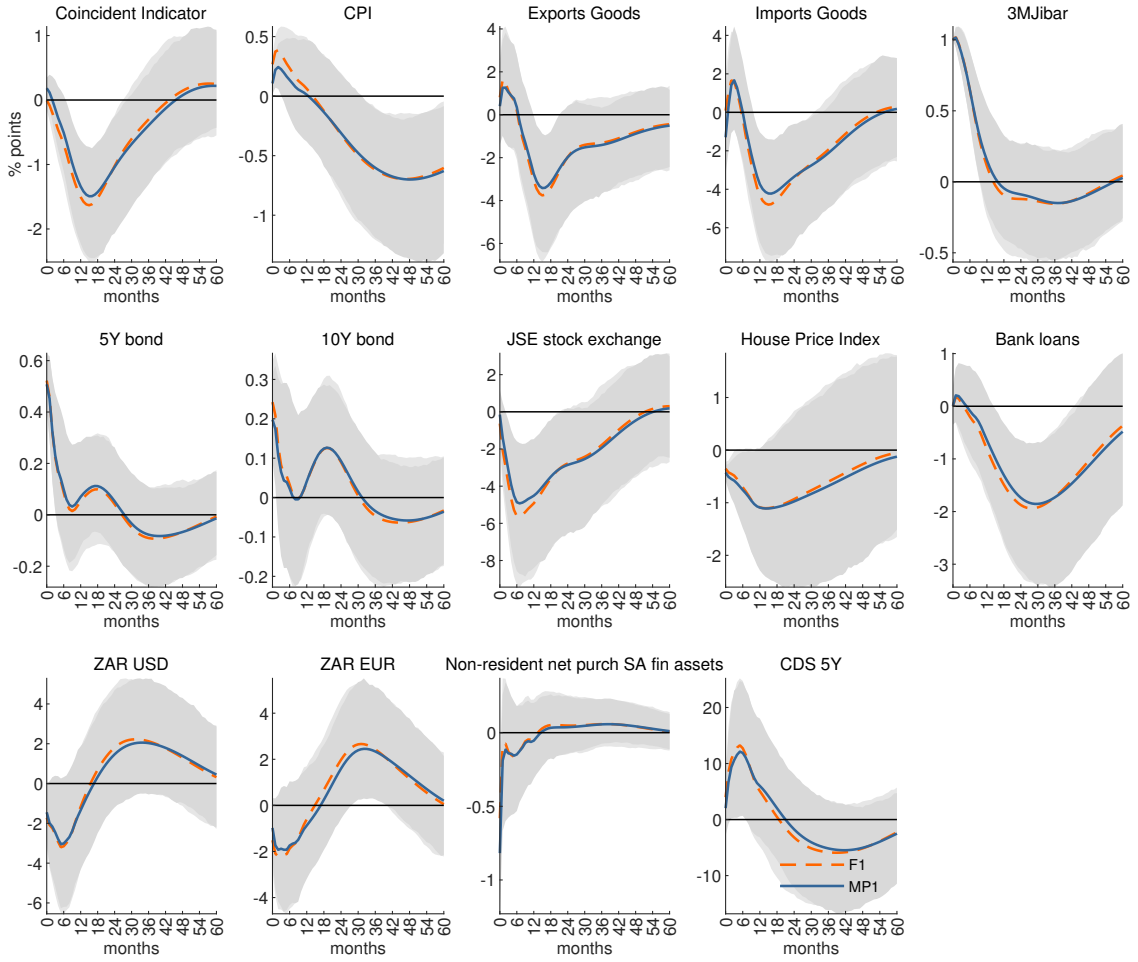
	Short-term	Medium-term	Term premium	Country risk
Correlation	0.62	-0.11	-0.24	0.07

Note. Correlation of changes in the SARB repurchase rate with identified monetary policy factors in each column. Sample is 2002M6-2020M1.

G VAR Analysis Additional Results

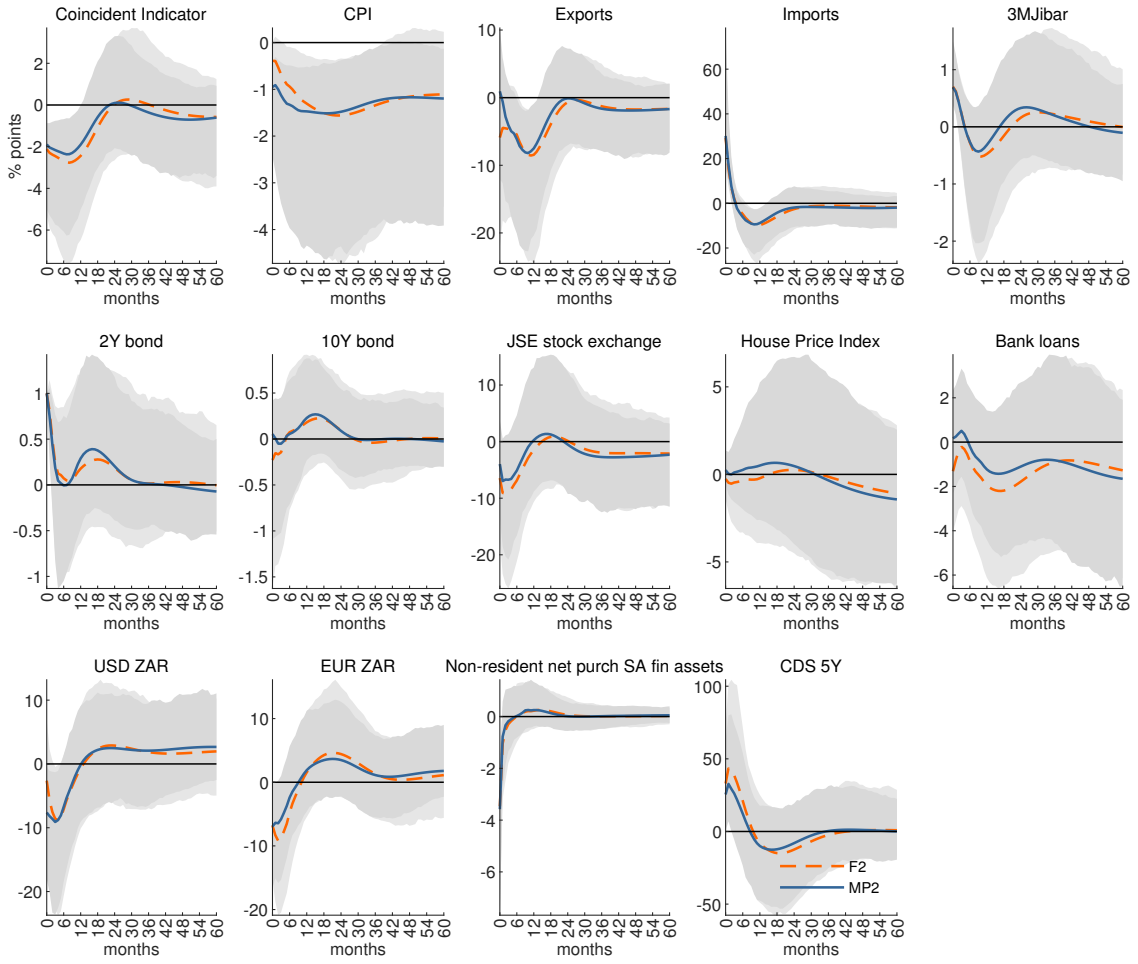
G.1 Impulse response functions

FIGURE IV: The effect of conventional monetary policy shock – alternative instruments



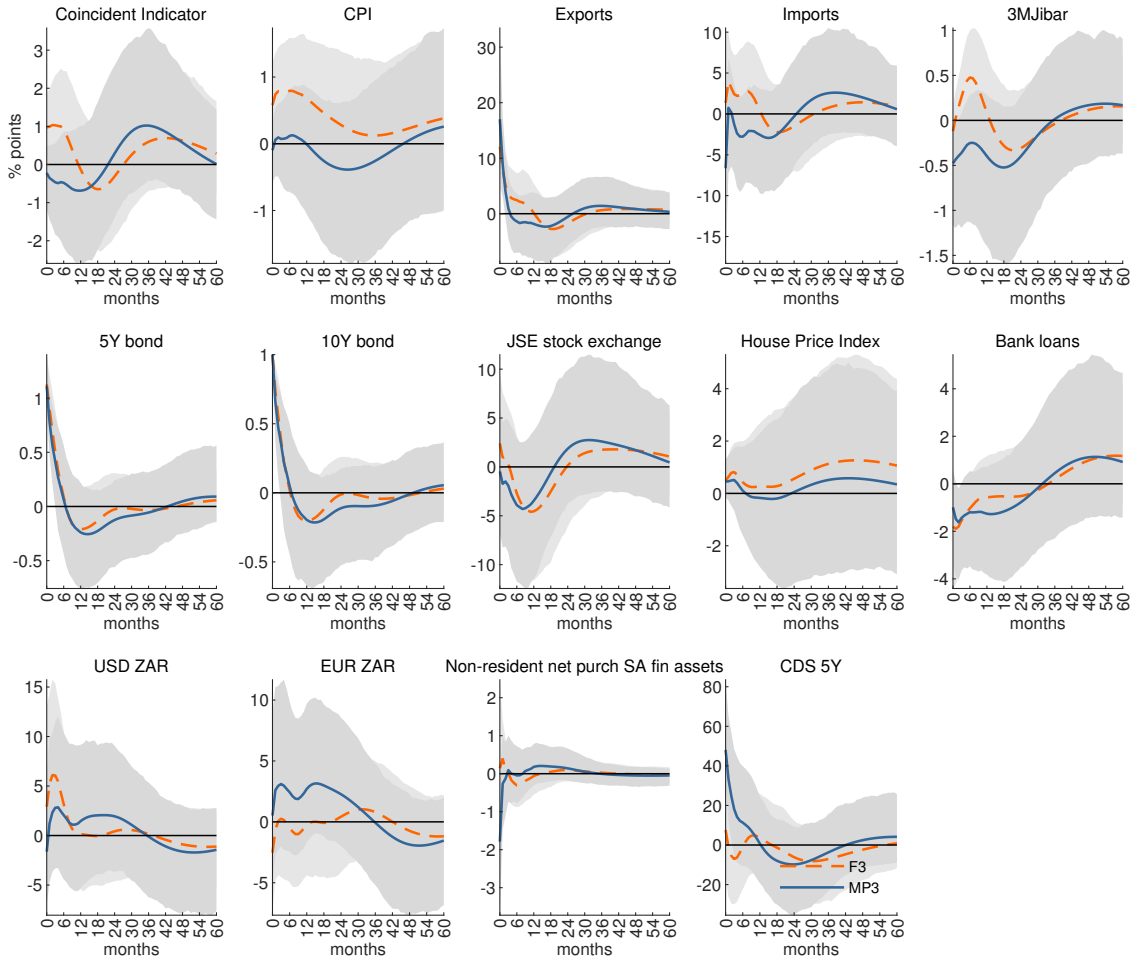
Note. Responses to a contractionary monetary policy shock. Shock identified with the short-term/F1 factor series (orange, dashed) and the short-term factor series corrected for the central bank's macroeconomic projections (dark blue line) (see Section 3 for details). The shock is normalized to induce a 100 basis point increase in the 3-month Jibar interbank rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. For details on variables used, see Table I.

