Trouble Every Day:

Monetary Policy in Emerging Economies, a Study of South Africa

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First Version: February 2021
This version: 9 January 2023

Abstract

We present a comprehensive analysis of monetary policy in South Africa by employing a state-of-the-art high-frequency identification. Using future contracts, we extract three monetary policy surprises affecting the short-, mid-, and long-end of the yield curve. We report three main results from an event study and an identified VAR. First, conventional monetary policy works in a standard manner in a small open emerging market, with tightenings generating contractionary effects on real, nominal, and financial variables. Second, the exogenous shocks to the longer maturities produce effects compatible with risk premia shocks. Third, monetary surprises represent a relevant share of policy rate decisions, indicating that policymakers always surprise market participants. Furthermore, surprises correlate with the central bank forecasts, as well as global shocks. These findings point to markets having uncertainty regarding both the state of the economy and the reaction function of the bank.

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

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We thank Riccardo Degasperi and Anshumaan Tuteja for research assistance. We are grateful to Refet Gürkaynak for sharing the series of updated daily US monetary surprise. We thank Mamokete Lijane for valuable comments and for sharing the methodology of the forward rates' transformation.

1 Introduction

Monetary policy practice in many emerging markets has largely converged to a common standard of inflation targeting, flexible exchange rate and credible monetary policy institutions. South Africa monetary policy is a typical example of this trend: 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 is 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.

This standard framework has to contend with an economic environment dominated by external shocks and internal tensions. Many years of low growth, high unemployment and extreme inequality put monetary policy under pressure to adopt a less orthodox approach, with calls for monetary policy to assume a variably defined developmental role of creditor of last resort. On the other hand, a continuum of global shocks has reinforced the need of monetary policy as a stabilizing force against the global uncertainty. Monetary policy has then to search a difficult balance between internal objectives and external stability in an environment characterized by economic and political uncertainty.

The complexity of this policy environment characterized by "Trouble Every Day" is the focus of this paper. In the paper we do the following:

- first, we measure the South African Reserve Bank (SARB) monetary policy as a three-dimensional process (following Gürkaynak et al. (2005), Altavilla et al. (2019) and Swanson (2021)): one dimension captures the conventional short-term interest rate setting by the Bank, while two other dimensions encompass the Bank's communication pertaining to medium- and long-run horizons, taking also account for the information content of the central bank policy announcements (Miranda-Agrippino and Ricco, 2021);

- second, we examine the transmission of monetary policy surprises identified in step one on yields, assets prices and capital flows using the event study approach;

- third, we analyse the dynamic impulse responses of macroeconomic conditions in a BVAR with external instruments;

- finally, we analyse the degree to which monetary policy in South Africa is influenced by external effects - monetary policy shocks in the US and in the EA, oil supply news

shocks and global uncertainty.

Our main results can be summarized as follows:

- Any decision of the central bank about the policy rate is to some extent surprising for the market. In other words, any policy rate decision is highly correlated with a short run monetary policy surprise. This shows a significant degree of uncertainty of market participants about the central bank reaction function.

- Global shocks - oil supply and monetary conditions in the US and in the EU, - exert significant influence on the SARB's monetary policy, especially through it effect on the country risk premium.

- Disentangling between different dimensions of the central bank announcements' effects allows to document novel influence of the emerging country medium-term and long-term monetary surprises that is compatible to risk-premia shocks.

In the whole analysis, the country risk premium plays a central role in explaining the functioning of monetary policy in South Africa, - a result that we think can be generalized to other emerging markets. Monetary policy influences the economy both with its actions and, more importantly, with what its action and communication signifies for the long term macroeconomic stability of the country. Forward guidance is less about the path of interest rates and is more about market learning the bank reaction function to frequent external and internal shocks.

The importance of the risk channel in the global transmission of monetary policy has been recurrently emphasized in the literature, especially after the global financial crisis. The seminal work of Rey (2013) about the influence of the United States' monetary policy on the global financial cycle first introduced the idea that the risk channel might be the most important determinant of monetary policy in a small and (financially) open economy, an idea further developed by Bruno and Shin (2015) and Farhi and Werning (2014). The postulate of Rey (2013) that flexible exchange rate is not enough to provide monetary policy autonomy is supported by findings of Kalemli-Özcan (2019) showing that disconnect between changes in the policy and short-term rates is explained by fluctuations in risk perceptions following the US monetary policy shocks. The results in Degasperi et al. (2020) demonstrate that financial channels dominate over demand and exchange rate channels in the US monetary policy transmission to foreign economies. This transmission channel was emphasized in Albagli

et al. (2019) and Solıs (2021), where they show that US monetary policy is transmitted to emerging markets through its effect on term premia and credit risk, to which monetary policy can respond by narrowing the interest rate differential (therefore disregarding the internal targets) or accepting large exchange rate fluctuations. This non-traditional trade-off appears everywhere in the analysis of the emerging markets' monetary policy.

Our work decomposes all these effects discussed in the literature and recovers monetary policy autonomy by re-defining it as the monetary policy that is compatible with the long run macroeconomic stability of the country, given the prevalent external shocks. Communication, forward guidance and a clear definition of the central bank reaction function to external shocks helps in anchoring the long term expected macroeconomic trend, thus freeing monetary policy to stabilize the economy in the short run.

The paper is organized as follows. In the next section we describe our high-frequency identification of market-based policy surprises and decompose them in three time dimensions, and in information and pure monetary shocks. In sections 3 and 4 we show the transmission of monetary policy in South Africa by looking at the surprises' effect on yields, asset prices and capital flows in the event study, and by looking at their dynamic effect at the policy horizon using a Bayesian VAR with external instruments. In section 5 we analyse the correlation between the identified monetary surprises and the US and EA monetary policy shocks, global uncertainty and oil supply shocks. In section 6 we conclude by emphasising the centrality of the risk channel in explaining the functioning of monetary policy in emerging markets.

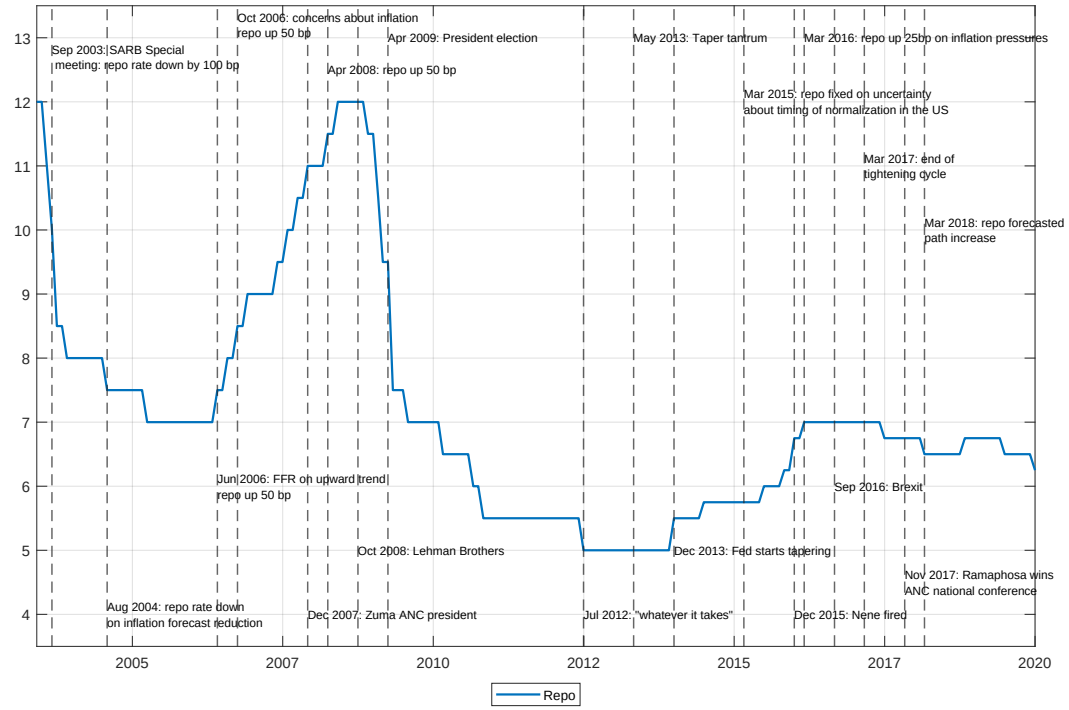
2 Factors in South Africa Monetary Policy Surprises

We use market-based policy surprises to shed light on the effects of monetary policy. In particular, we aim to identify changes in the policy stance that are orthogonal to the information set of market participants. We assume that monetary policy does not respond to changes in the financial market instruments within a day, what allows us to analyse the reaction of asset prices to changes in policy.

2.1 The SARB policy communication

The monetary policy in South Africa is communicated by the South African Reserve Bank in the form of the Monetary Policy Committee (MPC) statements and media briefings broadcasted and streamed live. Usually a statement provides an overview of the most important

FIGURE 1: Repo rate and important events.



recent domestic and foreign economic developments, informs about the level of the repo rate as set by the MPC members, as well as reasoning for this choice. An MPC statement is published at the SARB website as soon as a media briefing ends[1]. At the same time with an MPC statement, the two year ahead quarterly forecast of key macroeconomic variables, such as GDP growth rate and a CPI, is published on the SARB website.

The MPC meeting dates are not the same every year and are typically announced for the following year in the last MPC statement of the previous year. Starting from February 2000, when the SARB had introduced the inflation targeting framework, the vast majority of MPC meetings have been scheduled - 120 out of 127 in total. With an exception of 2020, there have been 6 MPC meetings per year since 2010, which are held every other month[2].

We take the series of the MPC meeting dates as disclosed on the SARB website, while the timing of the MPC statement announcements is retrieved from the Bloomberg macroeconomic news stream database, as it is not reported by the SARB.

[1]Typically, an MPC meeting starts at 15:00 CAT and a statement is published around 15:10-15:30 CAT, depending on how long the statement is and when an announcement ends.

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

2.2 Market-based policy surprises

First, we use high-frequency data on asset prices to construct a dataset of market-based policy surprises. Second, based on the principal component analysis we extract three components on monetary policy announcements matching the short, medium and long maturities of instruments in our dataset. In the following sections we use these identified components for analyzing the effects of different monetary policy dimensions on the financial market and real economy.

Following Kuttner (2001), we use interest rate derivatives' prices as a market-based proxy for market's expectations of the central bank policy actions at different horizons. Given that a price of an asset before a monetary policy announcement reflects the market's expectation of the decision about the policy rate, and the price after the announcement captures the market's reaction to the policy decision made by the central bank, the difference between these prices can be used to identify unexpected part of monetary policy announcement.

We use yields on interest rate instruments to measure monetary policy surprises. Our set of instruments includes the 3-month Johannesburg Interbank Average rate (Jibar) and thirteen interest rate derivative contracts - Forward Rate Agreements (FRAs) and interest rate swaps:

- 3M Jibar
- FRA1x4, FRA3x6, FRA6x9, FRA9x12, FRA12x15, FRA15x18, FRA18x21, FRA21x24
- Sw1Y, Sw2Y, Sw3Y, Sw5Y, Sw10Y

The 3-month Jibar rate is a widely used and accepted benchmark short-term rate at the South African financial market underpinning various contracts and valuations; this is the rate at which banks make transactions with the Negotiable Certificates of Deposit (NCDs). The Jibar rate captures the expected prevailing rate three months ahead and is an underlying rate for FRA contracts and interest rate swaps. The termination dates of FRAs in the dataset range from 4 to 24 months, while the maturity of interest rate swaps spans from 1 to 10 years.

