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The Transmission of Monetary Policy via the Banks' Balance Sheet - Does Bank Size Matter?

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The transmission of monetary policy via the banks' balance sheet - does bank size matter?

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Abstract

We study the credit channel of monetary policy in South Africa between 2002 and 2019 using banks' balance sheets. We show that there is a significant heterogeneity within the banking sector in both the loan and deposit sides of the banks' balance sheets. In response to a contractionary monetary policy shock, big banks adjust their loan portfolio by lending to businesses and reducing lending to households whereas for small banks we find the opposite. The increase in corporate lending amid declining inventories is consistent with the hypothesis of “hedging and safeguarding the capital adequacy ratio” rather than funding business inventories. This paper highlights the importance of heterogeneity in customers, market power and business models in the banking sector, which characterises the socio-demographics dynamics in South Africa.

JEL Codes: E32, E52, G21

Keywords: Credit channel, banks balance sheets, monetary policy

1 Introduction

The effects of the 2008/9 global financial crisis on the lending activities of banks and the subsequent monetary policy actions by central banks have re-ignited interest in the role of banks in transmitting shocks to the real economy. This role, defined as the credit channel, postulates that monetary policy can affect credit either via the borrowers balance sheets or banks loan supply. As Bernanke and Gertler (1995) emphasize, the credit channel does not operate in isolation but rather amplifies the normal interest rate channel.

In this paper, we re-explore the broad credit channel using South African banks balance sheet data to identify its existence in South Africa, and, more importantly, to analyse how the credit channel operates in a large and heterogeneous banking sector.

In 2011, according to the IMF (2011) report, the financial sector in South Africa was almost three times the size of the economy, with assets of the banking industry being a little over 100% of gross domestic products. Moreover, the banking industry is both highly concentrated and interconnected, with four major banks holding 35% of assets in life insurance and 65% of assets under management. Therefore, high credit impairments to the banks' balance sheets has the potential to trigger a systemic risk to the economy.

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On the other hand, small banks do not have systemic importance but are very significant in the socio-economic fabric of the South African society. By serving mainly the lower strata of the income distribution they are playing an important role in expanding financial access throughout the population. It is also the most unstable part of the banking system, with some banks suffering liquidity problems and liquidation from the advent of 1994 democracy. According to Hawkins (2004), the dawn of democracy in South Africa highlighted the “lack of financial provision to the majority of South Africans”. While the first democratic decade saw an increase in the number of banks, this was quickly reversed when 22 banks exited the South African banking sector between the end of 1999 and the early 2003, Mboweni (2004). According to Mboweni (2004), this episode was part of consolidation in the industry rather than a failure of small and medium banks. African bank, one of the small banks in our sample, was also part of the small banks that experienced liquidity problems during that period. Ten years later, the same bank, together with VBS bank faced bank failures.¹

Underpinning the credit channel is the assumption that information asymmetry between bank lenders and borrowers creates a wedge between the cost borrowers incur in raising external or non-bank credit compared to internal or bank credit, Bernanke and Gertler (1989, 1995). The external finance premium is affected by the financial health (balance sheet) of both lenders and borrowers, Bernanke (2018). For household and non-financial firm, adverse effect to their balance sheets affect their savings/spending and investment/employment decisions respectively. Similarly, any effect on the lenders’ balance sheets will also affect their external finance premium. And depending on the lenders dependence on market-based funding, this can affect their lending decision. At the aggregate level the external finance premium can amplify the effect of monetary policy on the economy.²

Kashyap and Stein (1995, 2000) argue that just like bank-dependent borrowers or small firms, small banks are also subject to credit market imperfections. Following their argument, the main assumption underpinning our empirical questions is that small banks in South Africa face credit market imperfections relative to the big banks, thus potentially amplifying financial instability at the lower end of the bank (and income) distribution. During the sample period of January 2002 to September 2019, small banks depend more on non-deposit funding whereas the big banks have maintained deposits to liabilities ratio of almost 80% over the same period. Therefore, it is plausible to assume that small banks face higher cost of raising non-deposit finance either by spending more on advertising costs or paying higher rates to constantly attract investors.

Empirical research for the bank lending channel in South Africa has focused on aggregate credit data. For example, Mishi and Tsegaye (2012) and Sichei (2005) find that the bank specific characteristic (bank size) is positive and significant, indicating that smaller banks respond strongly to a contractionary monetary policy shock than big banks. However, their aggregation of loans hides the heterogeneity highlighted by Gertler and Gilchrist (1993) and Den Haan et al. (2007), who find that a contractionary monetary policy shock increases non-financial corporate loans while consumer and real estate loans decrease. For non-financial corporate loans, we only analyse the credit channel with respect to overdrafts, loans and advances. However, Ivashina et al. (2020) show that the bank-lending channel varies by different corporate loan types for Spain and Peru, thus highlighting the importance of disaggregation loans.

Gumata et al. (2013) have analysed the bank lending channel using disaggregated quarterly banks data for the whole South Africa banking sector, separating real estate and business loans. Using a large Bayesian vector autoregression (LBVAR) model for the period 2001Q1 to 2012Q2, the authors find that the lending channel is the third most important channel in the overall ranking of the five channels, and the strongest of the credit channel. Even though these results are supportive of the lending channel,

¹See Myburgh (2016) and Motau (2018) reports for more details.