FIGURE V: The effect of monetary policy shock instrumented with medium-term factor – alternative instruments



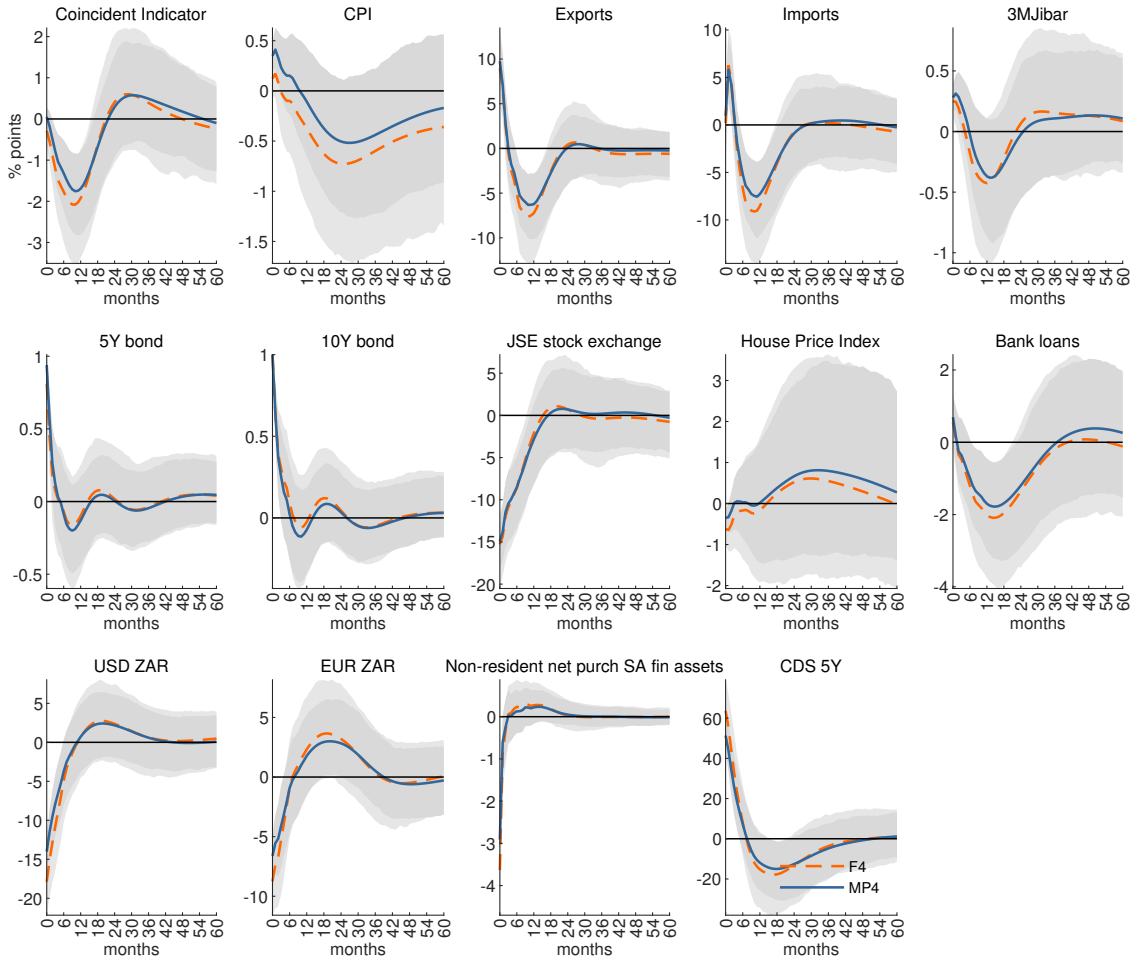
Note. Responses to a monetary policy shock. Shock identified with the medium-term/F2 factor series (orange, dashed) and the medium-term factor series corrected for the central bank's macroeconomic projections (dark blue line) (see Section 3 for details). The shock is normalised to induce a 100 basis point increase in the 2-year rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. For details on variables used, see Table I.

FIGURE VI: The effect of monetary policy shock instrumented with the term premium factor – alternative instruments



Note. Responses to a monetary policy shock. Shock identified with the term premium/F3 factor series (orange, dashed) and the term premium factor series corrected for the central bank's macroeconomic projections (dark blue line) (see Section 3 for details). The shock is normalised to induce a 100 basis point increase in the 10-year rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. For details on variables used, see Table I.

FIGURE VII: The effect of monetary policy shock instrumented with Risk factor – alternative instruments



Note. Responses to a monetary policy shock. Shock identified with the country risk/F4 factor series (orange, dashed) and the country risk factor series corrected for the central bank's macroeconomic projections (dark blue line) (see Section 3 for details). The shock is normalised to induce a 100 basis point increase in the 10-year rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are nominal exchange rates expressed as prices of South African rand in US dollar and euro, respectively. For details on variables used, see Table I in the Appendix.

H Variance decomposition

In computing the variance decomposition, we follow Forni et al. (2023), and measure the explained variance as the ratio between the variance explained by the shock of interest and the total variance of a variable, in a given range of frequency. Specifically, the contribution of a structural shock u_{it} to the variance of a variable y_{ht} on the frequency band $[\theta_1\theta_2)$ is computed as

$$\hat{c}_h(\theta_1, \theta_2) = \frac{\int_{\theta_1}^{\theta_2} \hat{b}_{ih}(e^{-j\theta})\hat{b}_{ih}(e^{j\theta})d\theta}{\int_{\theta_1}^{\theta_2} \hat{S}_h(\theta)d\theta}, \tag{83}$$

where the numerator $\int_{\theta_1}^{\theta_2} \hat{b}_{ih}(e^{-j\theta})\hat{b}_{ih}(e^{j\theta})d\theta/\pi$ is the variance of the variable y_{ht} due to the structural shock u_{it} on the frequency band $[\theta_1\theta_2)$, and j denotes the imaginary unit. In the denominator, $\int_{\theta_1}^{\theta_2} \hat{S}_h(\theta)d\theta/\pi$ is the total variance of the variable y_{ht} over the frequency band $[\theta_1\theta_2)$, which is obtained by considering the h-th row of the $C(L)$ matrix of the Wold representation $C_h(L)$:[6]

$$\hat{S}_h(\theta) = \hat{C}_h(e^{-j\theta})\hat{\Sigma}_\varepsilon\hat{C}_h(e^{j\theta})'. \tag{84}$$

$b_{ih}(L)$ in the numerator of Eq. (83) is the h-th element of $b_i(L)$, which is the i-th column of the matrix of absolute impulse-response functions, $B(L)$, and L is the lag operator.

To find the absolute impulse response functions, we first regress the VAR residuals ε_t on each of the proxies, z_t, i.e.

$$\varepsilon_t = \psi' z_t + e_t. \tag{85}$$

The coefficient ψ_t is then used to compute absolute impulse responses $b_i(L)$:

$$b_i(L) = \frac{C(L)\psi}{\sqrt{\psi'\hat{\sum}_\varepsilon^{-1}\psi}}. \tag{86}$$

To obtain variance decomposition for the short-term waves periodicity – i.e. 1M to 24M –, business cycle periodicity – i.e. 2Y to 5Y –, and waves of periodicities that exceed 5Y, we employ the corresponding angular frequencies. Specifically, with monthly data these frequencies are $\theta_1 = \pi/12$ and $\theta_2 = 2\pi$ for the short-term periodicity of waves, $\theta_1 = \pi/30$ and $\theta_2 = \pi/12$ for the business cycle periodicity, and $\theta_1 = 0$ and $\theta_2 = \pi/30$ for the long-term waves periodicity. Integrals in the numerator and denominator of Eq. (83) are approximated by averaging over a grid within a frequency band.

[6] The Wold representation of the VAR considered is $y_t = C(L)\varepsilon_t$.

TABLE VII: Variance decomposition - all variables

	Conventional policy shock			**Forward guidance shock**		
Waves periodicity	1M-2Y	2Y-5Y	5Y+	1M-2Y	2Y-5Y	5Y+
Coincident Indicator	0.6	1.3	1.9	1.6	1.6	0.5
	(0.3–1.1)	(0.4–1.6)	(0.5–2.1)	(0.7–2.3)	(0.5–2.5)	(0.3–1.3)
CPI	0.8	0.7	1.6	1	0.9	2.5
	(0.3–1.2)	(0.3–1.2)	(0.3–1.9)	(0.5–1.6)	(0.4–1.7)	(0.8–3.5)
Exports Goods	0.7	1.1	2	0.9	1.8	1.2
	(0.3–1.3)	(0.3–1.4)	(0.4–1.9)	(0.5–2.0)	(0.5–2.7)	(0.4–2.3)
Imports Goods	0.7	0.9	1.8	11.3	2.2	0.5
	(0.4–1.3)	(0.3–1.3)	(0.5–2.0)	(4.0–9.7)	(0.7–3.1)	(0.2–1.4)
3MJibar	2.7	2.3	1.8	0.5	0.3	0.1
	(2.0–2.9)	(0.9–2.3)	(0.4–1.9)	(0.3–1.0)	(0.2–1.2)	(0.1–1.3)
5Y bond	0.6	0.4	0.9	0.5	0.1	0.4
	(0.5–1.0)	(0.2–0.8)	(0.2–1.2)	(0.3–0.9)	(0.2–1.0)	(0.2–1.4)
10Y bond	0.1	0.1	0.2	0	0.2	0.2
	(0.1–0.3)	(0.1–0.5)	(0.1–0.8)	(0.1–0.3)	(0.1–0.8)	(0.1–1.1)
JSE stock exchange	0.8	1.1	1.7	1.2	0.8	0.2
	(0.3–1.2)	(0.3–1.4)	(0.5–2.1)	(0.5–2.2)	(0.3–1.9)	(0.1–1.0)
House Price Index	0.2	0.6	0.8	0.6	0.7	0.2
	(0.1–0.8)	(0.2–1.0)	(0.1–1.4)	(0.2–1.4)	(0.2–1.6)	(0.1–1.4)
Bank loans	0.3	1	1.8	0.9	0.6	0.3
	(0.2–0.9)	(0.3–1.3)	(0.4–2.3)	(0.4–1.6)	(0.3–1.7)	(0.1–1.1)
ZAR USD	0.1	0.7	1	0.8	1.2	0.8
	(0.1–0.5)	(0.3–1.3)	(0.2–1.5)	(0.4–1.5)	(0.4–2.1)	(0.3–1.7)
ZAR EUR	0.1	0.8	1.4	0.9	1.2	0.5
	(0.1–0.6)	(0.3–1.3)	(0.3–1.7)	(0.4–1.7)	(0.4–2.1)	(0.2–1.4)
Non-resident net purch	0.4	0.9	1.6	2.2	2.5	0.6
	(0.3–0.9)	(0.2–1.4)	(0.2–1.6)	(1.0–3.3)	(0.5–3.1)	(0.3–1.8)
CDS 5Y	0.2	0.7	1.4	0.8	1.4	0.2
	(0.1–0.6)	(0.2–1.3)	(0.3–1.7)	(0.4–1.6)	(0.4–2.5)	(0.2–1.3)
	Term premia shock			**Country risk shock**		
Waves periodicity	1M-2Y	2Y-5Y	5Y+	1M-2Y	2Y-5Y	5Y+
Coincident Indicator	0.1	0.9	0.6	2	4	1.2
	(0.2–1.2)	(0.3–1.9)	(0.2–1.5)	(0.7–2.7)	(1.0–4.1)	(0.3–1.9)
CPI	0.1	0.4	0.1	0.3	0.7	0.8
	(0.1–0.7)	(0.2–1.2)	(0.1–1.1)	(0.2–0.9)	(0.3–1.5)	(0.2–1.6)
Exports Goods	9.2	2.3	0.2	10.9	7	1.8
	(2.2–7.2)	(0.5–2.7)	(0.2–1.2)	(3.6–8.8)	(1.7–5.6)	(0.4–2.5)
Imports Goods	0.8	0.7	0.7	4.8	4.7	1.7
	(0.5–2.0)	(0.3–1.8)	(0.2–1.5)	(1.8–4.7)	(1.3–4.3)	(0.5–2.5)
3MJibar	0.3	0.4	1.6	0.6	1	0.5
	(0.2–0.8)	(0.2–1.3)	(0.2–2.1)	(0.4–1.2)	(0.4–1.9)	(0.1–1.5)
5Y bond	1.4	2.1	0.6	2	0.8	0.1
	(0.7–2.0)	(0.7–2.5)	(0.2–1.5)	(1.5–2.5)	(0.4–1.7)	(0.1–1.1)
10Y bond	0.7	0.9	0.3	1.5	0.5	0.3
	(0.4–1.2)	(0.4–1.6)	(0.1–1.1)	(1.2–2.0)	(0.4–1.2)	(0.1–1.0)
JSE stock exchange	0.3	1.5	0.6	16.5	9.6	2
	(0.3–1.5)	(0.3–2.4)	(0.1–1.4)	(5.3–12.7)	(2.0–6.9)	(0.6–2.5)
House Price Index	0.5	0.6	0.1	0.4	0.4	0.5
	(0.2–1.2)	(0.2–1.5)	(0.1–1.4)	(0.2–1.2)	(0.2–1.5)	(0.1–1.4)
Bank loans	1.7	1.5	0.6	1.1	3.8	0.9
	(0.4–2.2)	(0.3–2.2)	(0.2–1.6)	(0.5–2.0)	(0.7–3.4)	(0.2–1.7)
ZAR USD	0.2	0.2	0.5	4.1	4	1.1
	(0.2–0.8)	(0.2–1.2)	(0.1–1.5)	(2.6–5.4)	(1.7–4.6)	(0.3–1.9)
ZAR EUR	0.3	0.4	1.4	2.4	3	1
	(0.2–1.1)	(0.3–1.5)	(0.2–2.1)	(1.3–3.2)	(1.1–3.4)	(0.3–1.8)
Non-resident net purch	1.3	2.2	1.1	6.5	7.6	2
	(0.5–2.5)	(0.4–2.6)	(0.2–1.8)	(3.8–7.6)	(1.5–5.3)	(0.3–2.2)
CDS 5Y	1.5	2.1	0.9	4.7	5.6	2.8
	(0.7–2.4)	(0.4–3.1)	(0.2–1.8)	(3.1–6.1)	(1.7–5.6)	(0.6–2.9)

Note: The table reports the fraction of the total variance of variables in the left column explained by the conventional monetary policy shock (top left panel), forward guidance shock (top right panel), term premia shock (bottom left panel) and country risk shock (bottom right panel) for waves of periodicity 1 month - 2 years (short run), 2-5 years (business cycle) and 5+ years (long run). 68% confidence bands in the brackets. The details of methodology used to compute the variance decomposition and the results for all the variables in the VAR are shown in Section H of the Appendix.