For consistency, we convert the FRA rates to their swap rates' counterparts. The FRA rates' transformation ensures that the rates of the same type are used for the principal components' extraction, such that factor loadings are compatible and interpretable. The details of the FRA rates' conversion to swap rates are given in the Appendix.

To measure policy surprises we use a daily window. Specifically, we look at the difference between the last value on a day of an MPC meeting, when the monetary policy statement is

announced, and the last value on a previous day[3]:

$$Surp^{i}_{t_{MPC}} = P^{i,Last}_{t_{MPC}} - P^{i,Last}_{t_{MPC}-1}, \tag{1}$$

where $Surp^{i}_{t_{MPC}}$ is a surprise effect on asset i of MPC statement announcement on day t_{MPC}, $P^{i,Last}_{t_{MPC}}$ is the close price of asset i on day t_{MPC} and $P^{i,Last}_{t_{MPC}-1}$ is the close price of asset i on day before that.

2.3 Monetary Policy Surprises in South Africa

Next, we identify factors that characterize different dimensions of monetary policy announcements based on a set of market-based surprises. Similarly to Gürkaynak et al. (2005), Altavilla et al. (2019) and Swanson (2021), we first extract latent factors underlying the market-based surprises and then rotate them to allow for factors' structural interpretation[4]

We use factor model to decompose the behaviour of market-based surprises X into a component driven by few unobserved factors F that are common to all the assets, specific effects on them Λ, and asset-specific idiosyncratic components ε:

$$X = F\Lambda + \varepsilon \tag{2}$$

Columns of X i correspond to changes in different maturity yields, while rows t - to the SARB announcement dates, such that x_{ti} is a change in yield of an asset i in response to the announcement made at t. Elements of the matrix of loadings Λ measure the effect of latent factors on assets.

Model 2 is estimated using the principal components analysis (PCA). Latent factors extracted with the PCA do not characterize specific dimensions of monetary policy, as they cannot be interpreted in terms of having an effect on a particular part on the yield curve. To

[3]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- or tick-) data are available for us on Bloomberg - our source of market data, - starting from 2008 only, so resorting to it would cut our sample by 8 years. Second, lower liquidity of the South African market as compared to markets in the US or the EA implies that changes in yields in a narrow window do not necessarily reflect the surprise component of market value induced by policy announcement. It takes longer for agents to find a counterparty for a deal, so there might be delays in how long it takes for market values to reflect changes in agents' views on fair asset values post-MPC meeting announcement.

[4]We use the test of Cragg and Donald (1997) as an indication to how many statistically significant factors explain the market-based surprises and find five factors.

illustrate, transformation of F with any orthonormal matrix U[5] is possible such that

$$X = \widetilde{F}\widetilde{\Lambda} + \varepsilon, \tag{3}$$

where $\widetilde{F} = FU$ and $\widetilde{\Lambda} = U'\Lambda$.

To allow for factors' structural interpretation, we identify U^* by imposing on it the following restrictions:

- only the first factor loads on the shortest maturity yield, while the second and the third factors are orthogonal to it;
- among the second and the third factor, the second factor loads the least on the longest maturity.

Imposing these restrictions allows to derive a unique U^* that is used to rotate factors extracted with the PCA: $F^* = FU^*$, - and to obtain the rotated factor loadings: $\Lambda^* = (U^*)'\Lambda$. We then rescale the factors, such that the effect of the first and the third factors is unity on the 3M (shortest) and 10Y (longest) yields respectively. The second factor is rescaled to have a unit effect on the 12M yield - this is the maturity for which the value of rotated second factor loading reaches its maximum. The resulting identified and rescaled factor loadings are plotted on figure 2. It shows that the importance of first factor in driving the surprises in yields decreases for longer maturities, while its role is most prominent for yields up to 2Y. The second factor is the most important for explaining surprises in yields from 6M to 24M, and plays almost no role for yields exceeding 2Y. The relevance of the third factor is substantial for maturities above 2Y, it increases monotonically for longer yields, and is less pronounced for short yields.

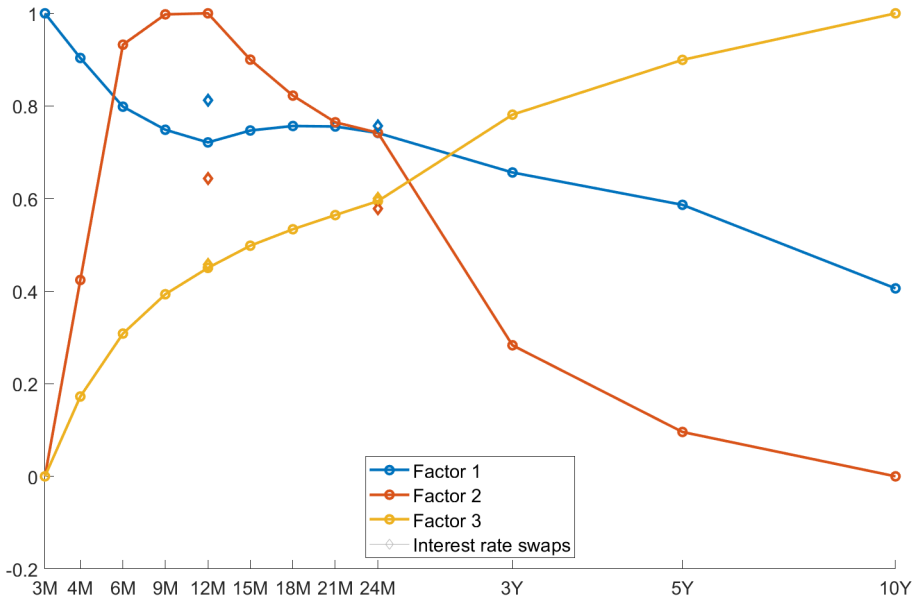
To summarize, the first factor captures surprises in short rates induced by MPC decisions, while the second and third factors are surprises at medium and long horizons.

2.4 Informationally-Robust Monetary Policy Factors

The recent empirical literature documents the existence of signalling (or information) channel of monetary policy (see Romer and Romer (2000), Nakamura and Steinsson (2018) and Melosi (2016)). The idea of this channel is that central bank decisions provide a signal about the current and projected states of economy. A change in the policy rate could be

[5] An orthonormal matrix U satisfies $UU' = 1$.

FIGURE 2: Identified factor loadings



Note. The ticks' location on x axis is not scaled exactly to improve readability on the short end of the axis. 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.

read by imperfectly informed agents as either a deviation from the monetary policy rule of the central bank, or as its endogenous response to macroeconomic developments. For example, a repo rate hike decided by the SARB can signal growth in South African economy higher than expected. Jarociński and Karadi (2020) and Miranda-Agrippino and Ricco (2021) document the presence of information about the state of economy in the high-frequency surprises alongside the 'true' monetary policy shocks.

To control for the information channel in our monetary policy factors, we use the approach proposed by Miranda-Agrippino and Ricco (2021). In particular, we regress our identified factors on the real-time SARB forecasts and forecast revisions of output growth and inflation that become a part of the SARB information set before each MPC meeting[6]. We do this in order to control for the information provided by the central bank to the market at the time of announcement. Specifically, we run the following regression at the SARB monetary policy committee (MPC) meeting frequency:

$$F_m^i = \alpha_0 + \sum_{j=-1}^{3} \theta_j FC_m^{SARB} x_{q+j} + \sum_{j=-1}^{3} \eta_j [FC_m^{SARB} x_{q+j} - FC_{m-1}^{SARB} x_{q+j}] + Finfo_m^i, \qquad (4)$$

where F_m^i denotes the monetary policy factor i identified using the high-frequency market-based monetary surprises around the SARB MPC meeting announcement m. $FC_m^{SARB} x_{q+j}$ are the real-time SARB forecasts of macroeconomic variable x (output growth or inflation) at horizon $q+t$ that are available to the SARB before each of MPC meeting. $FC_m^{SARB} x_{q+j} - FC_{m-1}^{SARB} x_{q+j}$ denote forecast revisions of a variable x_{q+j} between MPC meetings at dates $m-1$ and m. Because the SARB macroeconomic forecasts are produced at quarterly frequency, the forecast horizon we consider is in quarters q.

The share of variation in factors explained by the SARB's information is shown in table 1; in other words, it shows the extent to which raw factors are contaminated by the information channel. It summarizes the R-squared coefficients for regressions 4 and indicates that the presence of the SARB information is the largest in the third factor and is the smallest in the first factor.

There is at most one MPC meeting within each month over our sample. So to aggregate daily factor series at MPC frequency IRF_m^i into the monthly one $\overline{IRF_t^i}$ we take a daily factor value to represent the month, when the MPC meeting has occurred. $\overline{IRF_t^i}$ are set to zero for

[6]Since 2017, the SARB macroeconomic forecasts are produced using the Quarterly Projection Model (Botha et al., 2017). Prior to that the forecasts were made with the macroeconomics Core model of the SARB.

TABLE 1: SARB information in raw monetary policy factors.

	F1	F2	F3
R-squared	0.199	0.288	0.431
Adjusted R-squared	0.050	0.155	0.326

FIGURE 3: Factor 1 and important events

those month, when no MPC meeting was held.

As the last step, we remove the autoregressive component from the monthly factor series $\overline{IRF_t^i}$. Our resulting informationally-robust monetary policy factors are residuals IRF_t^i of the following regression:

$$\overline{Finfo_t^i} = \phi_0 + \sum_{j=1}^{12} \phi_1 \overline{Finfo_{t-1}^i} + Finfo_t^i, \tag{5}$$

which is run using only non-zero monthly observations for the dependent variable. Once again, $Finfo_t^i$ is assigned a zero value for the months without MPC meetings.

Figures 3, 4 and 5 show plots of raw and informationally-robust factors together with events associated with some extreme values of each factor.