²See Bernanke (2018) and Gertler and Gilchrist (2018) for recent review of empirical work on external finance premium and the role of balance sheets in propagating shocks to the real economy before and after the 2008/9 global financial crisis.

analysing the data at an aggregate bank level hides some of the differences in the way monetary policy shock is transmitted to different economic agents due to bank characteristics. This means that the results of the paper might be driven by the big banks and not necessarily reflect the response for the small banks, given the market share of the big banks. It is these two aggregation issues that we are attempting to address in this paper. Pirozhkova and Vieg (2020) instead study the transmission of monetary policy to credit conditions by employing monthly data on household mortgages issued by banks and non-banks financial institutions. They find that the bank credit lending channel is operative, but, as in the study of Gumata et al. (2013), they don't distinguish between big and small banks.

The main loan categories used in the literature are commercial and industrial (C&I), real estate, and consumer loans. The disaggregation of loan data into these categories has two advantages. The first advantage is that these loans represents two different sectors, namely the household and the corporate sector, providing insight into how monetary policy actions affect these two sectors. The second advantage is that the maturity of the loans differs. Household and C&I loans tend to be more short- to medium-term with high returns for banks while real estate loans are long-term and considered low risk-return assets since they are mostly collateralised, Den Haan et al. (2007). Therefore, we can gain more insight into the banks risk-return behaviour.

We utilise the Bayesian structural vector autoregression (B-SVAR) to answer our empirical questions. Specifically, we test for the credit channel at both the aggregated and the disaggregated bank levels. Our sample period of January 2002 to September 2019 falls under the current inflation targeting regime by the South African central bank. We find that heterogeneity does exist within the banking sector in both the loan and deposit sides of the bank balance sheet. The impulse response functions indicate that following a contractionary monetary policy shock, big banks adjust their loan portfolio by lending more to businesses and less to the household sector whereas for the small banks, we find the opposite. The increase in corporate lending amid declining inventories is consistent with the hypothesis of "hedging and safeguarding the capital adequacy ratio" rather than funding business inventories. Contrary to the monetary transmission literature, total deposits for the big banks increase, driven by short-term deposits. We argue that the difference in balance sheet responses is due to the two banks operating in different markets, and it is in these markets that they choose to adjust their risk-return behaviour. The behaviour of the small banks mimic that of retailers, extending credit to consumers during difficult financial times to smooth their consumption by passing on higher interest rates to consumers through higher risk premium, thereby temporarily increasing their income. While these small banks might not be systematically important, their importance in filling in the gap in the low-income market and contributing towards financial inclusion makes them socially important. Therefore it is important for policy makers to consider the heterogeneity within the banking sector in achieving their monetary policy and financial stability objectives.

The remainder of the paper is organised as follows. In section 2, we review the relevant literature. Section 3 discusses the methodology and data used in the paper. Section 4 documents the results. The last section concludes.

2 Related Literature

Our paper is related to the literature that looks at the role of banks in the transmission of monetary policy shocks. Specifically, we look at the literature that focuses on cross-sectional differences of monetary policy within the banking sector. We focus on the empirical challenge of the credit channel (especially the bank lending channel) and evolution of the theoretical frameworks.

The empirical challenge of proving the lending-channel induced cross-section difference across banks

can be summarised as a two-stage process. The first stage of the test is to prove the lending channel. The second stage of the test is to prove that the effects are heterogeneous among banks. Each stage requires its own identification in order to discriminate against other competing theories that can produce similar results.

In the first stage, there must be evidence that a tight monetary policy results in loan supply effects. The loan supply curve must shift inward instead of the loan demand curve (in the extreme case of loan demand inelasticity). Alternatively, the net effects at the new loan market equilibrium must result from the loan supply effects, i.e. the loan supply curve must shift inward more than the loan demand curve. These are the arguments of Bernanke and Blinder (1988)’s paper.

In an attempt to address the challenge of disentangling the amplifying effect of credit demand and supply, some authors use granular data. Jiménez et al. (2012) use a combination of the loan level data available through the credit register and the banks balance sheet data for Spain. They find that both contractionary monetary policy and low economic growth reduces loan granting to firms especially for weaker banks with low capital and liquidity. Using bank lending and loan survey data, Ciccarelli et al. (2015) find that all credit channels are operative in the Euro area whereas only the balance sheet channel is significant in the US.

For the second stage, there must be evidence that the effects of the lending channel depend on the characteristics of the bank. Initial study by Kashyap and Stein (1995) focused on bank size and later added other bank characteristics to reflect banks balance sheet strength, such as capital (Kishan and Opiela (2000)) and liquidity (Kashyap and Stein (2000))³. Gambacorta (2005) finds that heterogeneity in the banking sector exists in terms of liquidity and capitalisation for Italy while bank size does not play a significant role due to the close relationship between small banks and their customers. Even though the paper stresses that bank size is not important, the estimated coefficients of the effect of monetary policy are larger for small banks than for the big banks. Furthermore, Gambacorta (2005), and Aysun (2016), also find that the existence of internal capital markets for the small banks from their parent companies help insulate them from monetary-policy shocks. In the case of Aysun (2016), the author finds that subsidiaries of big parent companies in the US are more sensitive to both the supply and demand effects, with the demand effect being more important - therefore borrower balance sheets matter more than the banks balance sheets. Another differentiating factor discussed in Bernanke (2018) paper following the 2008/9 global crisis is exposure to mortgage loans by banks. The literature discussed in this paper finds that banks that were more exposed to mortgage losses either reduced their non-mortgage lending or increased their lending spreads as their capital was eroded by these losses.