I Falsification test

The purpose of the falsification, or 'placebo', test is to ensure that our results are not driven by effects or events other than MPC meeting announcements. In order to check that, we extract monetary policy factors from daily surprises outside of the SARB MPC meeting dates using our identification approach outlined in Section 3.3. We compute daily 'surprises' for the financial market instruments in our dataset (3M Jibar, FRAs, swaps and CDS spread) for 2, 12 and 20 days prior to MPC meetings, and identify 'false' monetary policy surprises based on them.

The variance contributions by latent factors indicate that the first principal component explains less of daily changes in 3M Jibar rate outside of MPC meeting dates, see Tables VIII, X and XII (baseline results are reported in Table II). The effect is especially pronounced for longer lags between our chosen 'placebo' days and MPC dates – 12 days (Table X) and 20 days (table XII). This result confirms that no short-term monetary factor is found on days outside of MPC decisions.

Dynamic responses in the VAR confirm this finding. In particular, as low values of F statistic and reliability criterion show, the 'false' short-term factor, extracted from daily changes in the financial market instrument values away from the monetary policy announcements, are weak instruments for the monetary policy shock, see Figures VIII, IX and X. For the case of 2 days lag between the 'placebo' test and MPC meeting dates, F statistic value is somewhat higher, potentially, indicating that a bit of information about the coming MPC decision does arrive to the market on the days before meetings take place.

TABLE VIII: Variance contributions by 'false' latent factors – 'surprises' 2 days prior to MPC meetings

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21	FRA21x24	Sw1y	Sw2y	Sw3y	Sw5y	Sw10y	CDS5Y
PComp1	29.2	59.5	72.8	86.5	93.9	93.8	89.4	84.8	86.0	91.5	91.8	85.2	61.0	46.4	1.7
PComp2	43.6	20.6	11.9	6.0	1.7	0.4	0.1	0.8	1.3	0.2	1.7	7.7	26.8	32.0	22.9
PComp3	10.0	3.8	1.9	0.6	0.0	0.1	1.6	3.1	3.1	0.5	0.2	0.3	0.0	0.2	66.0
PComp4	6.2	1.3	0.7	0.2	0.9	1.7	6.7	7.4	6.6	0.2	0.6	1.3	8.9	16.5	9.3
Residual	11.1	14.8	12.7	6.8	3.4	4.0	2.2	3.8	3.0	7.6	5.7	5.5	3.3	4.9	0.1

TABLE IX: Variance contributions by 'false' identified factors – 'surprises' 2 days prior to MPC meetings

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21	FRA21x24	Sw1y	Sw2y	Sw3y	Sw5y	Sw10y	CDS5Y
Short	88.9	73.1	63.8	51.6	38.0	30.5	16.7	11.1	10.6	32.0	21.5	12.0	2.7	1.4	0.5
Medium	0.0	6.8	11.6	24.6	34.6	38.1	54.1	56.0	54.6	23.7	19.8	16.0	2.4	0.0	0.0
Long	0.0	4.9	11.2	15.3	22.5	25.0	25.0	27.4	30.0	36.2	50.3	62.5	84.2	85.7	0.0
Risk	0.0	0.4	0.8	1.6	1.5	2.4	2.1	1.7	1.8	0.5	2.6	4.0	7.4	8.1	99.4
Residual	11.1	14.8	12.7	6.8	3.4	4.0	2.2	3.8	3.0	7.6	5.7	5.5	3.3	4.9	0.1

TABLE X: Variance contributions by 'false' latent factors – 'surprises' 12 days prior to MPC meetings

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21	FRA21x24	Sw1y	Sw2y	Sw3y	Sw5y	Sw10y	CDS5Y
PComp1	11.9	50.4	60.4	82.4	92.4	78.1	96.1	96.1	92.7	89.2	81.9	78.9	64.5	46.3	6.3
PComp2	32.1	22.9	29.3	13.1	3.5	0.9	0.3	0.0	0.6	1.7	4.3	12.4	24.9	39.2	5.0
PComp3	3.4	0.8	0.2	0.0	0.0	0.8	0.0	0.1	0.8	1.0	0.3	0.4	0.1	0.1	86.8
PComp4	52.4	3.0	0.9	1.2	1.1	1.4	0.5	0.2	0.0	0.0	0.2	0.9	3.0	2.3	1.1
Residual	0.2	22.9	9.2	3.2	3.0	18.8	3.0	3.6	6.0	8.1	13.3	7.4	7.5	12.0	0.8

TABLE XI: Variance contributions by 'false' identified factors – 'surprises' 12 days prior to MPC meetings

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21	FRA21x24	Sw1y	Sw2y	Sw3y	Sw5y	Sw10y	CDS5Y
Short	99.8	16.7	24.7	19.1	13.2	8.3	10.2	8.5	7.5	6.1	4.7	2.7	1.3	0.0	0.3
Medium	0.0	56.4	61.9	61.1	52.1	39.7	42.2	35.2	28.8	24.1	16.6	8.8	1.5	0.0	0.0
Long	0.0	1.8	4.1	15.2	28.2	25.2	40.4	48.3	55.1	59.3	61.2	76.1	83.1	80.5	0.0
Risk	0.0	2.2	0.0	1.4	3.5	8.0	4.2	4.4	2.6	2.5	4.2	5.1	6.6	7.4	98.8
Residual	0.2	22.9	9.2	3.2	3.0	18.8	3.0	3.6	6.0	8.1	13.3	7.4	7.5	12.0	0.8

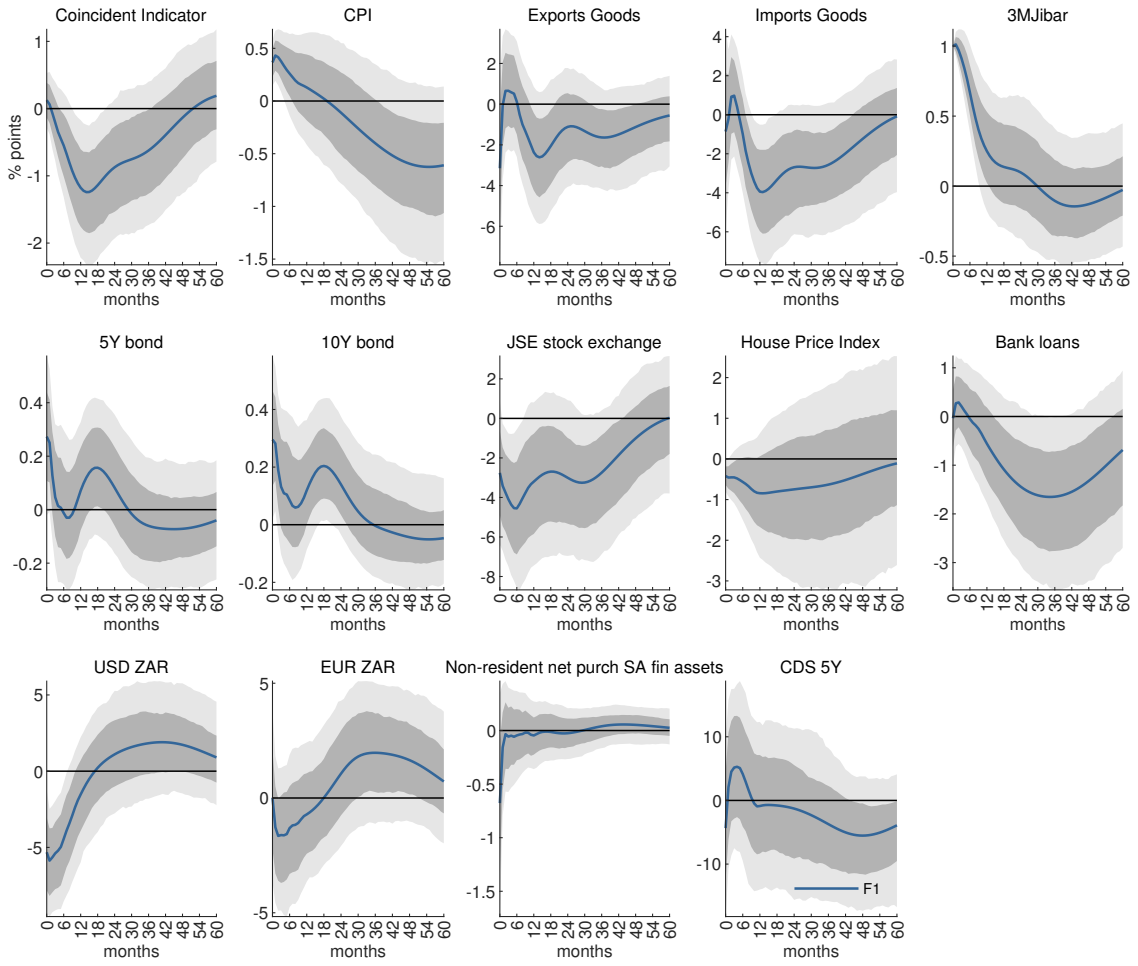
TABLE XII: Variance contributions by 'false' latent factors – 'surprises' 20 days prior to MPC meetings

	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21	FRA21x24	Sw1y	Sw2y	Sw3y	Sw5y	Sw10y	CDS5Y
PComp1	7.2	11.8	57.9	82.3	90.6	85.8	91.6	93.4	92.6	91.2	92.7	86.6	68.0	61.0	32.2
PComp2	33.8	31.1	19.6	7.8	2.7	1.2	0.4	0.0	0.1	0.2	0.1	6.2	20.2	22.6	10.1
PComp3	30.1	29.9	3.9	0.3	0.1	0.7	0.2	0.2	0.2	0.3	0.3	0.9	0.6	0.3	26.1
PComp4	23.2	11.9	2.0	2.2	1.6	0.0	2.3	2.3	2.2	1.8	0.0	1.0	6.0	8.1	6.1
Residual	5.7	15.3	16.5	7.4	5.0	12.3	5.4	4.2	4.9	6.4	6.8	5.4	5.3	8.0	25.5

TABLE XIII: Variance contributions by 'false' identified factors – 'surprises' 20 days prior to MPC meetings

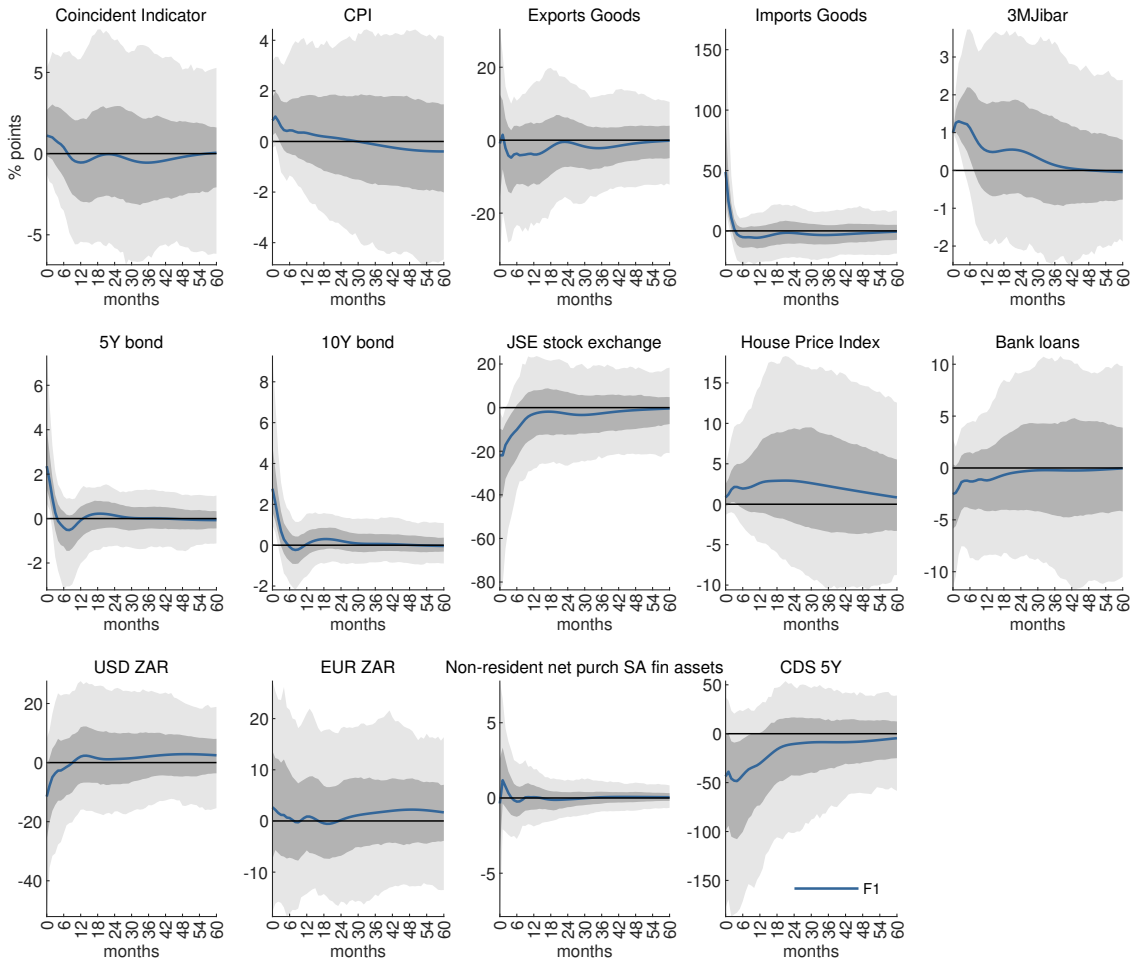
	3MJibar	FRA1x4	FRA3x6	FRA6x9	FRA9x12	FRA12x15	FRA15x18	FRA18x21	FRA21x24	Sw1y	Sw2y	Sw3y	Sw5y	Sw10y	CDS5Y
Short	94.3	8.5	8.6	9.6	9.7	14.0	6.3	4.7	4.1	4.1	8.0	4.4	1.5	1.0	4.0
Medium	0.0	3.0	48.2	49.3	43.6	26.6	40.8	38.1	36.2	33.8	23.0	9.5	0.4	0.0	0.0
Long	0.0	45.8	2.4	0.9	5.5	7.7	10.4	13.1	14.4	15.2	13.1	25.3	31.8	29.7	0.0
Risk	0.0	27.5	24.4	32.8	36.2	39.4	37.0	40.1	40.4	40.4	49.1	55.5	61.1	61.3	70.5
Residual	5.7	15.3	16.5	7.4	5.0	12.3	5.4	4.2	4.9	6.4	6.8	5.4	5.3	8.0	25.5