FIGURE 4: Factor 2 and important events

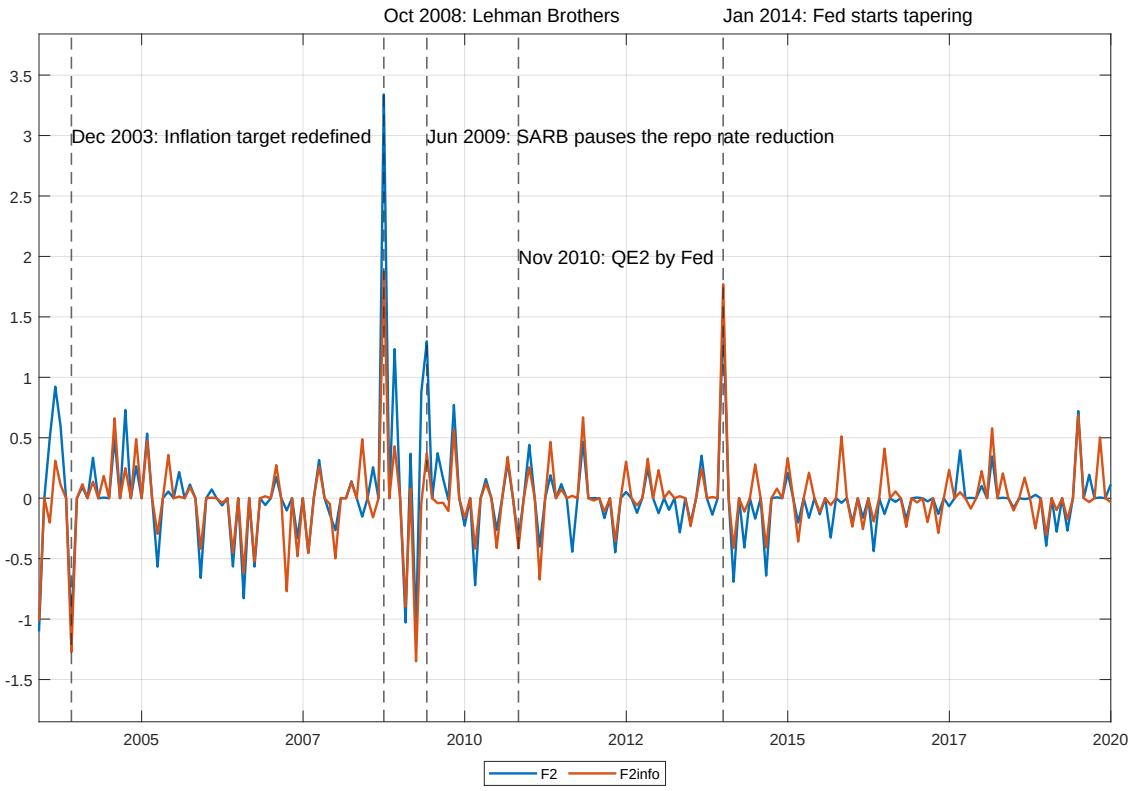
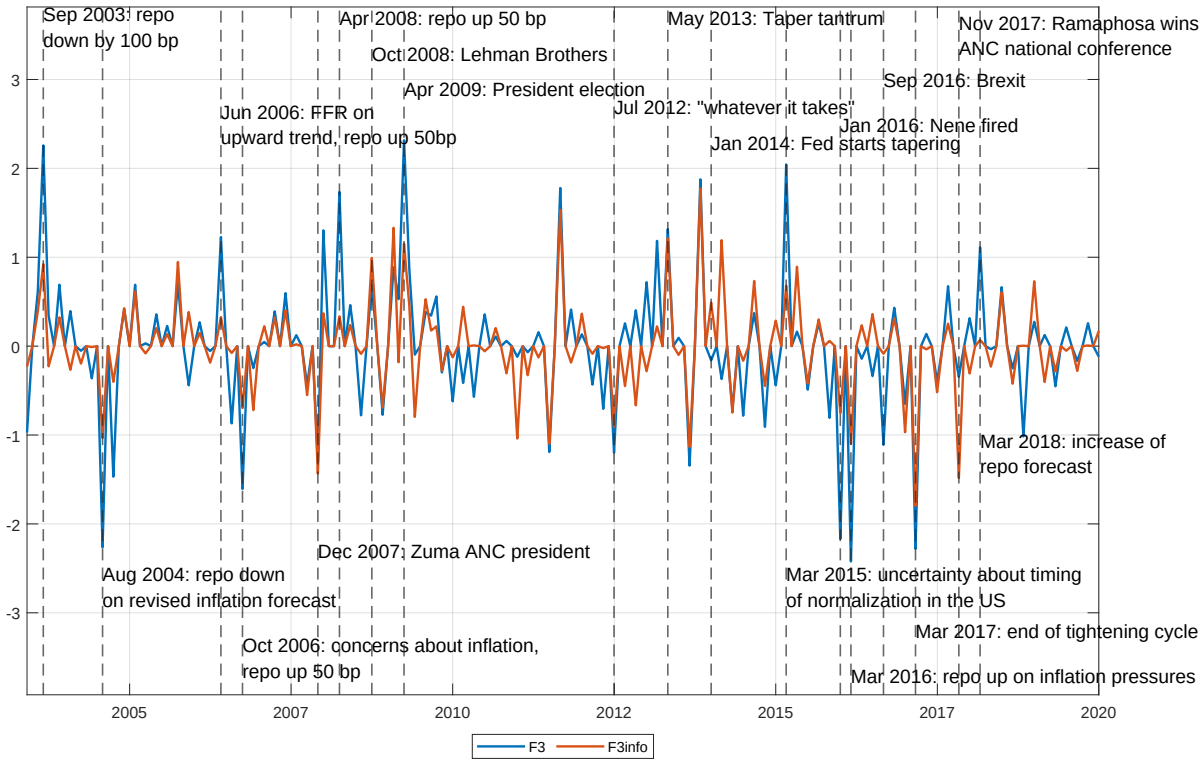


FIGURE 5: Factor 3 and important events



Identified factor F1 - in both raw and informationally-robust specifications - is strongly correlated with changes in the policy rate, see table 2. Figure 3 illustrates this point indicating that large factor F1 shifts commonly coincide with changes in the repo rate. F2 and F3 are uncorrelated with changes in the policy rate (see table 2). F2 values pick up the important events in the domestic and external environments, for example, extreme tightening associated with the Lehman Brothers collapse in October 2008 and with the beginning of the quantitative easing policy tapering by Federal Reserve in December 2013, while F3 features more systematic variation (see figures 4 and 5).

TABLE 2: Factors' correlation with changes in policy rate.

	F1	F1info	F2	F2info	F3	F3info
Correlation coefficient	0.62	0.51	-0.08	0.19	-0.21	-0.16

2.5 Selected MPC episodes

To illustrate how our monetary policy factors capture different dimensions of the SARB announcements, several MPC episodes are considered, see table 3.

The October 2008 MPC meeting features a big spike in F2. Lehman Brothers had filed for bankruptcy on the 15th of September 2008, what initiated the collapse of the global financial market. The SARB MPC decided not to change policy rate over that meeting, with the decision being expected by the market - this is reflected in the relatively low absolute value of F1. The large value of F2 captures market concerns about macroeconomic stability in the medium run as induced by the policy announcement made by the SARB.

On the March 2015 meeting, the MPC has not changed policy rate due to uncertainty in timing of monetary policy normalization in the U.S.[7] Market had expected this decision, as short rates did not respond to the announcement much (low absolute value of F1). However, explicitly expressed worries about capital flows signalled to the market the significant risks to long-run macroeconomic stability, what is reflected by the high value of the factor F3.

The MPC meeting in January 2016 took place in a period of heightened political uncertainty in South Africa. In December 2015 the Minister of Finance Nene was fired by then-president of the country. The deteriorated inflation outlook called for the policy rate

[7]The 26.03.2015 MPC statement reads: "In its previous statement the Committee noted that the more favourable inflation path allowed for some room to pause in the process of domestic monetary policy normalization. The deterioration in the outlook suggests that this scope has narrowed. However, given the uncertainties related to U.S. policy normalization and the weak state of the domestic economy, the MPC has unanimously decided to keep the repurchase rate unchanged for now".

TABLE 3: Selected MPC episodes

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MPC date	Repo change	Repo level	F1	F2	F3	Event
09.10.2008	0	12	-0.58	**3.34**	0.69	Lehman Brothers files for bankruptcy
26.03.2015	0	5.75	0.04	-0.20	**2.04**	Unchanged repo over uncertainty about US policy normalisation
28.01.2016	50 bp	6.75	**1.52**	-0.20	**-2.17**	Minister Nene fired
30.03.2017	0	7	0.20	-0.03	**-2.28**	Committment to keep low inflation

increase, what was done by the SARB - the repurchase rate was increased by 50 bp in January 2016. This strong move was unexpected by the market in the ongoing conditions of high uncertainty, what is reflected in the high value of F1 meaning monetary contraction in the conventional/short-term monetary policy domain. On the other hand, the SARB decision to increase policy rate signaled to the market the central bank commitment to its price stability mandate and independence. This signal serves as a condition reassuring in the long run macroeconomic stability and lower risks for domestic economy, what is reflected by a large negative value of the factor F3.

In March 2017 the MPC decided not to change the policy rate. This decision was in line with market expectations, what is reflected in a low absolute value of F1. The MPC statement reads: "MPC would like to see a more sustained improvement in inflation outlook before reducing rates". The SARB commitment to ensure price stability reassured the market and provided guidance about the Bank's future policy. The factor F3 captures this as a negative surprise on the long end of the yield curve that we interpret as a reduction of long-run risks to stability.

3 Event Study

In the event study we analyse how the SARB monetary policy factors identified in the previous section map on surprises in money market rates, sovereign bond yields, stock prices, exchange rates, sovereign risk premium and capital flows around policy announcements. Surprises are calculated according to equation 1 at a daily and over 2-days window (see results in the

Appendix for the latter)[8]. The latter is done for detecting the effects, that take time to be reflected in market data. Tables 4-?? report the effects of factors F1, F2 and F3 and their informationally-robust counterparts on daily market surprises.

[8]For the 2-days window, surprises are calculated as a difference between the last/close value on the following day after a SARB's announcement and the last/close value on the day before that. For the JIBAR interbank rates daily surprises are calculated as a difference in the last/close value on the day following a SARB announcement and the last/close price on the day of a SARB announcement. This is due to the fact that the JIBAR rate publication is released by the Johannesburg Stock Exchange daily at 10:05 am (JSE, 2012). Hence, the JIBAR rate incorporating the market reaction to a SARB announcement is published on the next day after the SARB announcement is made.

TABLE 4: The effect of monetary policy factors on surprises in yields

	Factors						Info Robust Factors					
	Constant	F1	F2	F3	Rsq	N Obs	Constant	F1info	F2info	F3info	Rsq	N Obs
Overnight	-0,028	0.172***	-0,076	-0,016	0,38	81	-0,035	0.125**	-0,005	-0,016	0,18	81
	(0,02)	(0,05)	(0,07)	(0,01)			(0,03)	(0,05)	(0,05)	(0,03)		
1M Jibar	-0.035**	0.212***	-0,023	-0,015	0,79	109	-0.043**	0.211***	0,029	0,003	0,58	105
	(0,01)	(0,02)	(0,03)	(0,01)			(0,02)	(0,03)	(0,04)	(0,02)		
3M Jibar	-0.026***	0.200***	0	0	0,94	109	-0.032***	0.203***	0,014	0,01	0,73	105
	(0,01)	(0,01)	(0,02)	(0,01)			(0,01)	(0,01)	(0,03)	(0,02)		
3M Tbill	-0,002	0	0,005	-0,004	0,13	76	-0,002	0	0,01	-0,004	0,16	76
	(0,00)	(0,00)	(0,01)	(0,00)			(0,00)	(0,00)	(0,01)	(0,00)		
1Y bond	-0.013**	0.053***	0.035**	0.063***	0,65	83	-0,012	0.046***	0,015	0.048***	0,27	83
	(0,01)	(0,01)	(0,02)	(0,01)			(0,01)	(0,02)	(0,02)	(0,02)		
2Y bond	-0.009*	0.081***	0,009	0.087***	0,86	70	-0,006	0.082***	0,011	0.114***	0,55	69
	(0,01)	(0,01)	(0,03)	(0,01)			(0,01)	(0,01)	(0,05)	(0,02)		
3Y bond	-0.009**	0.082***	0.033**	0.095***	0,91	79	-0,007	0.084***	0,033	0.111***	0,55	75
	(0,00)	(0,01)	(0,01)	(0,01)			(0,01)	(0,02)	(0,04)	(0,02)		
5Y bond	-0.014***	0.061***	0.020**	0.088***	0,92	92	-0.019**	0.060***	0,026	0.091***	0,54	88
	(0,00)	(0,00)	(0,01)	(0,01)			(0,01)	(0,01)	(0,02)	(0,02)		
10Y bond	-0.012***	0.025***	0,001	0.080***	0,78	109	-0.012*	0.026***	0,001	0.081***	0,4	105
	(0,00)	(0,01)	(0,01)	(0,01)			(0,01)	(0,01)	(0,01)	(0,01)		
20Y bond	-0.017***	0.023***	-0,001	0.081***	0,75	105	-0.018**	0.021**	0,004	0.076***	0,35	101
	(0,00)	(0,01)	(0,01)	(0,01)			(0,01)	(0,01)	(0,02)	(0,02)		
30Y bond	-0.016***	0.023***	-0,004	0.078***	0,69	103	-0.017**	0.022**	-0,002	0.069***	0,31	99
	(0,01)	(0,01)	(0,01)	(0,01)			(0,01)	(0,01)	(0,02)	(0,02)		
5Y5Y forward	-0.015**	-0,014	-0,017	0.078***	0,51	109	-0.016*	-0,018	-0,008	0.080***	0,29	105
	(0,01)	(0,01)	(0,02)	(0,01)			(0,01)	(0,02)	(0,03)	(0,02)		