Some authors have challenged the theoretical framework of the bank lending channel and propose new channels that affect loan supply either via new or existing lending. Disyatat (2011) argue that the theoretical framework on bank lending should “de-emphasize” the role of deposits in constraining the supply of loans. According to the author, loans create deposits and not the opposite. With this view, and in light of the availability and reliance on external funding for banks, instead of focusing on deposits, the literature should focus on the effect of monetary policy on the sensitivity of banks to market-based funding. Unless the economy is bank dependent with less developed capital markets, monetary policy affects the banks external finance premium and not deposits. Therefore, the author argues that insofar as the empirical findings that bank characteristics such as capitalisation and liquidity insulate banks from monetary policy induced effect on deposits, they should instead be seen as reducing the sensitivity of banks to market-funding. Another view highlights the importance of risk in what Borio and Zhu (2012) call the “risk-taking channel” of monetary policy. Here the authors argue that the evolution

³Using Kashyap and Stein (2000) empirical approach, Salachas et al. (2017) also find that banks’ liquidity contributed to credit growth before and after the 2008/9 global financial crisis. However, this bank characteristic becomes insignificant in both periods when the authors control it for endogeneity using the two-step Generalized Method of Moments (GMM).

of the financial system has brought to the fore the importance of risk. Minimum capital regulations, which focus on risk, influence the behaviour of economic agents - households and financial and non-financial business sectors. Monetary policy actions can affect this risk perceptions/tolerance of economic agents. Furthermore, the perception and tolerance of risk interact with liquidity conditions and thereby amplifying the effects of monetary policy.

Another strand of the literature on bank lending looks at the importance of interest rate risk, in the transmission of monetary policy to the real economy. Gomez et al. (2020) find that net interest income of banks with higher income gap increases after an interest rate hike, and thereby dampening the effects of monetary policy on lending and real activity. However, Borio et al. (2017) find that the relationship between monetary policy and net interest income is concave - banks profit from high interest rates during periods of economic prosperity while during crisis periods when interest rates are low, this profitability is eroded. The erosion of profits during periods of low interest rates is driven by the cap on how low deposit rates can be, such as during the zero-lower bound period. To reduce interest rate risk, banks can also pass through interest rate risk exposure by issuing floating-rate loans, which is what the floating-rate channel argues. Given floating-rate liabilities, Kirti (2020) shows how banks hedge interest rate risk by extending floating-rate loans to bank-dependent borrowers. In this way, monetary policy does not work via reduced new lending as the bank-lending channel would posit, but rather via the borrower balance sheet channel - reduced net worth due to lower demand or economic activity and high interest rate expense.

Lastly, there's the deposit and the shadow banking channels of Drechsler et al. (2017) and Xiao (2020) respectively. With the deposit channel, banks with more market power, and big banks, increase their deposit spreads more than other banks, allowing them to increase profits after a contractionary monetary policy shock. This then results in an outflow in deposits and therefore less lending and selling of securities. For the shadow bank channel, Xiao (2020) argues that commercial banks and shadow banks compete for deposits from investors in search of returns. Given the deposit spreads by commercial banks, investors seek higher returns by moving their funds from the commercial banks to shadow banks. Contrary to the credit channel or deposit channel, the author finds that lending increase after a contractionary monetary policy.

It is evident from the above literature that it is not possible to disentangle the demand and supply factors using the banks' balance sheet data. Similarly, the initial cross-sectional differences of monetary policy by Kashyap and Stein (1995) which used to depend on bank size are no longer as straight forward in the presence of internal markets for small banks, the use of floating rates to hedge interest rate risk and the interconnection between the banking sector and the shadow banking sector. Despite this data limitation, our aim is to analyse the heterogeneity of the transmission of monetary policy in South Africa.

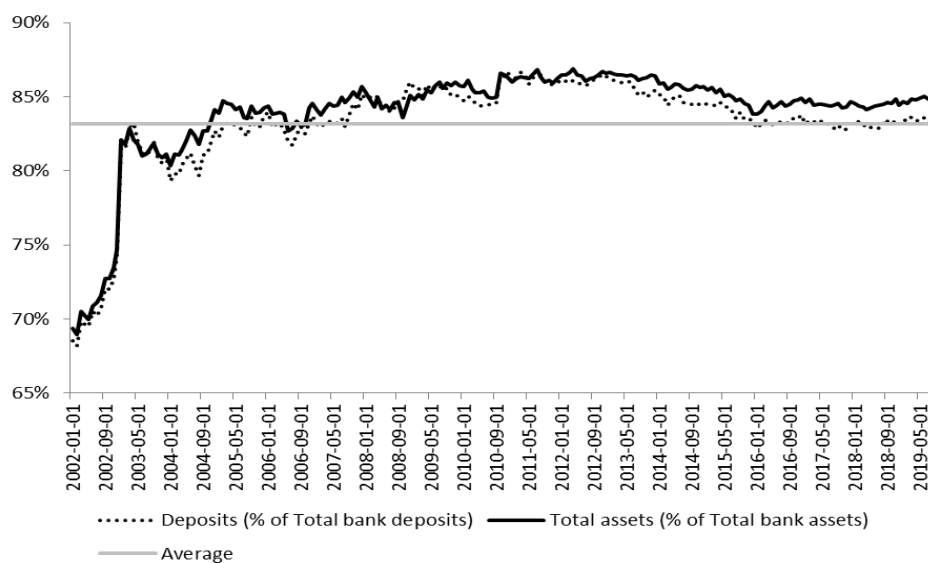
2.1 Why should bank size matter in South Africa?