FIGURE VIII: The effect of conventional monetary policy shock identified with 'false' short-term factor: 'surprises' 2 days prior to MPC meetings



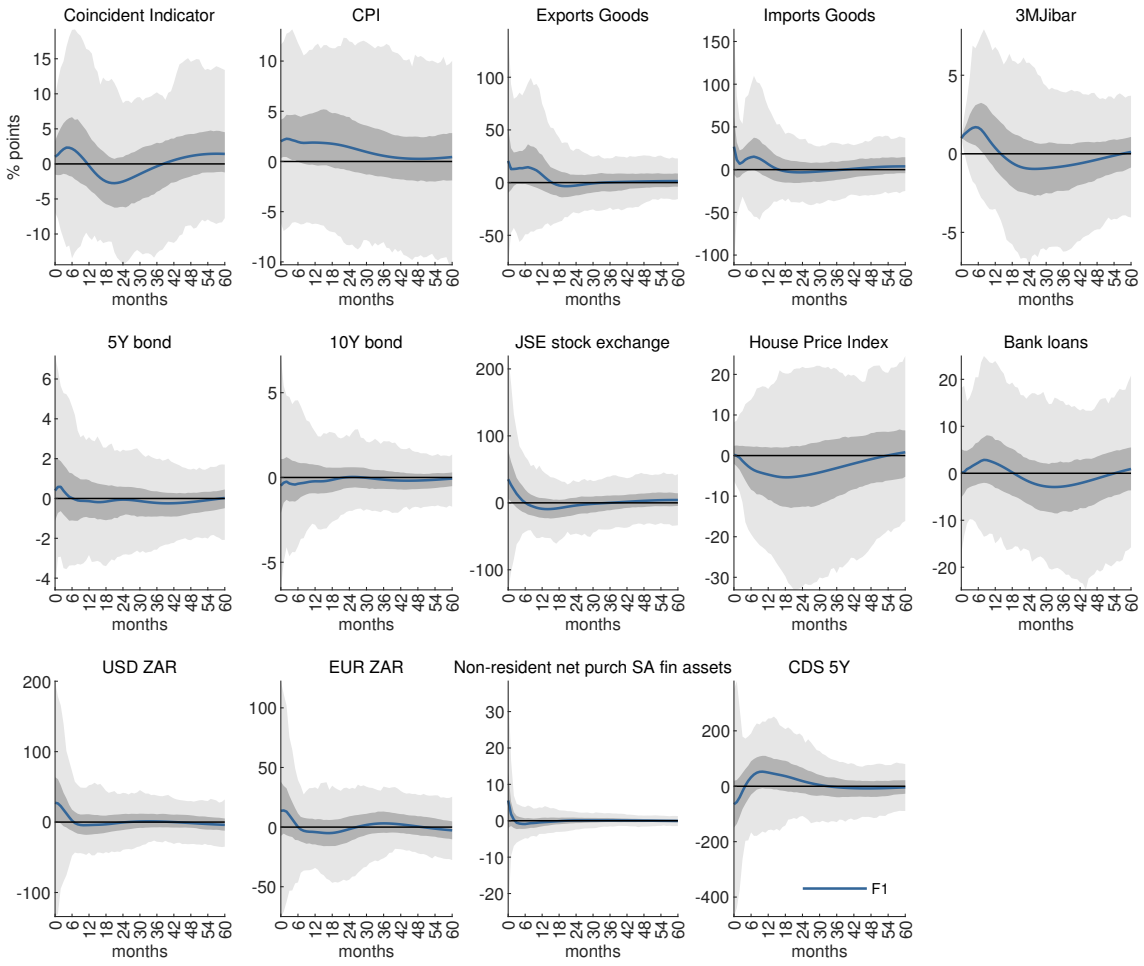
Note. Responses to a contractionary monetary policy shock. The shock identified with 'false' short-term factor/F1 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 3M Jibar rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 36.430. Reliability of the instrument is 0.560. For details on variables used, see Table I in the Appendix.

FIGURE IX: The effect of conventional monetary policy shock identified with 'false' short-term factor: 'surprises' 12 days prior to MPC meetings



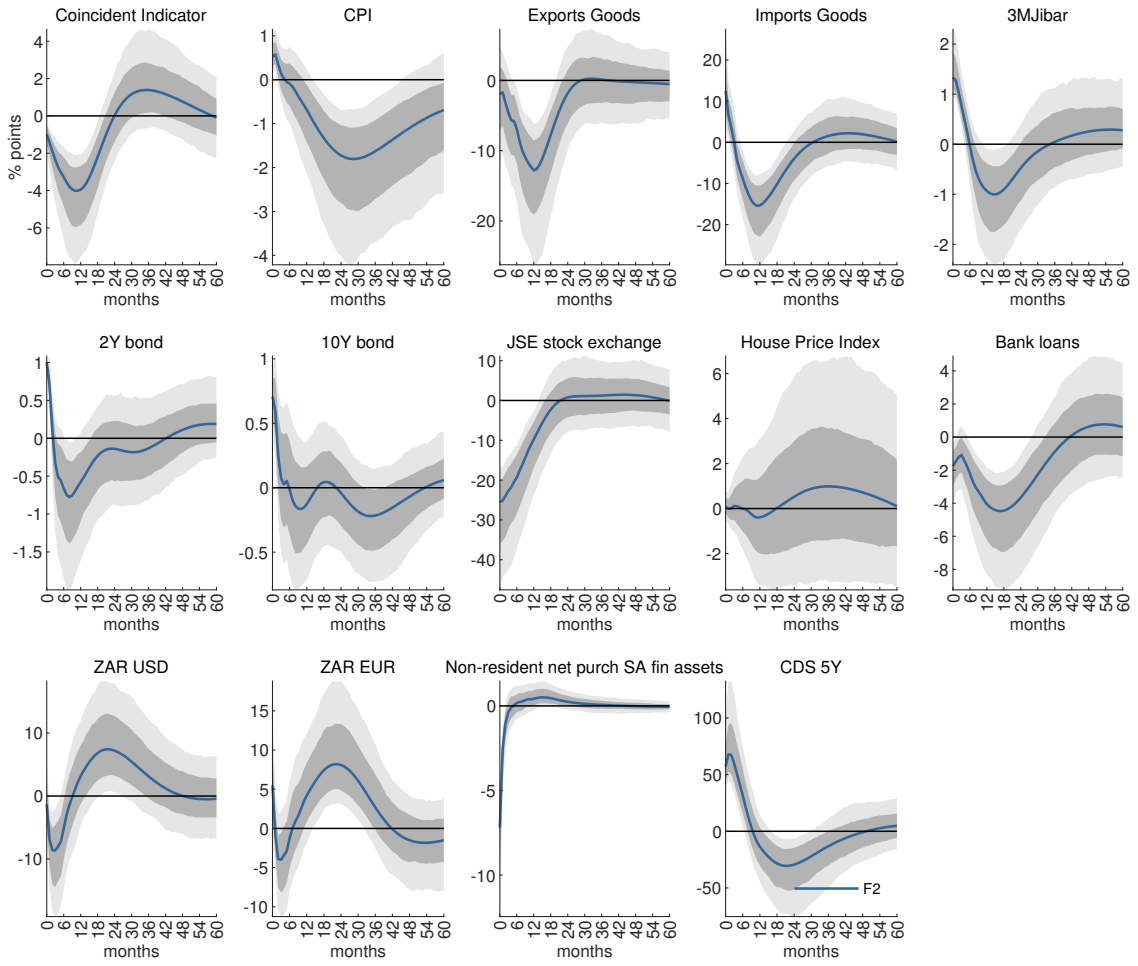
Note. Responses to a contractionary monetary policy shock. The shock identified with 'false' short-term factor/F1 series based on daily 'surprises' calculated 12 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 3M Jibar rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 1.053. Reliability of the instrument is 0.357. For details on variables used, see Table I in the Appendix.

FIGURE X: The effect of conventional monetary policy shock identified with 'false' short-term factor: 'surprises' 20 days prior to MPC meetings



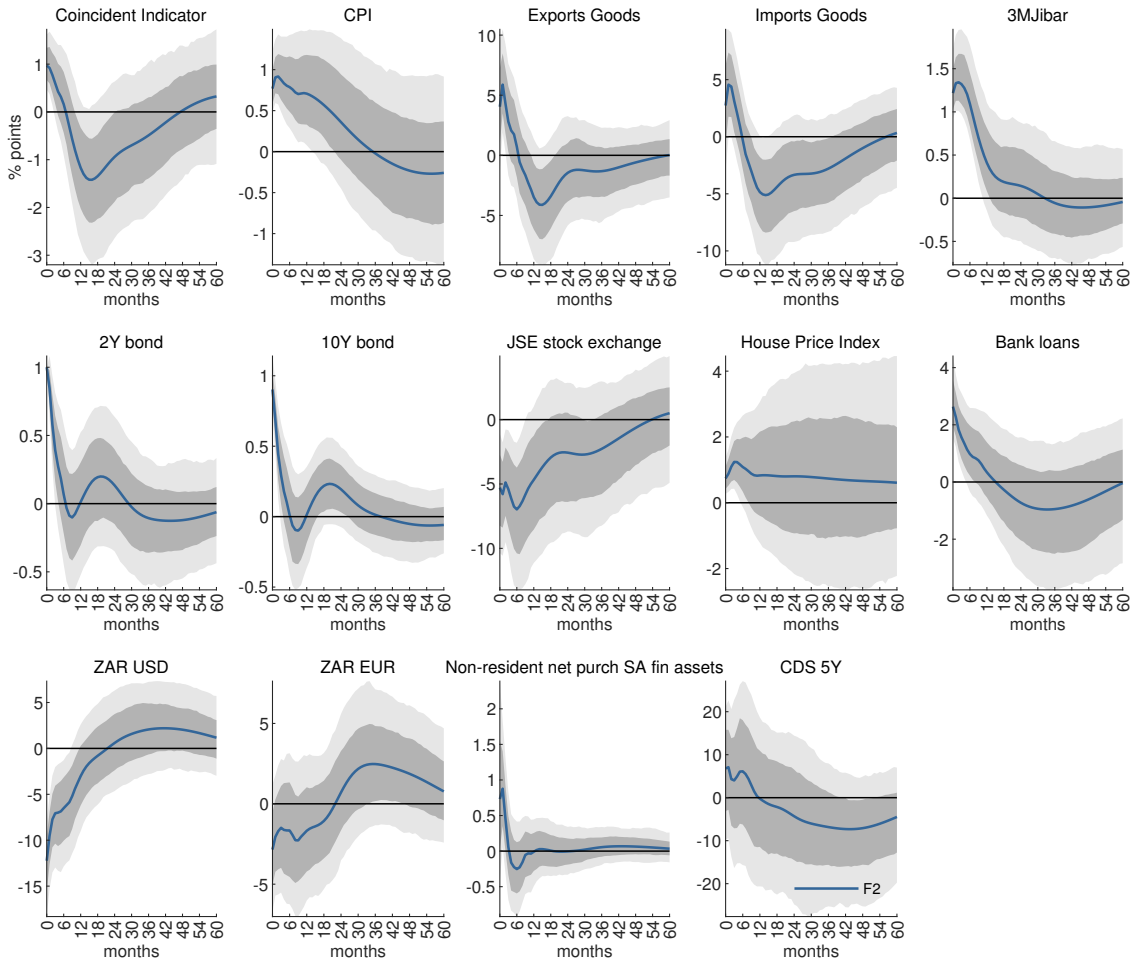
Note. Responses to a contractionary monetary policy shock. The shock identified with 'false' short-term factor/F1 series based on daily 'surprises' calculated 20 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 3M Jibar rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 0.445. Reliability of the instrument is 0.140. For details on variables used, see Table I in the Appendix.