Note: The sample is 2002:06-2020:01. 'Factors' are raw factors of monetary policy and 'Info Robust Factors' are the factors corrected for the SARB's macroeconomic projections discussed in section 2. Variables in the leftmost column are daily surprises in yields. '1M Jibar' and '3M Jibar' are Jibar/interbank rates at 1M and 3M maturity, respectively. '1Y bond', '2Y bond', '3Y bond', '5Y bond', '10Y bond', '20Y bond' and '30Y bond' are respective constant maturities yields of government bonds as quoted on Bloomberg. The surprise units for yields are percentage points. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The factor **F1** induces effects that are in line with the 'Target' factor as in Gürkaynak et al. (2005). It explains the shift of the yield curve with the effect on short maturities being larger than the effect on the long end of the yield curve, see table 4. Increase of F1 causes the stock market values to fall consistently with the conventional monetary tightening effect, see table 5. As expected, the true policy shock that is clean from the central bank information effects produces stronger stock market response - the effect is larger, when induced by the informationally-robust factor F1info[9]. Consistent with the UIP, the wider interest rate differential produced by domestic short-term rate increase, brings about appreciation of domestic currency detected for 2-days window exchange rate surprises, but not for daily surprises - see tables 5 and 12. Thereby, we find that it takes time for nominal exchange rates to absorb the effect of monetary policy announcements. This likely reflects the fact that FX trade with South African rand predominantly takes place at international FX market platforms outside of South Africa, that start and come in full force with their operations after the end of trading day in South Africa. Thereby the nominal exchange rates' shifts are realized on the next day after the SARB MPC meeting according to the South African timing of trade days.

The factor **F3** associated with unanticipated effects of the SARB communication appears to reflect the variation in uncertainty perceived by the market - it produces sizeable repricing of risk and capital outflow effects prompting portfolio reallocation of financial intermediaries, see tables 5 and 6. The sovereign risk premium hikes, and non-residents reduce their purchases of South African bonds, what is accompanied by increase of medium- and long-term bond yields, as higher factor F3 lifts the long end of the yield curve (see table 4). Stock market values fall, what appears to be a sell-off response by domestic traders, as non-resident deals with shares

[9]Raw factor F1 increase signals stronger than expected state of economy with stock market responding positively to this good news, thereby the conventional negative response to a tighter short-term policy stance is confounded.

TABLE 5: The effect of monetary policy factors on surprises in asset prices

	Factors						Info Robust Factors					
	Constant	F1	F2	F3	Rsq	N Obs	Constant	F1info	F2info	F3info	Rsq	N Obs
JSE All shares	-0,145	-0.390***	0,251	-0.485***	0,21	109	-0,119	-0.413**	0,193	-0.542***	0,14	105
	(0,11)	(0,14)	(0,20)	(0,15)			(0,12)	(0,17)	(0,28)	(0,19)		
USD/ZAR	0,101	0,254	-0,154	-0,181	0,07	109	0,112	0,218	-0.515*	-0,148	0,07	105
	(0,11)	(0,17)	(0,25)	(0,18)			(0,11)	(0,18)	(0,29)	(0,24)		
EUR/ZAR	0,018	0,166	-0,277	-0,034	0,04	109	0,04	0,112	-0.661***	-0,003	0,09	105
	(0,10)	(0,16)	(0,20)	(0,16)			(0,10)	(0,16)	(0,24)	(0,19)		
EMBI+SA	0,136	0,275	1,014	3.563***	0,11	103	-0,16	0,079	1,71	7.093***	0,2	100
	(0,90)	(1,01)	(2,51)	(1,35)			(0,89)	(1,05)	(2,51)	(1,81)		

Note: The sample is 2002:06-2020:01. 'Factors' are raw factors of monetary policy and 'Info Robust Factors' are the factors corrected for the SARB's macroeconomic projections discussed in section 2. Variables in the leftmost column are daily surprises in asset prices. The surprise units for JSE All shares index and USD/ZAR and EUR/ZAR exchange rate are percent changes. The surprise units for EMBI+SA index are basis points. USD/ZAR and EUR/ZAR exchange rates are ZAR prices in USD and EUR, respectively, so the exchange rate increase is ZAR appreciation. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

are not affected significantly (see tables 5 and 6).

TABLE 6: The effect of monetary policy factors on surprises in capital flows

	Factors						Info Robust Factors					
	Constant	F1	F2	F3	Rsq	N Obs	Constant	F1info	F2info	F3info	Rsq	N Obs
NNPtot	0,104	0	-0,071	-0,14	0,01	109	0,098	0,015	-0,171	-0.337**	0,03	105
	(0,13)	(0,12)	(0,16)	(0,15)			(0,13)	(0,15)	(0,27)	(0,17)		
NNPshares	0,018	-0,044	-0,125	0,039	0,01	109	0,002	0,014	-0,062	0,051	0	105
	(0,10)	(0,08)	(0,19)	(0,12)			(0,10)	(0,09)	(0,24)	(0,15)		
NNPbonds	0,114	0,026	-0,009	-0,191	0,02	109	0,116	0,01	-0,167	-0.435**	0,04	105
	(0,13)	(0,13)	(0,19)	(0,16)			(0,13)	(0,17)	(0,33)	(0,18)		
SharesPurch	0.285***	0,101	0,173	0,01	0,02	109	0.304***	0,169	0,03	0,014	0,02	105
	(0,11)	(0,10)	(0,14)	(0,15)			(0,10)	(0,12)	(0,16)	(0,15)		
SharesSales	0.253***	0,121	0.238*	-0,015	0,04	109	0.280***	0,148	0,066	-0,019	0,02	105
	(0,10)	(0,08)	(0,13)	(0,11)			(0,09)	(0,11)	(0,18)	(0,13)		
BondsPurch	0.464***	0,048	-0,158	-0.182*	0,03	109	0.468***	-0,048	-0,087	-0.343***	0,03	105
	(0,12)	(0,10)	(0,13)	(0,10)			(0,12)	(0,15)	(0,20)	(0,12)		
BondsSales	0.392***	0,031	-0,152	-0,064	0,01	109	0.395***	-0,054	0,015	-0,076	0	105
	(0,13)	(0,12)	(0,16)	(0,14)			(0,12)	(0,16)	(0,29)	(0,14)		

Note: The sample is 2002:06-2020:01. 'Factors' are raw factors of monetary policy and 'Info Robust Factors' are the factors corrected for the SARB's macroeconomic projections discussed in section 2. Variables in the leftmost column are daily surprises in capital flows. 'NNPtot' 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, 'SharesPurch' is non-residents' purchases of South African shares, 'SharesSales' is non-residents' sales of South African shares, 'BondsPurch' is non-residents' purchases of South African bonds, and 'BondsSales' is non-residents' sales of South African bonds. The surprise units for capital flow variables are z-scores of their real values (GDP deflator index, 2015 = 100 used to express nominal capital flow variables in real terms). Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The factor **F2** moves 1Y, 3Y and 5Y yields consistent with our identification scheme (see section 2) and brings about nominal exchange rate devaluation and reduction of the stock market values, see tables 4 and 5.

4 Dynamic Response to Monetary Policy Shocks

In this section we analyse the effect of monetary policy shocks on real and financial variables in a proxy/IV structural vector autoregression setup[10]. The monetary policy shocks are instrumented with factors F1info, F2info and F3info that, as discussed in section 2, encompass the short-, medium- and long-run implications of the SARB's announcements and are informationally-robust, meaning that the central bank information effect is controlled for. The VAR analysis allows to disentangle channels through which monetary policy shocks are transmitted and to quantify their effects.

The following variables are included in the VAR: the coincident indicator as a measure of aggregate activity, CPI, trade balance-to-GDP ratio, 3M JIBAR interbank rate, 2Y, 5Y and 10Y government bond yields, a stock market JSE All-Share index, a house price index, the volume of bank credit outstanding, the USD/ZAR and EUR/ZAR exchange rates, net non-residents' purchases of South African bonds and shares as a proxy of capital flows, and a measure of sovereign risk premium - EMBI+SA[11]. The sample spans from June 2003 until January 2020.

Monetary policy shock instrumented with **F1info** factor induces the effects that are consistent with responses to a conventional monetary policy shock (see figure 10). The shock is normalized to induce a 100 basis point increase in the 3M JIBAR interbank rate. The shock is contractionary on 2.5 years horizon with the coincident indicator and prices eventually going down by around 1 pp, being subject to a price puzzle upon shock impact. 5Y and 10Y yields go up, but by smaller than the short-term rate does thereby reflecting the level increase along the yield curve[12]. The credit issuance falls by 1.5% and is depressed for 4 years following the shock impact, indicating that the credit channel of monetary policy is operative. This is partly due to a fall of stock market upon a monetary tightening shock that puts downward pressure on collateral values. The trade balance-to-GDP ratio falls significantly upon impact consistent with the increased value of domestic currency detected over 2 days window, with the latter being the result in the event study (see table **??**), but being undetected in VAR impulse responses, possibly, due to the fact, that the exchange rate response is short-lived and is masked by the use of the end-of-month FX values employed[13]. The lasting exchange rate appreciation reaching its peak 2-2.5 years after the shock impact is likely to be induced by stock market recovery starting 6 months after the shock, increasing the demand for domestic financial assets, and therefore, for domestic currency, thus putting upward pressure on its value. The country risk premium and capital flows do not appear to be affected by the shock significantly.