Unlike many countries where banks are geographically distributed, big and small banks in South Africa have a national footprint. Since both type of banks are more likely to face similar economic and regulatory conditions, any differences in their balance sheet adjustments after a monetary policy shock is likely to reflect *customers*, *market power* and *business models* heterogeneity.

The data covers six local commercial banks which dominate the local retail market, four big banks and two small banks, as categorized by the South African Reserve Bank (SARB). As shown in Figure 1, over the period January 2002 to September 2019, the six banks in the study have consistently enjoyed a *market power/share* of over 84% and 83% in both assets and deposits markets respectively, most of which is by the biggest four banks. Survey studies by FinScope show that the percentage of the population who are banked has increased from 50% (Falkena et al. (2004)) to 80%, FinScope (2018)

between 2003 and 2018. The latest study for 2018 also shows that the use of non-bank and informal financial access is also still high and estimated to be 63% and 74% in 2018, respectively. An earlier study into the South African banking sector by Falkena et al. (2004) indicated that while there is competition in the high-income households segment, the opposite can be said for the low-income segment, which they call the mass-market. The study explores some of the reasons for the lack of competition and market incentives for low-income households. These include regulatory requirements impeding entry by small players and high-barriers (cost and access conditions) to the national payment system, which is necessary to operate in “high-volume, low-value transaction” segment. Therefore, small banks exist to fill in the gap, specifically for the income group whose income might be below the minimum income level to open a bank account, have unstable source of income or even be unemployed.

Figure 1: Deposits and Total Assets market share



Note: The figure shows the ratio of deposits and assets by the six banks to the total deposits and assets by the banks.

We differentiate *business models* by looking at the assets and liabilities sides of both banks. The descriptive statistics indicate that small banks hold more liquid assets, even though in some cases the differences are not large, such as in Kashyap and Stein (1995, 2000), Gambacorta (2005) and Aysun (2016) amongst others. Kashyap and Stein (1995) argue that this supports their model’s assumption that small banks prefer larger cash and securities to avoid the need to raise external finance at a high cost and short notice. On the liabilities side, small banks have a larger share of deposit funding. Taken together with the fact that small banks do not borrow much from the Fed market, Kashyap and Stein (1995, 2000) argue that this supports their model assumption that small banks find it hard to raise external funding.

Table 1 shows the descriptive statistics for the assets and liabilities by bank size for the period January 2002 to September 2019. From the table, we can see that big banks in South Africa have a diversified loan portfolio than the small banks. While residential mortgages are non-existent for the small banks they averages 25% of the big banks assets, with 91% of it being to the household sector. Overdrafts, loans and advances to the private sector, which we use as our proxy for credit to the private sector, averages 19% of the big banks assets. Contrary, these loans averages 77% of the small banks total assets and almost all of this to the household sector. In addition, the big banks hold twice (18%) as much securities (here proxied by investments and bills) as the small banks. Therefore, not only are the small

banks reliant on one type of loan in their loan portfolio, they also do not have a large buffer of stock of liquid assets.

Contrary to the international literature, big banks rely more on deposit funding, 77% average as compared to 58% for the small banks. However, both bank types deposits are mainly denominated in local currency. Another issue related to banks liabilities is the role of shadow banking. According to Kemp (2017), banks receive a large share of their deposits from shadow banking, with the funding amounting to almost 15% of the banks assets and making the South African banking sector the third in the world with such high funding. To explore this, we disaggregate deposits by three sectors - households, financial (money market funds and unit trusts but excluding pension funds and insurers) and non-financial sector. From this, we see that for the big banks, Rand-denominated deposits from financial corporates averages 24%, which is similar to households and non-financial sectors, while for the small banks it averages 63%. Deposits by non-financial corporates is non-existent for the small banks while household deposits has a significant share.