FIGURE XI: The effect of risk premium shock identified with 'false' medium-term factor: 'surprises' 2 days prior to MPC meetings



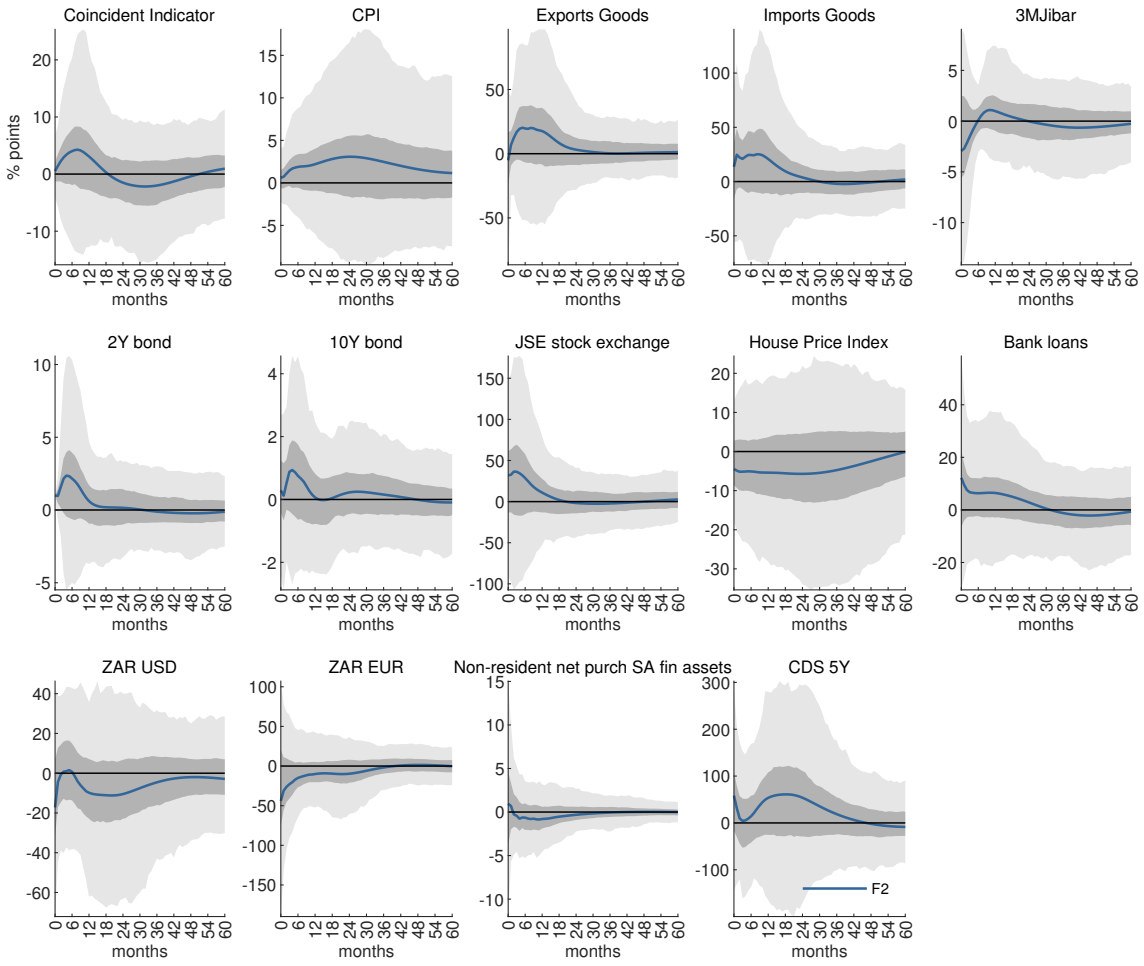
Note. Responses to a risk premium shock. The shock identified with 'false' medium-term factor/F2 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 2Y rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 2.050. Reliability of the instrument is 0.289. For details on variables used, see Table I in the Appendix.

FIGURE XII: The effect of risk premium shock identified with 'false' medium-term factor: 'surprises' 12 days prior to MPC meetings



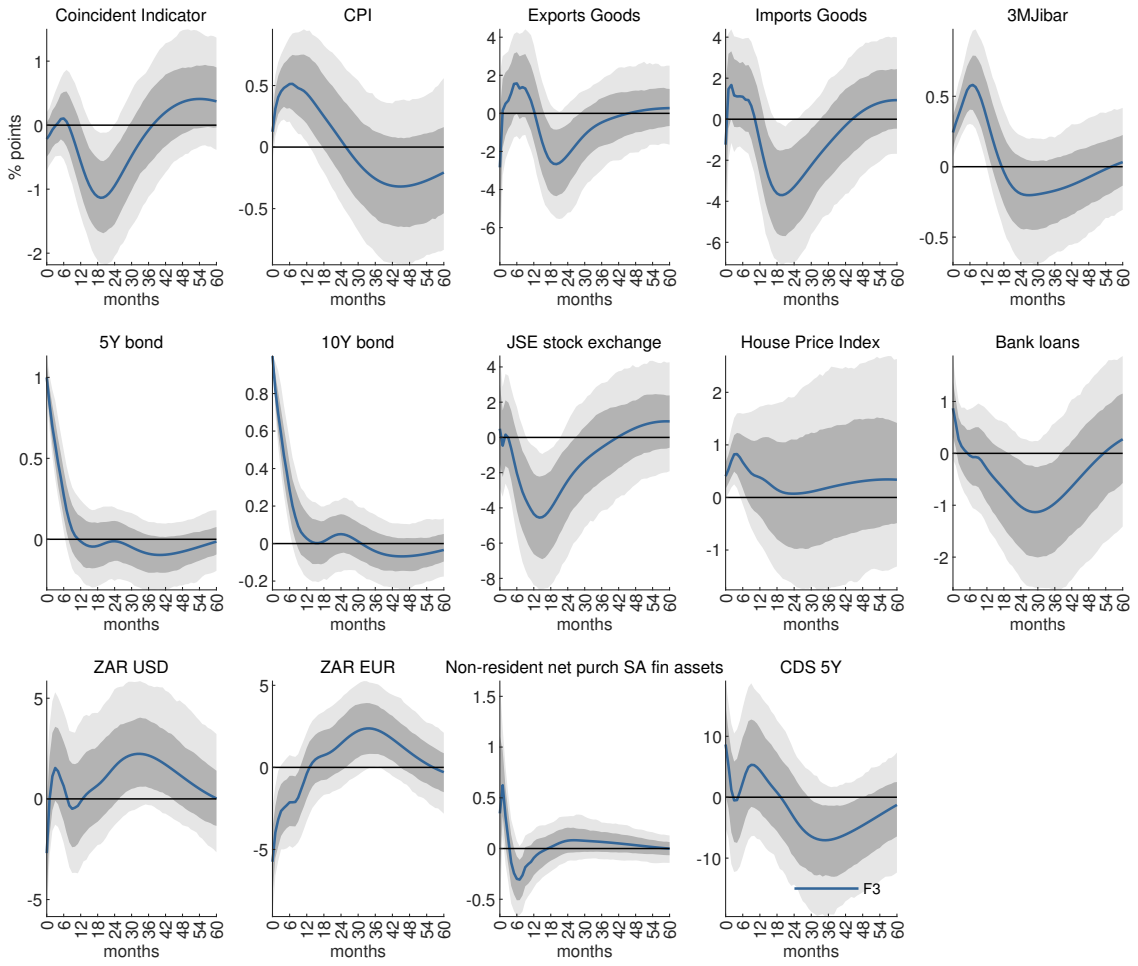
Note. Responses to a risk premium shock. The shock identified with 'false' medium-term factor/F2 series based on daily 'surprises' calculated 12 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 2Y rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 3.392. Reliability of the instrument is 0.503. For details on variables used, see Table I in the Appendix.

FIGURE XIII: The effect of risk premium shock identified with 'false' medium-term factor: 'surprises' 20 days prior to MPC meetings



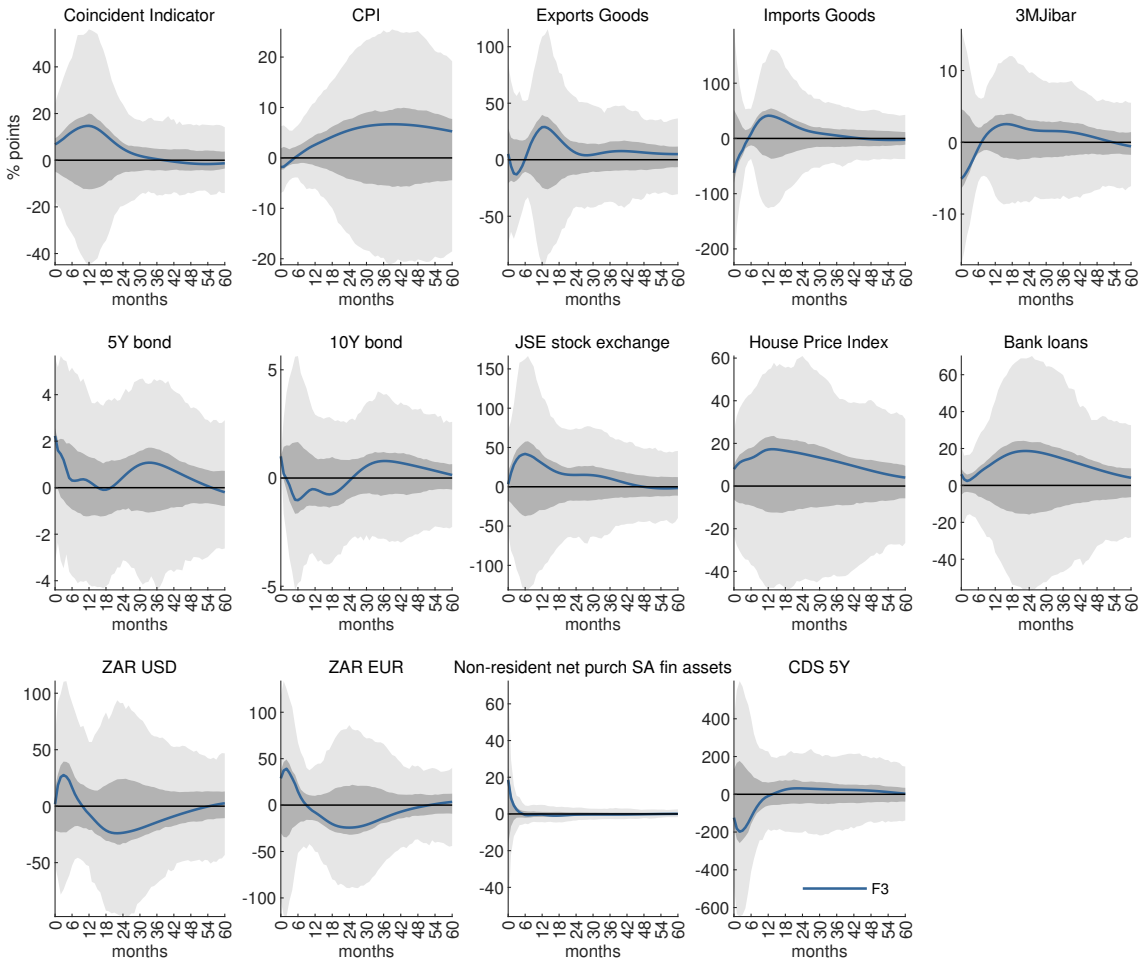
Note. Responses to a risk premium shock. The shock identified with 'false' medium-term factor/F2 series based on daily 'surprises' calculated 20 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 2Y rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 0.119. Reliability of the instrument is 0.200. For details on variables used, see Table I in the Appendix.