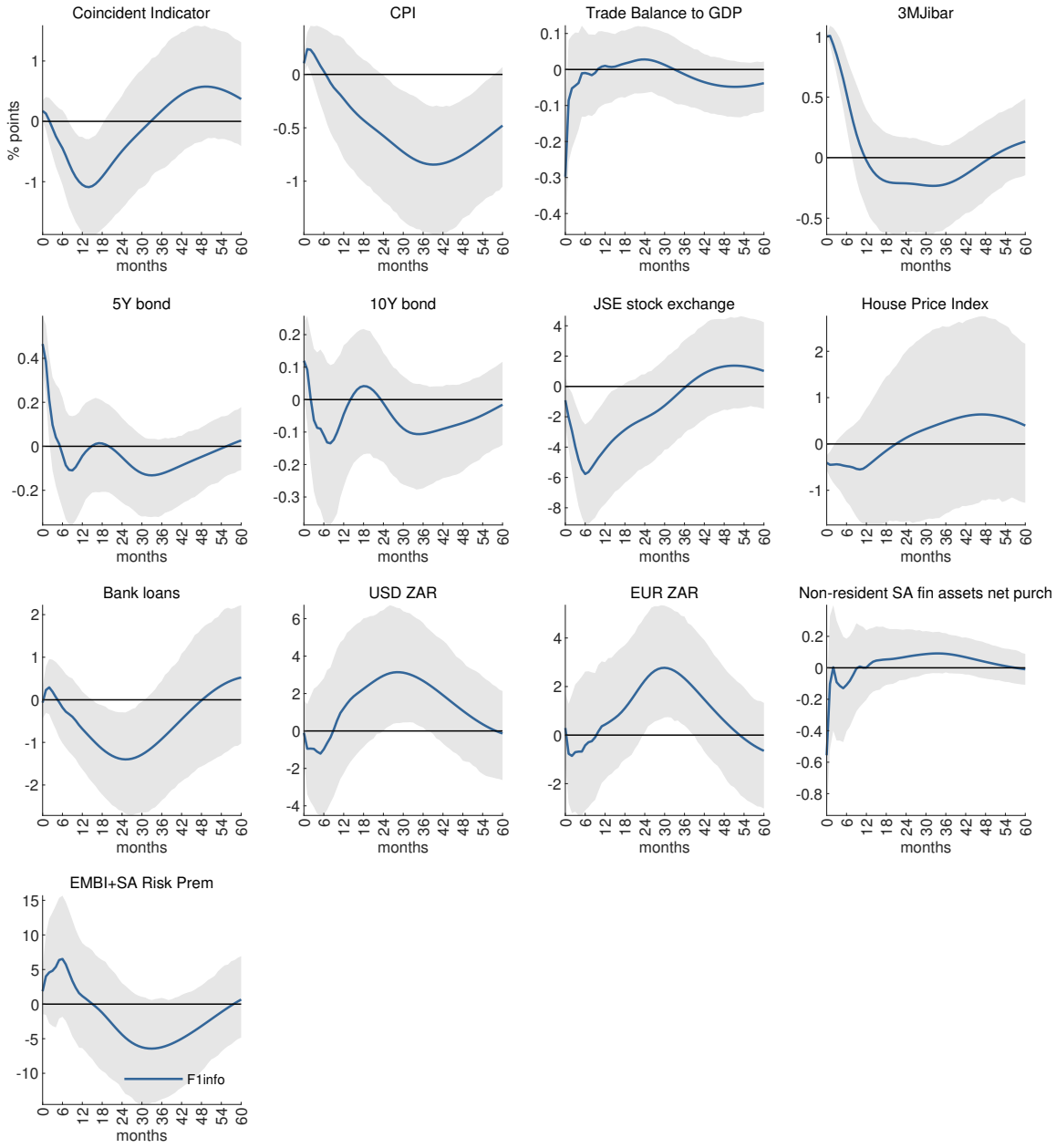
[10]The methodology has been proposed in Stock and Watson (2012) and in Mertens and Ravn (2013).

[11]To calculate the trade balance-to-GDP and net non-residents' purchases of South African bonds and shares to GDP ratios the quarterly nominal GDP levels are interpolated to monthly frequency.

[12]This result is consistent with our event study finding that a change in factor F1 pushes the yields of all maturities in the same direction, see table **??**.

[13]The use of FX monthly average series yields the same insignificant responses of the USD/ZAR and EUR/ZAR nominal exchange rates in a VAR.

FIGURE 6: Responses to monetary policy shock instrumented with factor F1.



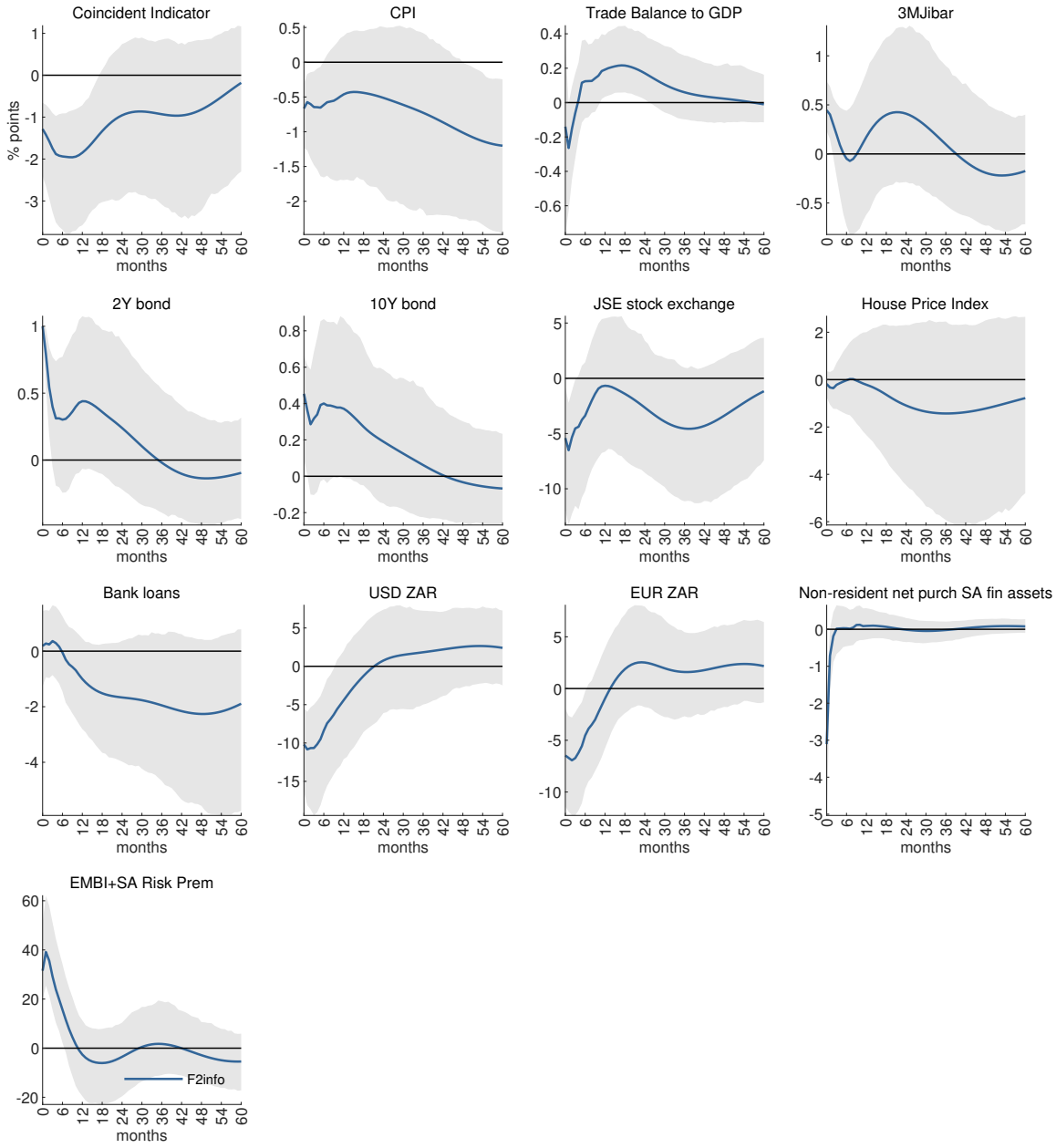
Note. Shock identified with informationally-robust factor F1 (F1info). The shock is normalized to induce a 100 basis point increase in the 3-month JIBAR rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are values of South African rand in US dollars 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.

The monetary shock instrumented with factor **F2info** operates via repricing country risk and capital outflows that induce aggregate demand contraction. The change in monetary conditions instrumented with factor F2info is normalized to induce a 100 basis point increase in the 2Y rate - this maturity is chosen, as factor F2 loads at medium-term maturities by construction and is found to have an effect on medium-term yields in the event study (see table **??**). The transmission channel is notably different from the shock instrumented with the factor F1. The SARB's communication misaligned with the market's expectations induces uncertainty reflected in a noteworthy increase of the country risk premium - it goes up by 40 pp upon the shock impact and stays elevated for 10 months. This is accompanied by reduction of South African financial assets' share in non-residents' portfolios that induces a fall in demand for domestic currency. Correspondingly, the nominal exchange rate value falls by 10 pp for the USD/ZAR and by 7 pp for the EUR/ZAR rate, boosting predominantly dollar-denominated goods' exports, such that trade balance-to-GDP ratio is temporarily on the rise following the shock. Financial assets' sell-off is also reflected in a fall of stock market. The persistent fall in aggregate activity induced by capital outflows reaches 2 pp, accompanied by a persistent fall in prices.

The monetary shock instrumented with factor **F3info** prompting an increase of the yield curve slope acts also via the increase of the sovereign risk premium. The shock is normalized to cause a 100 basis point increase in the 10Y yield and causes capital outflows reflecting non-residents' portfolio reallocation effects. The reduction in demand for domestic financial assets gives rise to currency devaluation, producing a brief boost of the trade balance-to-GDP ratio. The high long-term borrowing costs cause a lasting fall in credit, reinforced by reduction of collateral values due to stock market bust. The financial stress brings about 1 pp contraction of aggregate demand.

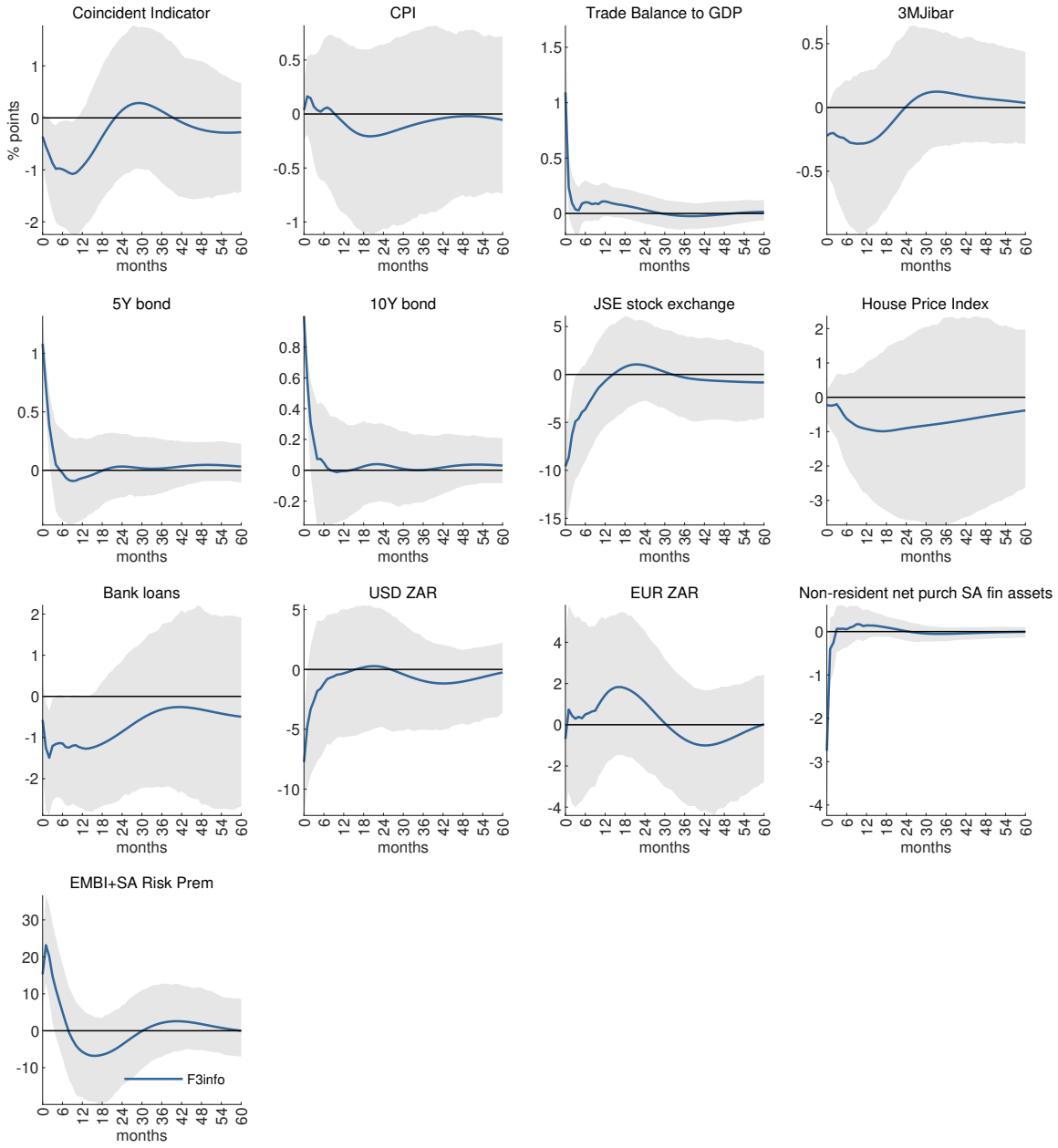
Summarizing the VAR evidence on impulse responses to monetary shocks instrumented with factors F2 and F3, the effect of central bank communication pertaining to medium- and long-run horizons is sizeable and unlike the conventional short-rate tightening, is compatible with a response to risk premia shock. involves activation of the country risk channel inducing capital outflows and domestic currency depreciation.