Table 1: Summary statistics for banks balance sheets

	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max
	Big banks				Small banks			
Number of banks			4				2	
Average asset size (R'billions)	R 861	R 186	R 407	R 1 079	R 30	R 24	R 3	R 71
Assets components (%TA)								
Total loans and advances	19	2	16	24	77	10	55	99
Households	10	1	7	11	95	5	81	100
NF Corporates	35	4	21	43	2	3	0	14
Other businesses	2	0	1	3	0	0	0	0
Others	54	4	48	69	3	3	0	15
Residential Mortgage loans	25	4	19	31	1	2	0	7
Households	91	2	86	94	15	36	0	100
Others	9	2	6	14	0	0	0	0
Investments and Bills	18	3	13	28	8	3	3	15
Other investments	3	1	1	4	4	3	1	13
Other assets	35	2	31	41	10	9	-19	33
Total Assets	100				100			
Liabilities components (%TL&E)								
Total liabilities	93	1	92	95	78	5	66	87
Total deposits	77	2	68	81	58	22	14	93
Total Foreign Deposits	3	1	1	5	0	0	0	0
Total Rand Deposits	97	1	95	99	100	0	99	100
NF Corporates	23	2	20	30	0	0	0	2
Financial Corporate	24	6	8	30	63	45	1	145
Households	21	2	18	26	41	29	4	90
Other deposits	29	5	21	38	-4	32	-58	73
Other liabilities to the public	12	2	9	16	37	22	2	79
Other liabilities	11	3	7	22	5	2	2	12
Equity	7	1	5	8	22	5	13	34
Total liabilities and equity	100				100			

Note: Total loans and advances are overdrafts, loans and advanced extended to the private sector. TA is total assets and TL&E is total liabilities and equity. All variables are in real terms.

These differences in the structure of the banks underpin our main hypothesis that small banks do face credit market imperfections relative to the big banks. Therefore we do expect some heterogeneity in how the monetary policy shock is transmitted to the different sectors of the economy. For the big banks,

we expect the response of loans to be similar to the international literature (Gertler and Gilchrist (1993) and Den Haan et al. (2007)) with loan portfolio adjustment from the household sector to the corporate sector. This expectation is supported by the results of Gumata et al. (2013) and Kabundi and Rapapali (2019), who use aggregate bank data which is dominated by the big banks.

The expected results for the small banks may not necessarily follow the international literature - small banks reduce lending more than the big banks following an increase in the interest rate. Given the high dependence of these small banks on household non-mortgage loans, the banks may choose to follow a high-risk-high-return strategy. Given the lower reliance on deposit funding and the high volatility of other financial source of funds, it is likely that small banks face higher cost in raising external funding either by spending more in attracting funds or paying higher rates to constantly attract investors. Knowing this, investors can also take advantage of the vulnerability of the small banks' reliance on non-deposit funding and request high premiums. Moreover, the lack of insurance of non-deposits by the national regulator would warrant even higher premiums by the investors.

In order for the small banks to recover the high cost of raising non-deposit funds, they will need to charge high interest rates on credit to the private sector. This high-risk-high-return strategy will lead to small banks increasing their household non-mortgage loan supply. However, failure to attract non-deposit or cheap funding could lead to a reduction in lending. As alluded by one of then independent non-executive directors of Abil in the Myburgh (2016) report on the investigation on the failure of the African Bank, one of the small banks in our sample, "Abil relies to a significant degree on wholesale funding and any loss of reputation or investor confidence could make it difficult for Abil to access additional sources of funds on acceptable terms or at all".

3 Bayesian VAR analysis and Data

We use a medium scale Bayesian VAR model by Bańbura et al. (2010) to answer our two empirical questions. In the Bańbura et al. (2010) paper, the medium scale BVAR model extends the seven variable model by Christiano et al. (1999) to 20 variables whereas the large scale model consisted of 131 variables. The advantage of both models is that they allow the inclusion of more variables, helping researchers to overcome the size limitation problem of variables which is common in regression analysis and particularly the VAR analysis. However, Bańbura et al. (2010) shows that the impulse-response functions of the medium scale model to a monetary policy shock are similar to that of the large model. Given the robustness of the medium scale model, the authors conclude that the medium scale model is equally fitting to perform as well as the large model with lesser or "redundant" information. Therefore to avoid redundant variables, we only include variables relevant to our analysis. See Appendix 7.1 for model details.

Our model consists of 10 variables for the aggregate and small banks and 12 variables for the big banks. The use of medium scale model allows us to run a single model with both small and big banks data. We use monthly data from January 2002 to September 2019. We order the slow moving variables first followed by the fast moving variables. Given $Y_t = X_t, r_t, Z_t'$, where X_t represent the slow moving variables, r_t is the monetary policy instrument and Z_t represents the fast moving variables, we assume that X_t contains all our variables - macro and bank data variables, r_t contains the interest rate and Z_t is an empty set. Within Z_t , we order macroeconomic variables first followed by the banks balance sheet variables. This assumption structure follows that of Den Haan et al. (2007) who also assume that the loan variables respond with a lag to a monetary policy shock at a monthly frequency. Monetary policy shock is identified by using zero restrictions.

The structural VAR can be represented as:

$$A_0 Y_t = c + A_1 Y_{t-1} \dots + A_p Y_{t-p} + \eta_t \quad (1)$$

where Y_t is the N vector of endogenous variables, A_0 is the $N \times N$ contemporaneous impact matrix, c is a N vector of coefficients and η_t is the $N \times N$ error matrix. The reduced form equation can be written as:

$$Y_t = B_0 + B_1 Y_{t-1} \dots + B_p Y_{t-p} + \varepsilon_t \quad (2)$$

where $B_0 = A_0^{-1} c$, $B_i = A_0^{-1} A_i$ for $i = 1, \dots, p$ and $\varepsilon_t = A_0^{-1} \eta_t$. And the variance covariance matrix of the reduced form VAR is given by:

$$E(\varepsilon_t \varepsilon_t') = E(A_0^{-1} A_0^{-1'}) = \Sigma \quad (3)$$

3.1 Data

Our main dataset is the banks' balance sheet data, also known as the BA900 report, by the South African Reserve Bank. The BA900 variables, together with macroeconomic variables, are obtained from Quantec and the South African Reserve Bank. From the dataset, we are mainly interested in loans, deposits and security holdings.