FIGURE XIV: The effect of term premium shock identified with 'false' term premium factor: 'surprises' 2 days prior to MPC meetings



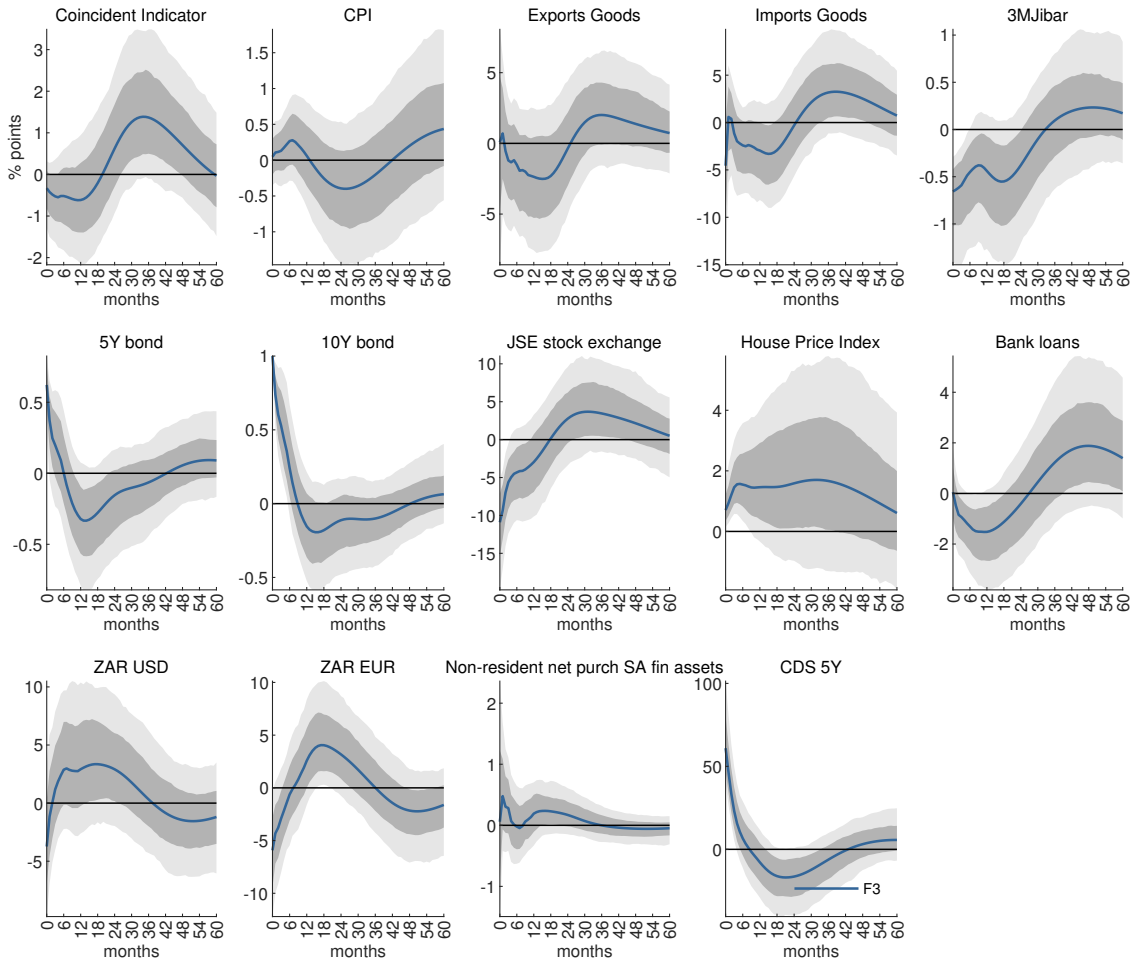
Note. Responses to a term premium shock. The shock identified with 'false' term premium factor/F3 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 10Y rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 6.126. Reliability of the instrument is 0.286. For details on variables used, see Table I in the Appendix.

FIGURE XV: The effect of term premium shock identified with 'false' term premium factor: 'surprises' 12 days prior to MPC meetings



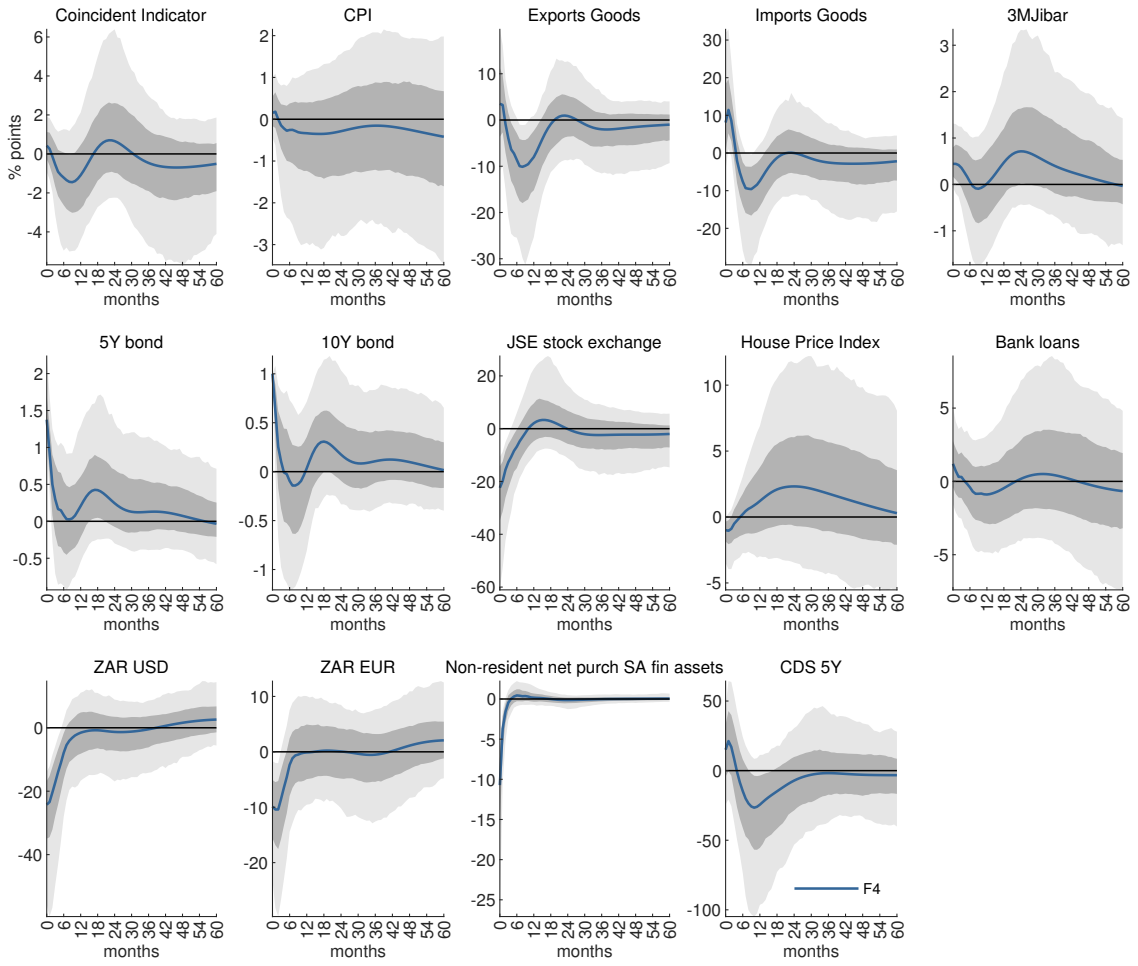
Note. Responses to a term premium shock. The shock identified with 'false' term premium factor/F3 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 10Y rate. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 0.048. Reliability of the instrument is 0.354. For details on variables used, see Table I in the Appendix.

FIGURE XVI: The effect of term premium shock identified with 'false' term premium factor: 'surprises' 20 days prior to MPC meetings



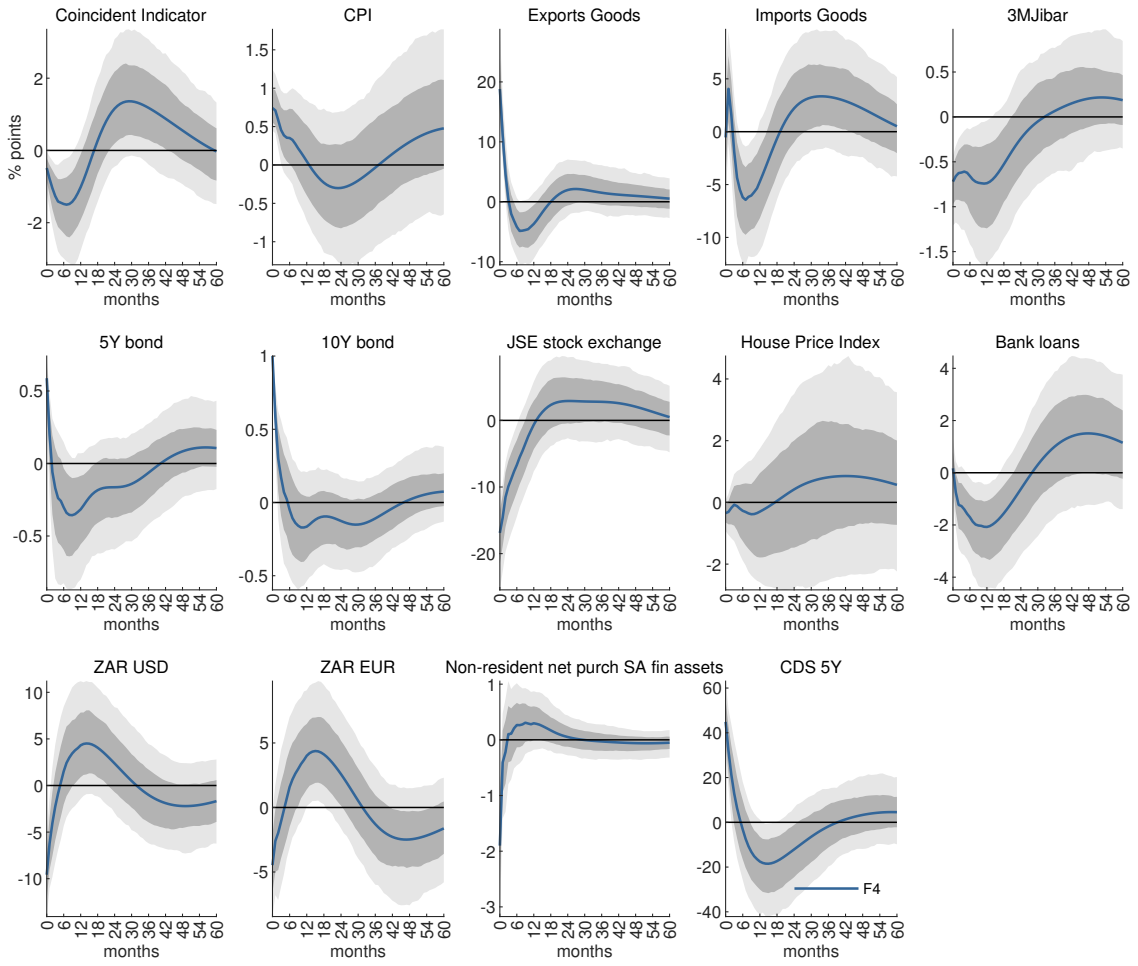
Note. Responses to a term premium shock. The shock identified with 'false' term premium factor/F3 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the 10Y. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 3.540. Reliability of the instrument is 0.421. For details on variables used, see Table I in the Appendix.

FIGURE XVII: The effect of country risk shock identified with 'false' country risk factor: 'surprises' 2 days prior to MPC meetings



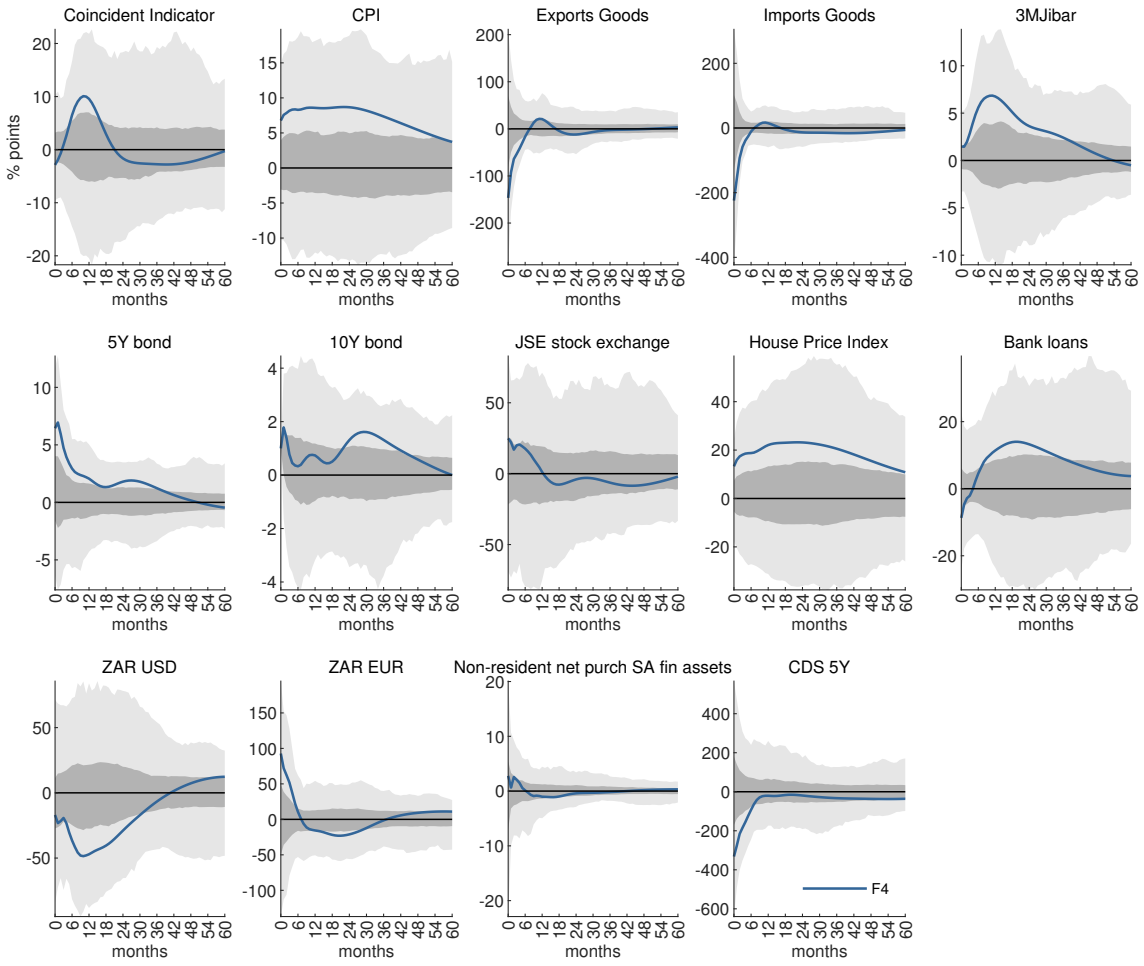
Note. Responses to a country risk shock. The shock identified with 'false' country risk factor/F4 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the CDS5Y spread. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 0.982. Reliability of the instrument is 0.230. For details on variables used, see Table I in the Appendix.