FIGURE 7: Responses to monetary policy shock identified with factor F2.



Note. Shock identified with informationally-robust factor F2 (F2info). The shock is normalized to induce a 100 basis point increase in the 2Y rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are values of 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.

FIGURE 8: Responses to monetary policy shock identified with factor F3.



Note. Shock identified with informationally-robust factor F3 (F3info). The shock is normalized to induce a 100 basis point increase in the 10Y rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are values of 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.

5 External Effects

In this section we analyse whether the SARB monetary policy factors are influenced by variables originating outside of the domestic economy. Specifically, we seek to find whether global uncertainty, oil supply news shocks, the US and EA monetary policies have a significant effect on how the market responds to the SARB announcements.

To answer that, each of three SARB monetary policy factors and their informationally-robust counterparts are regressed on external variables:

$$Fi_t = \alpha + \sum_{j=1}^{n} \beta^j Fext_t^j, \tag{6}$$

where i stands for a factor's number as assigned in section 2, t is the day of a SARB MPC meeting, $Fext^j$ is an external variable and n is a number of external effects tested in a regression. Separate regressions are used for different groups of external effects to avoid multicollinearity.

For the effects of global uncertainty and oil supply, one external factor is used in regression 6. The mean of daily VIX index values over the period between the $t-1$ and t SARB MPC meetings is used for $Fext$ as a proxy of global uncertainty outlook prevalent on the t SARB MPC meeting[14]. For the oil supply effects, the daily series of the oil supply news shocks from Känzig (2021) is used[15]; the latest value of the oil supply shock prior to a SARB MPC meeting t is used as $Fext_t$ in regression 6. To measure the US and EA monetary policy effects, we use the identified factors available in the literature. In case of the Federal Reserve policy, the Target (or the 'Federal Funds Rate factor'), Forward Guidance (FG) and Large Scale Asset Purchase (LSAP) factors from Swanson (2021) are used in estimating regression 6[16]. For the ECB monetary policy, the Target, Timing, FG and Quantitative Easing (QE) factors from Altavilla et al. (2019) are employed. The latest values of the US and the EA monetary factors prior to a SARB MPC meeting t are used as $Fext_t^j$ in the regression 6 specification. The sample is determined by availability of external variables' availability - it is 2002M6-2019M6 for the US monetary factors, and 2002M6-2020M1 for the other external effects. As the global financial crisis marks a significant change in the state of international finance and how central banks operate globally, the external effects are analysed at two sub-samples: pre- and post-2008[17].

Results are reported in tables 7-10. Importantly, they suggest that the US and EA

[14]The last value used for the mean of VIX index calculation is the closing (end-of-day) value on a day previous to the MPC meeting t. This is based on the fact that the end of day VIX value on the MPC meeting day t is not yet available to MPC members on day t, given that the meeting happens before the closing time of the CBOE where the VIX index is traded.

[15]The oil supply news shocks in Känzig (2021) are identified using high-frequency data and the OPEC institutional features.

[16]The negative value of the LSAP factor series is used to make its effect consistent in interpretation with the Target and the FG factors.

[17]Results for the external effects' regressions on the full sample are reported in the Appendix.

TABLE 7: The effect of the Federal Reserve policies on monetary policy factors.

	pre-2008						post-2008					
	F1	F2	F3	F1info	F2info	F3info	F1	F2	F3	F1info	F2info	F3info
Target Fed	-0.383**	0.131	-0.057	-0.940**	-0.398***	0.380**	0.630**	-0.492	0.242	0.547	-0.247	-0.078
	(0.17)	(0.29)	(0.20)	(0.35)	(0.09)	(0.16)	(0.31)	(0.53)	(0.42)	(0.36)	(0.32)	(0.16)
FG Fed	0.025	-0.042	-0.007	0.029	-0.033	-0.068	0.004	0.1	0.08	-0.024	0.082	0.128
	(0.22)	(0.07)	(0.10)	(0.16)	(0.04)	(0.05)	(0.11)	(0.09)	(0.21)	(0.10)	(0.06)	(0.12)
QE Fed	0.268	-0.239	-0.074	-0.631	-0.809***	0.316	0.056	-0.042	-0.018	0.059	-0.057	0.01
	(0.65)	(0.27)	(0.26)	(0.90)	(0.22)	(0.35)	(0.08)	(0.05)	(0.14)	(0.09)	(0.04)	(0.09)
Constant	0.018	-0.086	-0.016	-0.019	-0.015	-0.049	-0.05	0.07	-0.01	0.021	0.053	0.004
	(0.21)	(0.11)	(0.16)	(0.14)	(0.10)	(0.11)	(0.09)	(0.10)	(0.12)	(0.10)	(0.06)	(0.08)
Rsq	0.037	0.058	0.003	0.163	0.316	0.152	0.073	0.092	0.011	0.061	0.055	0.026
N Obs	33	33	33	29	29	29	72	72	72	72	72	72

Note. Regressions are run at MPC frequency. The sample is 2002M6-2019M6. The Federal Reserve monetary policy factors are from Swanson (2021), the SARB monetary policy factors' construction is discussed in section 2. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

monetary policy, global uncertainty and oil supply increase misalignment of Bank actions and communication with external environment as viewed by the market.

Prior to 2008 the effect of the Federal Reserve Target factor on South African monetary policy factors F1 and F2 is negative. This implies that when the Fed unexpectedly tightens its short-term interest rate, the market is surprised on the downside about the SARB's policy rate decision and about its communication pertaining to the medium-term horizon outlook. Put it differently, the market expected stronger SARB response to unanticipated Federal Reserve federal funds rate increases pre-2008. Interestingly, the effect of the Fed Target on F1 post-2008 changes - changes in the Fed Target are associated with the SARB's interest rate decisions being stronger than the market expects.

The positive effect of the Fed Target on F3info prior to 2008 implies that the market is surprised about the SARB communication resulting in the upward shift of the yield curve long end following the unexpected tightening of the short-term stance in the US. One could think of communication inducing a surprise increase in the long-term rates as being distressing for the market or inducing uncertainty about the domestic economic outlook.

TABLE 8: The effect of the ECB policies on monetary policy factors.

	pre-2008						post-2008					
	F1	F2	F3	F1info	F2info	F3info	F1	F2	F3	F1info	F2info	F3info
Target ECB	0.393	0.044	0.269	0.262	0.435**	0.083	0.261*	-0.135	-0.058	0.178	-0.154**	-0.082
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Timing ECB	0.009	0.021	0.02	-0.013	-0.029	0.037	-0.059	-0.111***	0.045	-0.054	-0.077***	0.04
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FG ECB	-0.009	0.019	-0.022	-0.035	0.012	-0.028	0.013	0.039*	-0.016	0.013	0.031**	-0.049*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
QE ECB	-0.019	0.211	0.126	-0.012	0.128	0.153	-0.033	0.004	0	-0.055	-0.018	-0.019
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.01	-0.032	-0.008	-0.136	-0.033	0.027	0.028	0.046	0.001	0.064	0.039	-0.02
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Rsq	0.024	0.185	0.046	0.01	0.312	0.051	0.11	0.254	0.018	0.091	0.269	0.083
N Obs	33	33	33	29	29	29	75	75	75	75	75	75

Note. Regressions are run at MPC frequency. The sample is 2002M6-2020M1. The ECB monetary policy factors are from Altavilla et al. (2019), the SARB monetary policy factors' construction is discussed in section 2. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The role of the ECB Target factor post-2008 for the domestic monetary policy factor F1 is similar to that of the Fed Target over the same period - the ECB Target shifts are associated with the SARB's repo rate decisions being stronger than the market anticipates. The SARB's communication factor F2 is affected by both the Timing and the FG dimensions of the ECB policy, see table 8.

TABLE 9: The effect of oil supply shocks on monetary policy factors.

	pre-2008						post-2008					
	F1	F2	F3	F1info	F2info	F3info	F1	F2	F3	F1info	F2info	F3info
Oil	-0.214	0.006	0.150*	-0.176	0.033	0.02	-0.015	-0.004	0.004	-0.014	-0.003	-0.015
	(0.13)	(0.06)	(0.08)	(0.11)	(0.04)	(0.05)	(0.02)	(0.02)	(0.04)	(0.03)	(0.01)	(0.02)
Constant	0.007	-0.094	-0.02	-0.148	-0.095	-0.009	-0.009	0.04	0.011	0.048	0.044	-0.011
	(0.21)	(0.10)	(0.15)	(0.19)	(0.09)	(0.10)	(0.08)	(0.07)	(0.11)	(0.08)	(0.05)	(0.08)
Rsq	0.056	0	0.062	0.068	0.012	0.003	0.004	0	0	0.003	0	0.005
N Obs	33	33	33	29	29	29	76	76	76	76	76	76

Note. Regressions are run at MPC frequency. The sample is 2002M6-2020M1. The oil supply news shock series is from Känzig (2021), the SARB monetary policy factors' construction is discussed in section 2. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The oil supply shocks associated with the increase in the oil price expectations are consequential for domestic monetary policy only prior to 2008, see table 9. Unexpected oil price hikes induce the upward shift of the domestic yield curve long end in response to the SARB's announcements. The global uncertainty, instead, shapes the domestic monetary policy factors only post-2008. The SARB's policy rate decisions are weaker than expected by the market in high uncertainty environment after the GFC, while the communication is not as reassuring as market anticipates - this is reflected in the positive surprise shifts of the long end of the yield curve, when global uncertainty is high (see the negative coefficient of the VIX on F1 and a positive one on F3info in the table 10.)

TABLE 10: The effect of global uncertainty on monetary policy factors.

	pre-2008						post-2008					
	F1	F2	F3	F1info	F2info	F3info	F1	F2	F3	F1info	F2info	F3info
VIX	0.029	-0.022	-0.004	0.003	-0.018	-0.047	-0.013*	0.013	0.021	-0.009	-0.003	0.014*
	(0.03)	(0.02)	(0.02)	(0.06)	(0.02)	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Constant	-0.486	0.284	0.038	-0.187	0.181	0.708	0.251	-0.225	-0.415	0.235	0.111	-0.279
	(0.57)	(0.25)	(0.39)	(0.85)	(0.36)	(0.57)	(0.16)	(0.18)	(0.31)	(0.20)	(0.14)	(0.20)
Rsq	0.017	0.056	0.001	0	0.019	0.095	0.022	0.042	0.046	0.013	0.004	0.034
N Obs	33	33	33	29	29	29	76	76	76	76	76	76

Note. Regressions are run at MPC frequency. The sample is 2002M6-2020M1. The VIX index series is the mean of daily VIX index values over the period between the SARB MPC meetings, the SARB monetary policy factors' construction is discussed in section 2. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

6 Conclusion

In this paper we have presented a comprehensive analysis of monetary policy in South Africa.