Credit is proxied by overdrafts, loans and advances extended to the household and nonfinancial corporate sectors. We also include credit extended to the private sector, to control for loans to other sectors. We use two proxies for security holdings. For our baseline results, we use investments and bills which also include trading portfolio assets. An alternative measure includes acceptances, commercial paper, bills, promissory notes and related debt purchased by the banks. Deposits are proxied by Rand-denominated deposits, which as indicated in Table 1 make up the majority of total deposits. For the small banks, we use total liabilities to the public, which are more stable than deposits. This include amongst others total deposits, other borrowed funds, loans under repurchase agreements and exclude derivatives and trading liabilities.

For macroeconomic variables, we use industrial production for the manufacturing sector as a proxy for real activity and to control for the demand effects. We also include inventories to test the hypothesis that credit is extended to businesses during tough times to help them fund their inventories. Inflation is proxied by the change in consumer price index. Lastly, monetary policy is proxied by the South African 91-day Treasury Bill rate. During the sample period, the correlation between the repurchase rate and the 91-day Treasury bill rate is 0.98. Therefore, the 91-day Treasury Bill rate is a good proxy for the monetary policy interest rate. All nominal values are deflated using the price deflator. The description of the data is provided in Table 3 in Appendix 7.1.

4 Results

We start the analysis by looking at the response of the total balance sheet of the six banks in our sample to a positive one standard deviation innovation to a monetary policy instrument. These results serve as our benchmark results to later show the importance of disaggregating by bank size. The impulse response functions show both the median responses with the significance of the median represented by the 68% and 90% posterior coverage intervals in light and dark shaded-areas respectively.

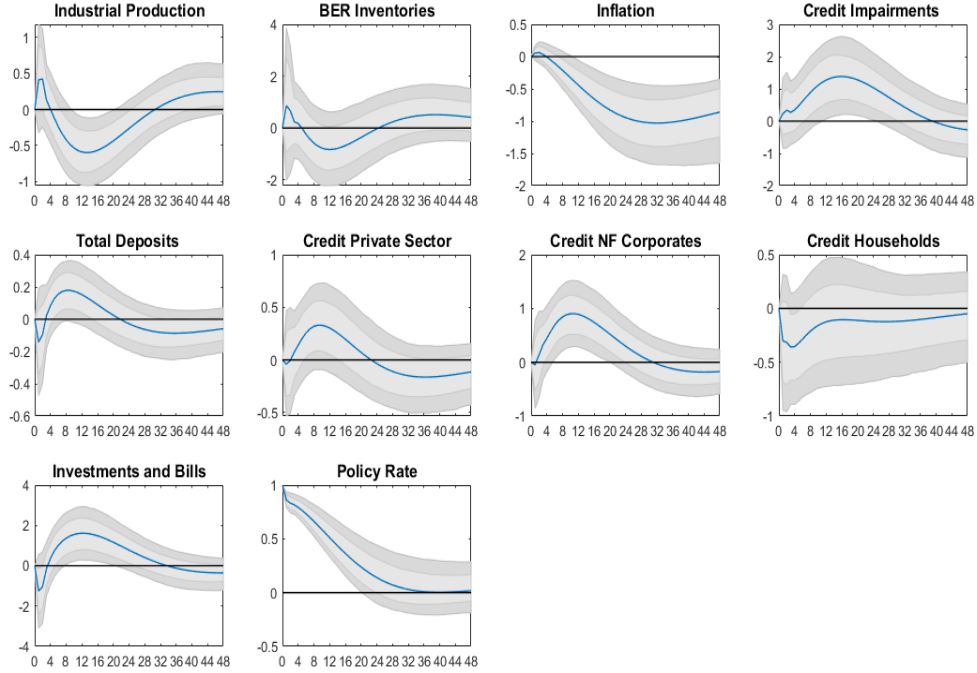
4.1 Re-visiting the lending channel

Figure 2 presents the impulse response functions of the BSVAR model for our baseline results. A one standard deviation increase in monetary policy results in a contemporaneous 100 basis point increase in interest rate. Economic theory dictates that a contractionary monetary policy should reduce aggregate demand, thereby reducing output and inflation. Indeed, the results for the real economy are as expected: an increase in interest rate reduces economic activity, proxied by industrial production growth. Inflation decline and is significant at both 68% and 90% posterior coverage intervals while inventories is insignificant.

The balance sheet data indicate that credit extended to the private sector increase within the first year before declining. Credit extended to the non-financial corporates increase while household credit decline, although household credit is mainly insignificant at both the 68% and 90% posterior coverage intervals. This suggest that the response of total credit is partly driven by non-financial corporates credit, which is countercyclical, at least in the first year after the shock. Bernanke and Gertler (1995) point out that this countercyclical behaviour of credit growth is not inconsistent with the credit channel. The authors argue that during periods of tight monetary policy, firms and households will still borrow to fund their inventories and income respectively, but will do so less and hence spend at a lesser rate than in the absence of the shock. However, our results are not consistent with funding increasing inventories. The credit channel predicts that deposits decline after a contractionary monetary policy shock. In response, banks can sell of security holdings. While both deposits and securities holding decline in the first month after the shock, they quickly increase.