FIGURE XVIII: The effect of country risk shock identified with 'false' country risk factor: 'surprises' 12 days prior to MPC meetings



Note. Responses to a country risk shock. The shock identified with 'false' country risk factor/F4 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the CDS5Y spread. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 4.622. Reliability of the instrument is 0.550. For details on variables used, see Table I in the Appendix.

FIGURE XIX: The effect of country risk shock identified with 'false' country risk factor: 'surprises' 20 days prior to MPC meetings



Note. Responses to a country risk shock. The shock identified with 'false' country risk factor/F4 series based on daily 'surprises' calculated 2 days prior to MPC meetings. The shock is normalised to induce a 100 basis point increase in the CDS5Y spread. Sample 2003:06-2020:01. Light grey shaded areas are 90% posterior coverage bands, dark grey shaded areas are 68% posterior coverage bands. 'ZAR USD' and 'ZAR EUR' are values of the South African rand in US dollars and euro, 'Non-resident net purch SA fin assets' is non-residents' net purchases of South African shares and bonds' ratio to GDP, 'EMBI+SA' is a JP Morgan's EMBI index for South Africa as a country risk premium measure. F statistic of the first stage regression of the reduced-form innovations on the instrument is 0.011. Reliability of the instrument is 0.195. For details on variables used, see Table I in the Appendix.

J Narrative around salient surprises

TABLE XIV: Narrative analysis

Events				Surprises				Narrative	
		Repo Change		Short-term	Medium-term	Term premium	Country risk	MPC Statement	Business Day Commentary
Dec-03	Moving from Annual Average Inflation Targeting to Continuous Target: slowing down speed of rate cut	-0.5	Unanticipated	**57.63**	**-13.82**	5.27	1.76	As already indicated, interest rates have been reduced significantly during the last half of 2003. These decreases in interest rates were undertaken after careful consideration of the inflation outlook at the time to ensure that CPIX inflation moves into and remains within the inflation target. With inflation expected to remain within the target range in the forecast period looking ahead, and taking the above mentioned risks into account, the Monetary Policy Committee has decided to reduce the repo rate by 50 basis points to 8,0 per cent per annum as of 12 December 2003.	**Reserve Bank has Created Opportunity for Future Cuts** [...] Everyone was expecting 100 points basis cut or more, but it has been 50 basis points. [...] Do not expect the Bank to keep on cutting rates by 100 or 150 basis points. It is sending the signal that money will not stay cheap forever and there will be a time in future where interest rates are in fact going to go up again. [Williams, D. (2003) 'Reserve Bank has created opportunity for future cuts', Business Day (Johannesburg, South Africa), 12 Dec, (online NewsBank)]
Aug-04	Pressure to weaken the rand from Chambers of Mines, Inflation outlook pivot and unexpected change in direction.	-0.5	Unanticipated	**-60.82**	5.21	**-20.19**	-2.10	The inflation outcome during the first six months of 2004 was more favourable than had been thought to be the case at the previous meeting of the Monetary Policy Committee. [...] The favourable inflation outcome was at first achieved with slower growth in the domestic economy. [...] Import price inflation is also dependent, in the second instance, on the external value of the rand. Having recovered during 2002 and 2003 from the sharp fall in the latter part of 2001, the nominal effective exchange rate of the rand increased by a further 9 per cent until the end of July 2004. This sharp rise in the average exchange rate of the rand has distorted the planning of many enterprises in the country and has had a serious negative impact on international price competitiveness with the resultant stress being witnessed in the export earnings of manufacturing and mining companies. At the same time, the exchange rate of the rand has also contributed to lower imported inflation and, looking forward, to a lower prospective profile of CPIX inflation within the target range.	**A Very Bad Idea To be Dogmatic – Governor** [...] The Reserve Bank's monetary policy committee took a shock decision yesterday to cut interest rates, reversing its previous cautious tone on inflation in a move interpreted by some as bowing to pressure to weaken the rand [...] Bank governor Tito Mboweni yesterday dismissed suggestions that the Bank had acted under pressure, but this did not stop the market selling off the rand to a two-month low of R6,47 against the dollar in what was interpreted as a shift in stance by the Bank to a greater focus on economic growth and employment. [Editorial Business Day, August 13, 2004 – (online NewsBank)]
Apr-05	Focus switch to output gap after six months of Rand appreciation	-0.5	Unanticipated	**-55.68**	-6.63	0.73	-1.12	Although the overall performance of the South African economy seems to be reasonably well sustained, the MPC noted with concern evidence of some slackening in activity in some sectors of the economy as a result of the move by the rand to a higher trading range over the past six months. It remains the view of the MPC that a competitive and stable exchange rate would contribute to continuing sustainable growth in output and employment. Taking all of the above-mentioned developments into consideration, the MPC has decided to reduce the repo rate by 50 basis points to 7,0 per cent per annum with immediate effect. The MPC is convinced that this is appropriate in the circumstances, and consistent with maintaining inflation within the target range.	**Blinkered Attention to Inflation Eschewed for Welcome Focus on Rand and Jobs** [...] Mboweni takes eye off target to survey SA's real economy [...] Is it a coincidence that the last time the Reserve Bank surprised the market with an interest rate cut, it also followed a hue and cry by labour unions about the strong rand's toll on the economy? That was in August last year, when the leaders of unions representing miners and textile workers led a protest to the Bank's Pretoria offices to demand a cut in interest rates to weaken the currency. Economists had ruled out a cut but, lo and behold, Bank governor Tito Mboweni emerged from the monetary policy committee meeting the next day and announced a 50 basis point reduction. [Mboweni takes eye off target to survey SA's real – Business Day (Johannesburg, South Africa) – April 15, 2005 – page 1]
Jun-08	Surging inflation for increasing international oil and food prices. Global economy uncertainty after the first wave of banking and credit crisis in the US	0.5	Unanticipated	**-42.87**	-1.21	5.19	-3.16	The outlook for inflation remains bleak in an environment of sustained increases in international oil and food prices. An increasing number of countries are experiencing intensified inflation pressures and the risk to both global and domestic inflation is seen to be firmly on the upside against the backdrop of a slowing international and domestic economy. Domestically, price increases have become more broad-based, and inflation expectations have deteriorated further. Adding to the inflation uncertainty is the impending announcement of the electricity price increases to be granted to Eskom. [...] The outlook for the global economy remains uncertain although there is some tentative evidence that the worst of the banking and credit crisis may be over. Global growth is also expected to remain subdued, but there is uncertainty regarding the extent and duration of the slowdown.	**'Prank' lowers rand and may tarnish investor views on SA** The Reserve Bank undermined its credibility by creating expectations it would raise interest rates more "drastically" than usual to tame runaway inflation, and not following through on its warnings. Markets were caught off guard yesterday when Bank Governor Tito Mboweni announced a decision to raise the repo rate by half a percentage point to 12%, after a stream of hawkish rhetoric – mainly from him – had prompted them to price in a full percentage-point increase. [Bank chief who cried 'wolf' once too often – Business Day (Johannesburg, South Africa) – June 13, 2008 – page 1]

Events				Shocks				Narrative	
		Repo Change		short term	medium term	term premium	country risk	MPC Statement	Business Day Commentary
Oct-08	Lehman Brothers filed for bankruptcy in September. Uncertainty about the direction of monetary policy as local inflation is high, but global economy is rapidly deteriorating	0	Anticipated	-7.93	**33.76**	-5.36	**32.39**	Governments and central banks have undertaken various actions, both individually and in concert. The South African banking and financial system remains stable. However, domestic financial markets have experienced the impact of these developments. The domestic equity market has suffered losses in line with international markets, and the exchange rate of the rand has been negatively affected by increased global risk aversion, resulting in higher volatility and a significant depreciation. The South African Reserve Bank is monitoring developments closely. The inflation outlook remains uncertain, as the risk profile has changed somewhat. The outlook has improved on account of the lower oil prices, but the exchange rate has emerged as a significant risk factor.	**Bank cites weak rand as rates stay on hold** Disappointment at Mboweni's decision to buck global trend. [...] SA did not need to join a round of rate cuts by central banks globally as its financial system remained stable in the face of global turmoil, said Bank governor Tito Mboweni. But he pointed out that local shares and the rand had been hit hard by global risk aversion, and the Bank was "monitoring developments closely". "The monetary policy committee (MPC) considered recent developments in the South African economy and the risks to the inflation outlook against the backdrop of conditions prevailing in the international financial markets," he said. "The MPC is of the view that an unchanged monetary policy stance is appropriate at this stage." Interest rate cuts had not even been considered at the two-day policy meeting, he told reporters later. The Bank's decision to keep rates steady was not a surprise, but disappointed local markets. [Bank cites weak rand as rates stay on hold – Business Day (Johannesburg, South Africa) – October 10, 2008 – page 1]
Mar-09	Data show contraction in GDP following GFC. the Bank switches focus on Output Gap	-1	Anticipated	-15.26	**9.69**	**14.00**	**-28.48**	The global economy has continued to weaken significantly in recent months as a result of the turmoil in the financial markets. There is growing uncertainty regarding the depth and duration of the economic slowdown. The South African economy has not escaped the impact of these developments, and domestic production has contracted as a result of weak domestic demand and a significant decline in export demand. Against this backdrop of widening domestic and global output gaps, the balance of risks to the inflation outlook has changed somewhat.	**Mind the output gap** Answering questions on the monetary policy committee's decision yesterday to cut interest rates by one percentage point, Reserve Bank governor Tito Mboweni drew particular attention to the fact that the committee's statement mentioned output, and the output gap, more than once. Growth, in other words, is a real concern. And from the Bank's point of view, given its mandate of price stability, the output gap suggests it should be worrying less about inflation and more about growth. Which is what it is doing. [Mind the output gap – Business Day (Johannesburg, South Africa) – March 25, 2009 – page 1]
May-09	Global economic downturn continues. No press conference	-1	Anticipated	-9.24	**-9.67**	**26.06**	**-14.48**	The Monetary Policy Committee considered the severe synchronised downturn in international and domestic economic conditions and noted their potential future downward impact on inflation, notwithstanding the higher-than-expected recent domestic inflation outcomes. The committee is of the view that the adverse economic conditions continue to tilt the balance of risks to the inflation outlook to the downside over the medium term and has therefore decided to reduce the repurchase rate by 100 basis points to 8,5 per cent per annum with effect from 4 May 2009.	**Another sharp rate cut looks likely** The severity of the global downturn meant although SA's near-term inflation outlook had deteriorated, the "balance of risks" over the longer term had "tilted to the downside", he said. That is central bank speak for "inflation is likely to be lower in the future than we think right now". [Another sharp rate cut looks likely – Business Day (Johannesburg, South Africa) – May 2, 2009 – page 1]
Aug-09	Uncertainty continues. Weak global and domestic demand but inflation still well above target	-0.5	Unanticipated	**-47.73**	4.52	2.91	2.13	There are encouraging signs that the global slowdown may have reached its lower turning point, although the speed and extent of the recovery are still subject to a high degree of uncertainty. The South African economy appears to be lagging behind these international developments and it is likely that the domestic economy contracted in the second quarter of this year. The domestic economy remains constrained by weak global and domestic demand.	**Mboweni cuts as SA misses out on global recovery** The Reserve Bank took markets and analysts by surprise yesterday, cutting lending rates despite stubborn price pressures in a bid to help jolt the economy out of recession. SA appeared to be "lagging" a global recovery and "adverse economic conditions" had tilted risks to the inflation outlook downwards, governor Tito Mboweni said. [Mboweni cuts as SA misses out on global recovery – Business Day (Johannesburg, South Africa) – August 14, 2009 – page 1]
Sep-11	European Debt crisis deepens. Several European banks credit rating downgraded the previous week. confidence crisis. Significant exchange rate devaluation	0	Anticipated	3.74	**-9.99**	6.15	**31.93**	Since the previous meeting of the Monetary Policy Committee the downside risks to the global and domestic growth prospects have increased. Growth in some of the advanced economies has weakened against the backdrop of financial market turbulence, generated in large part by the unresolved European sovereign debt crisis. Although economic growth in emerging markets is expected to continue to outperform that of the advanced economies, these economies are unlikely to emerge unscathed from the challenging environment. Heightened risk aversion has resulted in increased volatility of capital flows globally and a flight from what are perceived to be more risky emerging market assets. These developments have impacted on the domestic capital and foreign exchange markets.	**Interest rates kept steady on inflation fears** The Reserve Bank kept interest rates steady yesterday, as most had expected, but said there had been a 'significant' debate on whether a cut was warranted. [...] The Bank did not change the inflation outlook it had at its last meeting in July, but said the rand's sharp depreciation was a 'potential upside risk'. [...] The Bank revised its growth forecasts sharply down, and warned that they were still at risk from the global downturn. It was concerned about the potential impact of global turmoil and was ready to act appropriately should the need arise. [Interest rates kept steady on inflation fears – Business Day (Johannesburg, South Africa) – September 23, 2011 – page 1]