The results show that monetary policy in emerging markets is characterized by a difficult balance between short run objectives and long run stability.

In the short run, the traditional interest rate channel of monetary policy is fully effective in ways no different from what we find in developed countries. But monetary policy decisions give the private sector information about monetary policy preferences and their consistency with long run stability. This long run stability channel operates through variations in the country risk premium.

This main result gives a contribution in clarifying the role of global shocks in determining local monetary policy: while monetary policy targets internal objectives, its operation is constrained by the need to minimize the effect of the policy on the risk premium, a channel that can be as strong as the interest rate channel in determining the effect of monetary policy.

In this context, monetary policy communication should be focused on monetary policy preferences and its reaction function to external shocks and it should clarify the consistency between monetary policy reaction to external shocks and the long term macroeconomic stability.

7 Appendix

7.1 The FRA rates' transformation

The following formula is used for the FRA rates' conversion to swap rates:

$$S_t^{t_n} = \left(\left[\prod_{i=2}^{n} \left(1 + \frac{J_t^{t_1}}{400}\right) \left(1 + \frac{F_t^{t_{i-1},t_i}}{400}\right) \right]^{1/n} - 1 \right) 400, \tag{7}$$

where t_n is a term of swap rate, $J_t^{t_1}$ is a JIBAR rate of maturity t_1, $F_t^{t_{i-1},t_i}$ is a FRA rate with tenor t_{i-1}/t_i, and n is the number of rate components in 7. To illustrate, for conversion of the FRA rate of the 1x4 tenor to 4M swap rate, the 1M Jibar is used:

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

then starting from FRA3x6 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.

7.2 Factor loadings based on alternative specification of market surprises

To verify the consistency of monetary policy factors extracted using our identification scheme, we perform the following exercise. Given a relatively lower degree of liquidity of some FRA contracts, we allow additional time for market values of reflect the effect of monetary policy announcements, and thereby, extract an alternative set of factors using the same identification scheme. Specifically, we use 2-days window surprises for interest rate instruments in our dataset. The resulting factor loadings are shown in figure **??**.

7.3 Event study - market surprises based on 2-days window

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TABLE 11: The effect of monetary policy factors on surprises in yields

	Factors						Info Robust Factors					
	Constant	F1	F2	F3	Rsq	N Obs	Constant	F1info	F2info	F3info	Rsq	N Obs
Overnight	-0,04	0.202***	-0,049	-0,043	0,39	81	-0,049	0.143***	0,064	-0,045	0,21	81
	(0,04)	(0,04)	(0,05)	(0,04)			(0,04)	(0,05)	(0,08)	(0,03)		
1M Jibar	-0.036**	0.218***	-0,014	-0.030**	0,78	109	-0.044***	0.215***	0,05	-0,015	0,58	105
	(0,02)	(0,02)	(0,03)	(0,01)			(0,02)	(0,03)	(0,05)	(0,02)		
3M Jibar	-0.027***	0.205***	0,012	-0.010*	0,94	109	-0.034***	0.206***	0,032	-0,004	0,71	105
	(0,01)	(0,01)	(0,02)	(0,01)			(0,01)	(0,02)	(0,03)	(0,02)		
3M Tbill	-0.056***	0.188***	-0.047*	0,014	0,63	76	-0.066***	0.141***	-0,011	-0,023	0,36	76
	(0,01)	(0,02)	(0,03)	(0,01)			(0,02)	(0,03)	(0,04)	(0,02)		
1Y bond	0,003	0.076***	0,032	0.085***	0,54	83	0,003	0.058**	0,019	0.055***	0,19	83
	(0,01)	(0,02)	(0,02)	(0,02)			(0,01)	(0,02)	(0,03)	(0,02)		
2Y bond	-0,001	0.097***	0,054	0.108***	0,76	70	0	0.099***	0,053	0.126***	0,43	69
	(0,01)	(0,01)	(0,03)	(0,02)			(0,02)	(0,02)	(0,07)	(0,03)		
3Y bond	0,026	0.092***	0,053	0.146***	0,44	79	0,029	0.111***	0.103*	0.185**	0,33	75
	(0,02)	(0,01)	(0,04)	(0,04)			(0,03)	(0,03)	(0,06)	(0,07)		
5Y bond	0,003	0.070***	0.073***	0.102***	0,73	92	-0,006	0.071***	0.072**	0.091***	0,38	88
	(0,01)	(0,01)	(0,02)	(0,02)			(0,01)	(0,02)	(0,03)	(0,02)		
10Y bond	-0,004	0,022	0,022	0.088***	0,46	109	-0,004	0,027	0.041**	0.085***	0,23	105
	(0,01)	(0,01)	(0,02)	(0,02)			(0,01)	(0,02)	(0,02)	(0,02)		
20Y bond	-0,013	-0,002	0,025	0.085***	0,39	105	-0,014	-0,001	0.052*	0.077***	0,18	101
	(0,01)	(0,02)	(0,02)	(0,02)			(0,01)	(0,02)	(0,03)	(0,02)		
30Y bond	-0,026	-0,013	0,052	0.092***	0,23	103	-0,027	-0,021	0,087	0.072***	0,11	99
	(0,02)	(0,02)	(0,04)	(0,02)			(0,02)	(0,03)	(0,05)	(0,03)		
5Y5Y forward	-0,009	-0.058**	0,015	0.075***	0,29	109	-0,006	-0.055*	0,049	0.069**	0,18	105
	(0,01)	(0,02)	(0,02)	(0,02)			(0,02)	(0,03)	(0,04)	(0,03)		

Note: The sample is 2002:06-2020:01. 'Factors' are raw factors of monetary policy and 'Info Robust Factors' are the factors corrected for the SARB's macroeconomic projections discussed in section 2. Variables in the leftmost column are 2-days window surprises in yields. '1M Jibar' and '3M Jibar' are Jibar/interbank rates at 1M and 3M maturity, respectively. '1Y bond', '2Y bond', '3Y bond', '5Y bond', '10Y bond', '20Y bond' and '30Y bond' are respective constant maturities yields of government bonds as quoted on Bloomberg. The surprise units for yields are percentage points. Robust standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

TABLE 12: The effect of monetary policy factors on surprises in asset prices

	Factors						Info Robust Factors					
	Constant	F1	F2	F3	Rsq	N Obs	Constant	F1info	F2info	F3info	Rsq	N Obs
JSE All shares	0,039	-0.528***	-0,387	-0.356*	0,17	109	0,08	-0.528***	-0.627**	-0.545**	0,15	105
	(0,14)	(0,15)	(0,24)	(0,21)			(0,14)	(0,18)	(0,30)	(0,26)		
USD/ZAR	0,117	0.357*	-0,477	0,015	0,09	109	0,161	0.381**	-0.784**	0,204	0,12	105
	(0,14)	(0,19)	(0,29)	(0,21)			(0,13)	(0,18)	(0,34)	(0,29)		
EUR/ZAR	0,093	0.398**	-0.482**	0,086	0,1	109	0,137	0.359*	-0.669**	0,409	0,12	105
	(0,14)	(0,19)	(0,24)	(0,21)			(0,14)	(0,20)	(0,26)	(0,28)		
EMBI+SA	0,701	-1,274	4,369	2.739*	0,09	103	0,373	-1,569	4,566	6.217**	0,13	100
	(1,16)	(1,15)	(4,35)	(1,63)			(1,17)	(1,40)	(4,56)	(2,76)		

Note: The sample is 2002:06-2020:01. 'Factors' are raw factors of monetary policy and 'Info Robust Factors' are the factors corrected for the SARB's macroeconomic projections discussed in section 2. Variables in the leftmost column are 2-days window surprises in asset prices. The surprise units for JSE All shares index and USD/ZAR and EUR/ZAR exchange rate are percent changes. The surprise units for EMBI+SA index are basis points. USD/ZAR and EUR/ZAR exchange rates are ZAR prices in USD and EUR, respectively, so the exchange rate increase is ZAR appreciation. Robust standard errors in parentheses, $*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

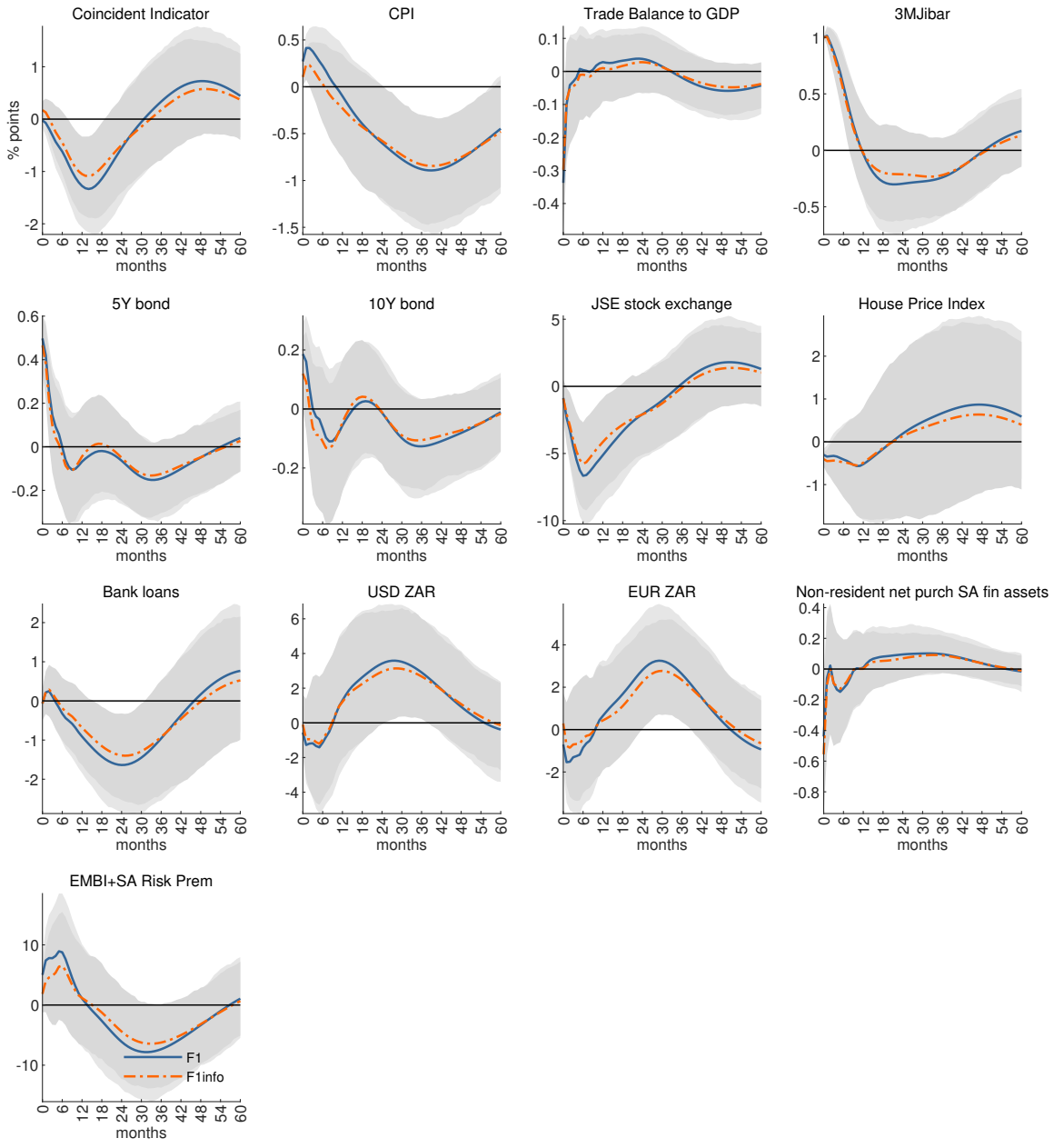
TABLE 13: The effect of monetary policy factors on surprises in capital flows