Therefore, at the aggregate level, the results do not indicate that loan supply and funding for the banks are constrained by monetary policy in the first year after the shock. If monetary policy is transmitted similarly across the banks or their customers, then we would expect similar results despite the bank size. This is what we look at next.

Figure 2: Response of total banks balance sheet



Note: The figure shows the impulse response functions to a monetary policy shock for the total banks. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

4.2 Does bank size matter?

We now look at the disaggregated results for different banks sizes. Using similar specification for the total banks model, we repeat the exercise with the following two additions. Firstly, we add mortgage loans. Since only the big banks offer these loans during the full-sample period, this addition is only for the big banks. Secondly, we add loans extended to unincorporated businesses, which we see as a proxy for small businesses or self-employed households. Since only the big banks have this data for the full-sample period, this addition is only for the big banks.

The results for the big and small banks are presented in Figure 3 and 4 respectively. A positive one standard deviation shock to the monetary policy rate results in a 1% increase in interest rate. As in the aggregate results, industrial production, inventories and inflation decrease after the monetary policy shock. Analysis of the distributional effects of monetary policy indicate the following.

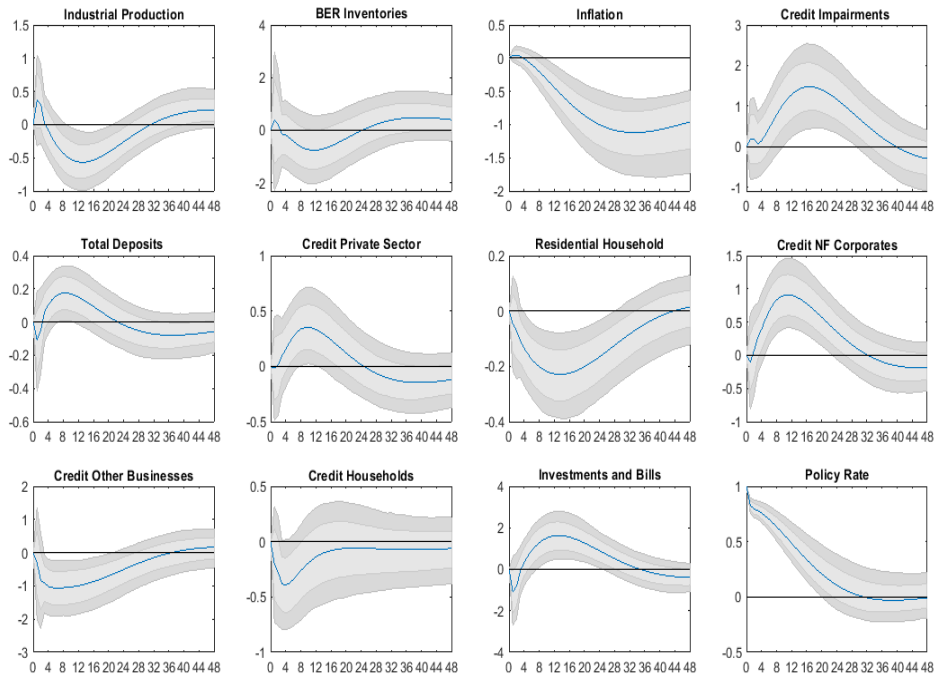
4.2.1 Mortgages, businesses and households loans

Starting with the big banks, a contractionary monetary policy reduces all loan types extended to the household sector, even though household credit is mainly insignificant. Contrary, loans extended to the “big” nonfinancial corporations increase. So far, our results are consistent with aggregate results by Kabundi and Rapapali (2019). The authors find that a contractionary monetary policy reduces both household credit and mortgage loans while nonfinancial corporate loans increase in the first year before declining, despite the different ordering of the banking sector variables, which are ordered as fast-moving variables in their paper. We do not expect loan adjustments to be contemporaneous to a monetary policy shock at a monthly frequency. Den Haan et al. (2007) also find similar results even

though the author ordered their loan variables as slow-moving variables, an assumption they indicate is plausible at a monthly frequency. Unlike for “big” nonfinancial corporations, credit extended to “small” or single-person unincorporated businesses declines.