Events				Shocks				Narrative	
		Repo Change		short term	medium term	term premium	country risk	MPC Statement	Business Day Commentary
Jul-12	Highest risk in the global economy, world's leading central banks expanding aggressively. Draghi's 'whatever it takes' speech to follow	-0.5	Unanticipated	**-44.88**	0.14	**-10.74**	-0.93	The MPC is concerned about the increased downside risks posed to the domestic economy from global developments. The problems in the Eurozone are likely to persist for a protracted period and since the previous meeting the negative growth outlook has spread beyond Europe, in particular to the US, China, India and other emerging market economies. The negative spill-over effects to South Africa are likely to intensify. This unfavourable outlook is reinforced further by the fragile domestic private sector investment and consumption trends which are confirmed by declining business and consumer confidence. The MPC therefore sees the risks to the growth forecast to be on the downside.	**Rate cut 'bid to shield SA' from global downturn** The Reserve Bank unexpectedly cut interest rates yesterday in what it described as a 'proactive' move to shield the economy from a global slowdown, signalling that concern over SA's subdued growth prospects had taken precedence over inflation. [...] Although the move took markets by surprise, the tone of the Bank's announcement suggested there could be further interest rate cuts this year to boost flagging investment, consumption and confidence. [...] Domestic bonds surged in response to the news, with yields on the maturity due 2015 plunging by 35 basis points to 5.42%, a record low. Local money markets are now pricing in a good chance of another rate cut this year. [Rate cut 'bid to shield SA' from global – Business Day (Johannesburg, South Africa) – July 20, 2012 – page 1]
Sep-13	US Fed delays tapering, reversing steep capital outflows experienced by EM.	0	Anticipated	1.87	**8.28**	-3.70	**-27.03**	Global financial markets have been dominated by continued speculation about the speed and timing of tapering of quantitative easing by the US Fed. The uncertainty related to this event resulted in a high degree of volatility and weakening in a number of emerging market economies foreign exchange and bond markets since May. The decision by the Fed to delay tapering surprised the markets, and emerging market currencies in particular responded strongly with many seeing significant overnight currency appreciation.	**Inflation still core Bank mandate** Markets might have been a little euphoric yesterday after the US Federal Reserve pulled back from the 'tapering' it had been expected to announce at Wednesday's meeting. But the Reserve Bank's monetary policy committee was definitely not about to be carried away. Its tone yesterday, as it announced its decision to keep interest rates unchanged, was anything but euphoric. It was wary of international developments and worried about local developments. [Inflation still core Bank mandate – Business Day (Johannesburg, South Africa) – September 20, 2013 – page 1]
Jan-14	US Fed starts tapering, with effect on EM exchange rates Inflationary pressure increasing but economy still very weak. Bank reaffirm the Inflation targeting framework	0.5	Unanticipated	**44.53**	**16.93**	-4.74	**10.85**	Since the previous meeting of the Monetary Policy Committee, the expected cutback in quantitative easing by the US Fed has begun. Although the initial response in global financial markets was generally fairly muted, emerging markets have subsequently experienced a high degree of turbulence, particularly in the wake of renewed fears of a slowdown in China. While the Fed action signals a recovery in the US, and the UK economic outlook is also improving, it does not mean that the global financial crisis is over. Rather, we are now entering a phase of the crisis that is creating new challenges for emerging market economies.	**Bank makes the right move** It was a credible move from a credible Bank – even if nobody in the market had seen it coming. If the Reserve Bank's monetary policy committee had done yesterday what Turkey's central bank did the day before – which was to go with a hectic and very belated interest rate hike to try to halt the rout in its currency – it would not have been clever at all. And indeed, though yesterday's rate hike might have been expected to strengthen the rand, it did quite the opposite, at least initially. Perhaps market players were so shocked that the Reserve Bank had spotted risks that they had failed to see that they (over) reacted by marking the rand down yet further. But if there was risk that had not been spotted, it was that we haven't yet really seen the effect on inflation of the rand's long slide. And though R11-plus to the dollar is a recent development, driven more by the rout in emerging markets than by the troubles in SA specifically, the rand has been in decline for much of the past two years, as SA's 'idiosyncratic' factors, as the Bank called them, have seen sentiment turn against us. [Bank makes the right move – Business Day (Johannesburg, South Africa) – January 30, 2014 – page 1]
Jan-16	Internal political uncertainty. Surprise dismissal of Finance Minister Nene previous December and period of uncertainty at the Treasury.	0.5	Anticipated	30.17	-2.25	**-17.71**	-6.60	Since the previous meeting of the Monetary Policy Committee, the inflation outlook has deteriorated significantly, mainly due to exchange rate and food price developments. The rand has depreciated considerably in response to domestic and external developments, while the impact of the worsening drought on food prices is becoming increasingly evident. The outlook is complicated by the fact that the domestic growth outlook has weakened further. The global backdrop has also become more challenging particularly for emerging markets, and downside risks to the sustainability of the recovery in the advanced economies have increased.	**Rate rise augurs tough year ahead** [...] But in an environment in which the credibility of economic policy is delicately balanced, and the rand is performing worse than other emerging-market currencies because of negative sentiment towards SA specifically, policy makers can't afford to take too many chances with policy credibility. For that reason alone, the decision to stay firm on inflation targeting was important. And with the market widely predicting 50 basis points, the committee would have had to do a lot of explaining had it taken any other decision. [Rate rise augurs tough year ahead – Business Day (Johannesburg, South Africa) – January 29, 2016 – page 1]
Mar-16	Continue political uncertainty. Continues pressure on the Treasury and revelations on the State Capture project.	0.25	Unanticipated	16.49	-0.20	**-16.81**	**-16.82**	Although the inflation forecast has improved moderately since the previous meeting of the Monetary Policy Committee, the committee remains concerned about the protracted nature of the breach of the target. Furthermore, the committee assesses the risks to the forecast to be on the upside. The main risk factors relate to the exchange rate and food prices. The exchange rate of the rand continues to be highly volatile and vulnerable to changes in both domestic and external developments. While the pass-through from the exchange to inflation is still relatively low, there are signs that this may be increasing.	**A quarter point compromise** It is hard not to wonder whether the events of the past few days were the factor that tipped the monetary policy committee into opting for a 25-basis point hike rather than a hold. And rightly so. This is not the time to take any chances with either policy credibility or the exchange rate. But the battle lines that have been drawn between Finance Minister Pravin Gordhan and the Hawks, and the dramatic disclosures of the Gupta family's influence on ministerial appointments have undermined SA's credibility with investors further and put new downward pressures on the rand. What seemed a high-risk and volatile environment at the start of the monetary policy committee's meeting on Tuesday was even more so by yesterday, and if the committee's response was on the hawkish side (in the monetary policy sense), it cannot be faulted for acting to manage the risks as best as it can. However, the decision to hike was clearly a tough and a contested one, with half of the committee's members starting out in favour of keeping rates on hold rather than implementing another increase after the 50-basis point hike in January. [A quarter point compromise – Business Day (Johannesburg, South Africa) – March 18, 2016 – page 1]

Events				Surprises				Narrative	
		Repo Change		Short term	Medium term	Term premium	Country risk	MPC Statement	Business Day Commentary
Mar-17	End of the tightening cycle, but persistent perturbations coming from political uncertainty.	0	Anticipated	4.16	-1.39	**-20.87**	-0.15	The MPC is of the view that we may have reached the end of the tightening cycle. However the Committee would like to see a more sustained improvement in the inflation outlook before reducing rates. This assessment may however change if the inflation outlook and the risks to the outlook deteriorate.	**A less reserved bank will help** The crazy SA politics factor was again the cause of the rand's decline this week, just when emerging market currencies were racing ahead. And it was the narrative that dominated the statement of the Reserve Bank's monetary policy committee – it left interest rates unchanged as expected on Thursday, but sounded dire warnings about the risk that our politics posed to the rand and hence to the country's inflation outlook. Though the committee again suggested that it may have reached the end of the rate-hiking cycle, it cautioned again that this could change – in other words, it could look at more interest rate increases – if the risks rose and the inflation outlook deteriorated again. [...] The only surprise, in a week of such intense political uncertainty, was that one committee member voted for an interest rate cut. Perhaps that was what emboldened market players to price in a higher chance of a rate cut later this year. [A less reserved bank will help – Business Day (Johannesburg, South Africa) – March 31, 2017 – page 1

References

Alessi, Lucia, Matteo Barigozzi, and Marco Capasso, "Improved penalization for determining the number of factors in approximate factor models," *Statistics & Probability Letters*, December 2010, *80* (23-24), 1806–1813.

Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Ragusa, "Measuring euro area monetary policy," *Journal of Monetary Economics*, 2019, *108* (C), 162–179.

Bai, Jushan and Serena Ng, "Determining the Number of Factors in Approximate Factor Models," *Econometrica*, January 2002, *70* (1), 191–221.

Forni, Mario, Domenico Giannone, Marco Lippi, and Lucrezia Reichlin, "Opening The Black Box: Structural Factor Models With Large Cross Sections," *Econometric Theory*, October 2009, *25* (5), 1319–1347.

_ , Luca Gambetti, and Giovanni Ricco, "External Instrument SVAR Analysis for Noninvertible Shocks," CEPR Discussion Papers 17886, C.E.P.R. Discussion Papers February 2023.

Känzig, Diego R., "The Macroeconomic Effects of Oil Supply News: Evidence from OPEC Announcements," *American Economic Review*, April 2021, *111* (4), 1092–1125.

Miranda-Agrippino, Silvia and Giovanni Ricco, "The Transmission of Monetary Policy Shocks," *American Economic Journal: Macroeconomics*, July 2021, *13* (3), 74–107.

Smith, Josephine M. and John B. Taylor, "The term structure of policy rules," *Journal of Monetary Economics*, October 2009, *56* (7), 907–917.

Swanson, Eric T., "Measuring the effects of federal reserve forward guidance and asset purchases on financial markets," *Journal of Monetary Economics*, 2021, *118* (C), 32–53.

ABOUT OFCE

The Paris-based Observatoire français des conjonctures économiques (OFCE), or French Economic Observatory is an independent and publicly-funded centre whose activities focus on economic research, forecasting and the evaluation of public policy.

Its 1981 founding charter established it as part of the French Fondation nationale des sciences politiques (Sciences Po) and gave it the mission is to "ensure that the fruits of scientific rigour and academic independence serve the public debate about the economy". The OFCE fulfils this mission by conducting theoretical and empirical studies, taking part in international scientific networks, and assuring a regular presence in the media through close cooperation with the French and European public authorities. The work of the OFCE covers most fields of economic analysis, from macroeconomics, growth, social welfare programmes, taxation and employment policy to sustainable development, competition, innovation and regulatory affairs.

ABOUT SCIENCES PO

Sciences Po is an institution of higher education and research in the humanities and social sciences. Its work in law, economics, history, political science and sociology is pursued through ten research units and several crosscutting programmes.
Its research community includes over two hundred twenty members and three hundred fifty PhD candidates. Recognized internationally, their work covers a wide range of topics including education, democracies, urban development, globalization and public health.
One of Sciences Po's key objectives is to make a significant contribution to methodological, epistemological and theoretical advances in the humanities and social sciences. Sciences Po's mission is also to share the results of its research with the international research community, students, and more broadly, society as a whole.

PARTNERSHIP