	Factors						Info Robust Factors					
	Constant	F1	F2	F3	Rsq	N Obs	Constant	F1info	F2info	F3info	Rsq	N Obs
NNPtot	0,104	0	-0,071	-0,14	0,01	109	0,098	0,015	-0,171	-0.337**	0,03	105
	(0,13)	(0,12)	(0,16)	(0,15)			(0,13)	(0,15)	(0,27)	(0,17)		
NNPshares	0,018	-0,044	-0,125	0,039	0,01	109	0,002	0,014	-0,062	0,051	0	105
	(0,10)	(0,08)	(0,19)	(0,12)			(0,10)	(0,09)	(0,24)	(0,15)		
NNPbonds	0,114	0,026	-0,009	-0,191	0,02	109	0,116	0,01	-0,167	-0.435**	0,04	105
	(0,13)	(0,13)	(0,19)	(0,16)			(0,13)	(0,17)	(0,33)	(0,18)		
SharesPurch	0.285***	0,101	0,173	0,01	0,02	109	0.304***	0,169	0,03	0,014	0,02	105
	(0,11)	(0,10)	(0,14)	(0,15)			(0,10)	(0,12)	(0,16)	(0,15)		
SharesSales	0.253***	0,121	0.238*	-0,015	0,04	109	0.280***	0,148	0,066	-0,019	0,02	105
	(0,10)	(0,08)	(0,13)	(0,11)			(0,09)	(0,11)	(0,18)	(0,13)		
BondsPurch	0.464***	0,048	-0,158	-0.182*	0,03	109	0.468***	-0,048	-0,087	-0.343***	0,03	105
	(0,12)	(0,10)	(0,13)	(0,10)			(0,12)	(0,15)	(0,20)	(0,12)		
BondsSales	0.392***	0,031	-0,152	-0,064	0,01	109	0.395***	-0,054	0,015	-0,076	0	105
	(0,13)	(0,12)	(0,16)	(0,14)			(0,12)	(0,16)	(0,29)	(0,14)		

Note: The sample is 2002:06-2020:01. 'Factors' are raw factors of monetary policy and 'Info Robust Factors' are the factors corrected for the SARB's macroeconomic projections discussed in section 2. Variables in the leftmost column are 2-days window surprises in capital flows. 'NNPtot' 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, 'SharesPurch' is non-residents' purchases of South African shares, 'SharesSales' is non-residents' sales of South African shares, 'BondsPurch' is non-residents' purchases of South African bonds, and 'BondsSales' is non-residents' sales of South African bonds. The surprise units for capital flow variables are z-scores of their real values (GDP deflator index, 2015 = 100 used to express nominal capital flow variables in real terms). Robust standard errors in parentheses, $*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

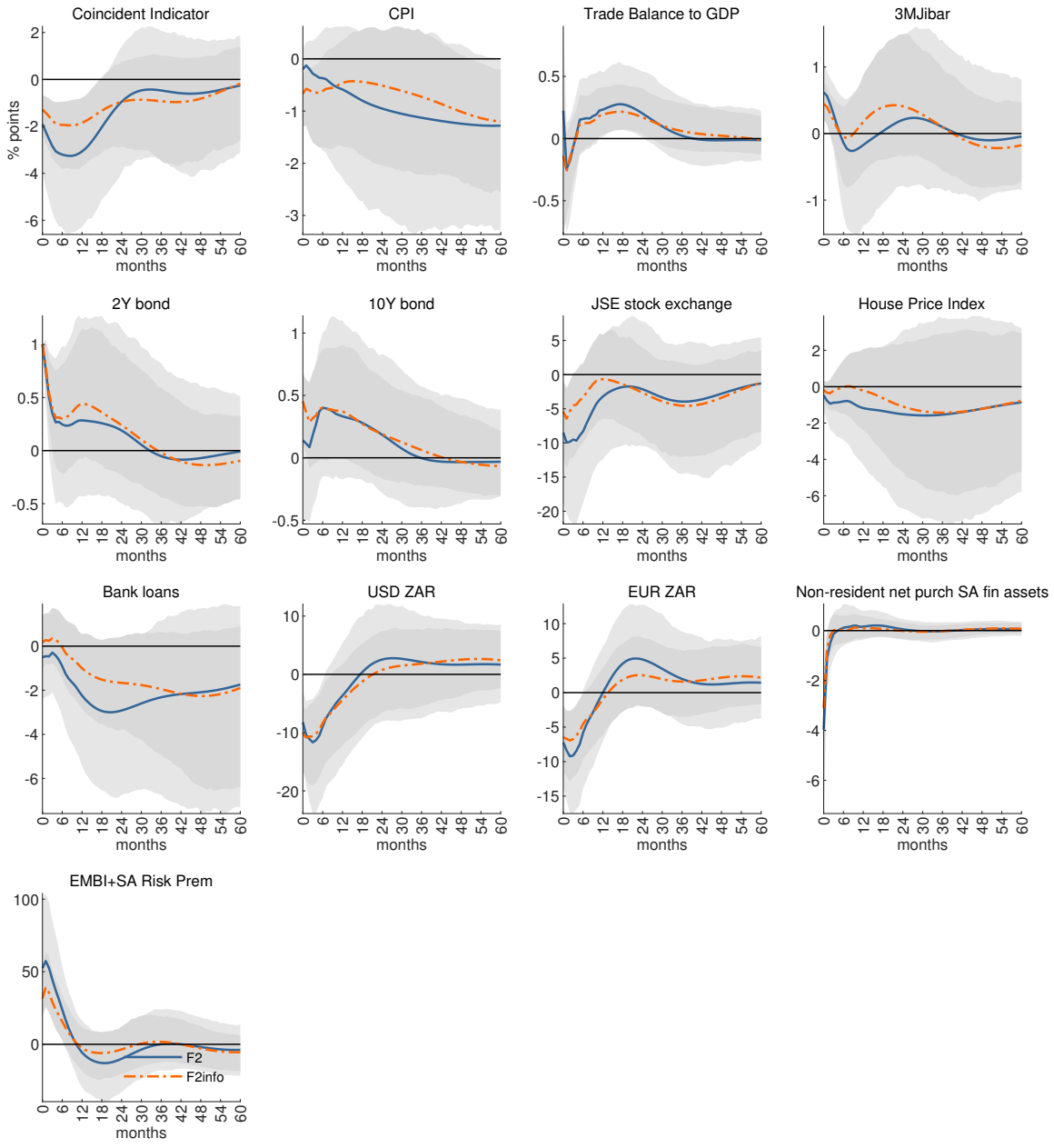
7.4 VAR impulse responses instrumenting monetary policy shock with raw and informationally-robust factors

FIGURE 10: Responses to monetary policy shock instrumented with factor F1 and F1info.



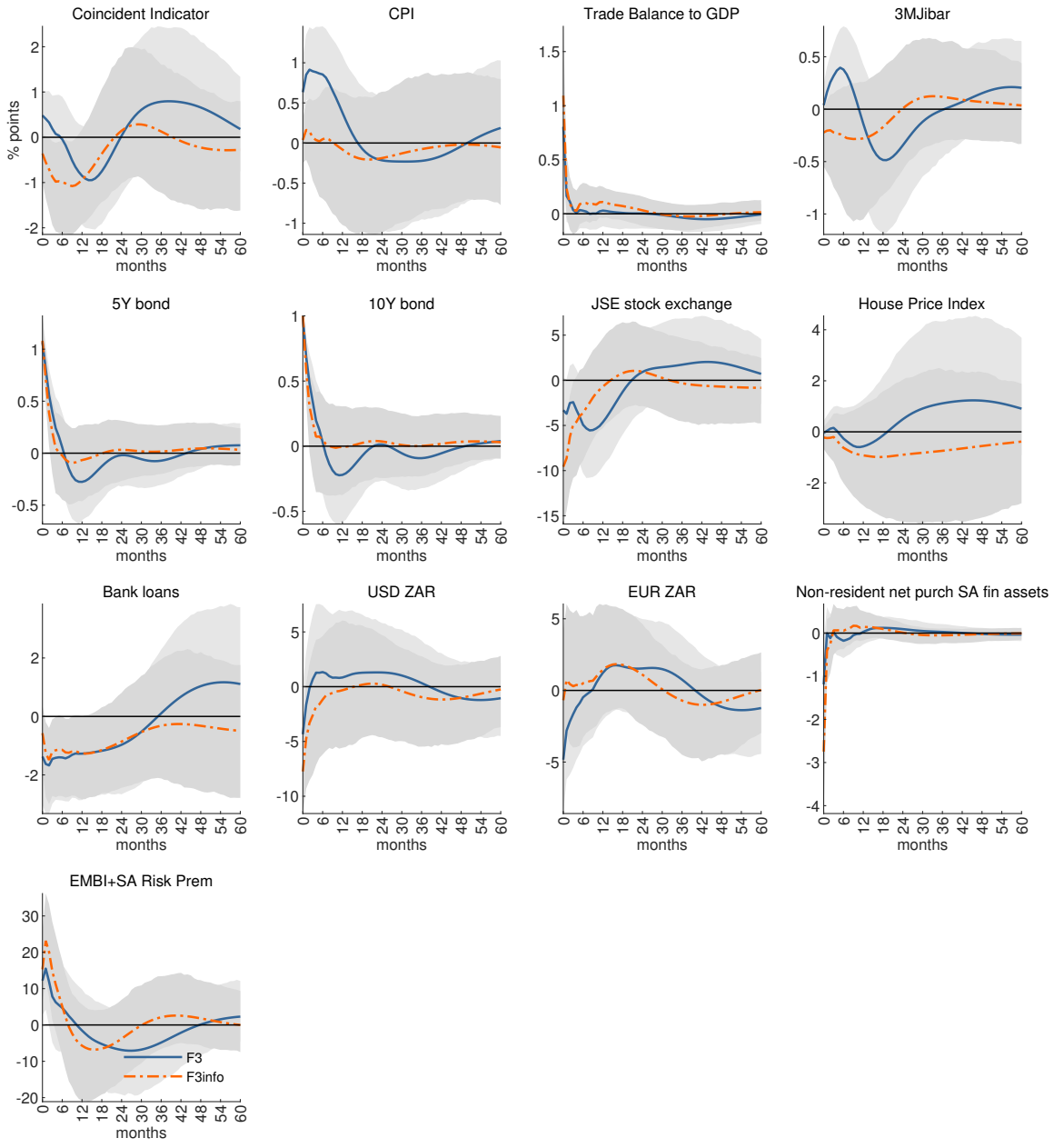
Note. Shock identified with a raw and informationally-robust factor F1 - F1 and F1info respectively. The shock is normalized to induce a 100 basis point increase in the 3-month JIBAR rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are values of South 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.

FIGURE 11: Responses to monetary policy shock identified with factor F2 and F2info.



Note. Shock identified with a raw and informationally-robust factor F2 - F2 and F2info, respectively. The shock is normalized to induce a 100 basis point increase in the 2Y rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are values of 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.

FIGURE 12: Responses to monetary policy shock identified with factor F3 and F3info.



Note. Shock identified with a raw and informationally-robust factor F3 - F3 and F3info, respectively. The shock is normalized to induce a 100 basis point increase in the 10Y rate. Sample 2003:06-2020:01. Shaded areas are 90% posterior coverage bands. 'USD ZAR' and 'EUR ZAR' are values of 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.

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