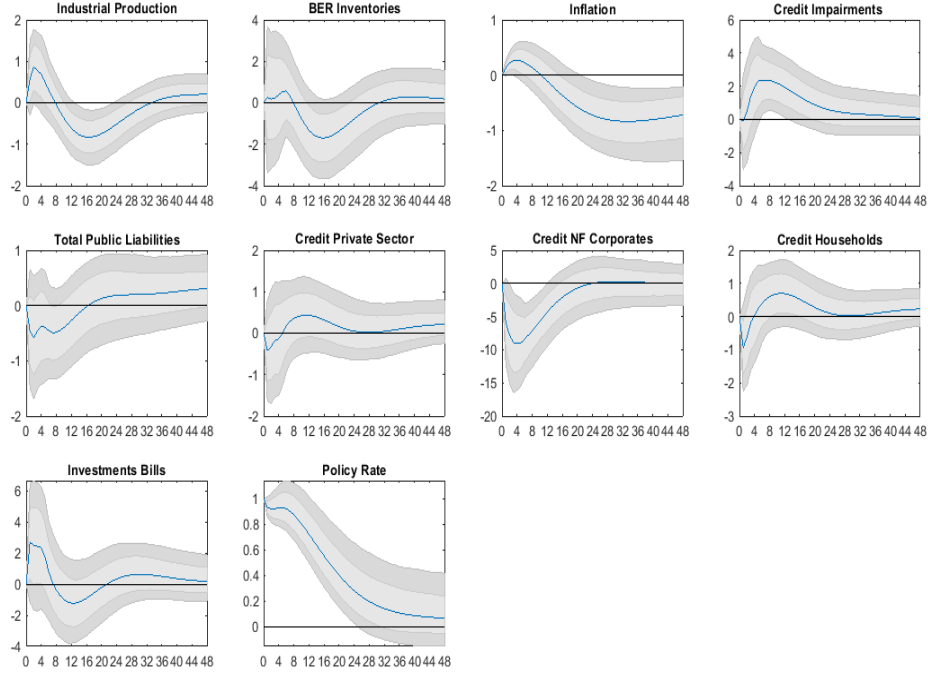
The results for small banks are in sharp contrast to that of the big banks: loans to households contemporaneously decline within the first quarter and then increase and peak within the same year in the last quarter while credit to nonfinancial corporates declines. Even though total credit to the private sector is insignificant, the direction of the impulse response function suggest that it’s driven by household credit, the small banks main customers. The behaviour of the small banks is unsurprising given that there’s less room for the re-allocation of assets because to an undiversified loan portfolio. This adjustment of assets between households and corporates yields cross-sectional differences between bank sizes on the asset side. In addition, it also supports the hypothesis from the credit channel that monetary policy falls more on small borrowers that are bank dependent, Oliner et al. (1995). While our data does not enable us to separate demand and supply effects, the sharp contrast between credit extended to big vs small corporates within the big banks lend support to the possibility of a monetary policy induced credit crunch to the small businesses.

Figure 3: Response of big banks balance sheet to a monetary policy shock



Note: The figure shows the impulse response functions to a contractionary monetary policy shock for the big banks. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

Figure 4: Response of small banks balance sheet to a monetary policy shock



Note: The figure shows the impulse response functions to a contractionary monetary policy shock for the small banks. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

4.2.2 Deposits and securities

We then look at the effect of monetary policy on banks' funding ability, which in this case is proxied by deposit funding for the big banks, given that this constitutes their main liabilities, and total liabilities to the public for small banks, given abrupt changes in the composition of their liabilities. In addition, we look at the possibility of securities holding as an alternative source of self-funding. For the big banks, total deposits increase. Securities holdings also increase, whether due to valuation effect or the banks increasing their securities holdings to take advantage of higher returns. Total liabilities for the small banks decline, though mainly insignificant, a possibility of overall funding constraints while security holdings contemporaneously increase before declining.

In Table 1 we showed how small banks are vulnerable to deposits, especially from some of the financial corporates. On the other hand, while the big banks have maintained stable deposits, they are mostly short-term, a concern raised by IMF (2011) report. Therefore, we explore the response of deposits by sectors - households, nonfinancial corporates and financial corporates - and maturities to a positive one standard deviation shock to the monetary policy rate. For maturities, we look at cheque deposits, short-term deposits with maturities of between 1 and 6 months and long-term deposits of maturities over 6 months. Since cheque deposits are almost non-existent for small banks, we only look at the response for big banks.

The results for household and nonfinancial sectors and financial sector are shown in Figures 5 and 6, respectively. Figure 7 shows the results for deposits by maturities - short-term and long-term. For the big banks, deposits by both households and nonfinancial sectors increase, whether it is due to an increase in price (deposit rate) or quantity. This suggests that the increase in total deposits is also driven by short-term deposits. In contrast, long-term deposits decline. Replacing long-term deposits

with cheque deposits in Figure 8 for the big banks show that cheque deposits decline while short-term deposits remain robust. The different responses of short and long-term deposits could explain the loan portfolio adjustment by big banks. That is, the decline in longer-term deposits could explain the portfolio adjustment from long-term assets such as mortgage loans. Business loans tend to be short-term, earn high return and considered safe than real-estate loans, Den Haan et al. (2007). If this is the case, then the behaviour of the big banks is consistent with this hypothesis and hence the banks would rather fund business lending using short-term deposits, increasing their profit. This the authors argue is “hedging and safeguarding the capital adequacy ratio” rather than funding business inventories as proposed by Bernanke and Gertler (1995). A third possible explanation for the increase in business loans is provided by Ivashina and Scharfstein (2010). The authors find that the increase in corporate & industrial loans observed on the banks’ balance sheets during the 2008/9 global financial crisis was due to corporates drawing down their credit lines (increase in credit demand) instead of banks issuing new loans (increase in credit supply). Since we also look at loans and advances extended to the nonfinancial corporate sector, this is also a possible explanation for the South African case. However, our results seem supportive to the “hedging and safeguarding the capital adequacy ratio” behaviour by the big banks.

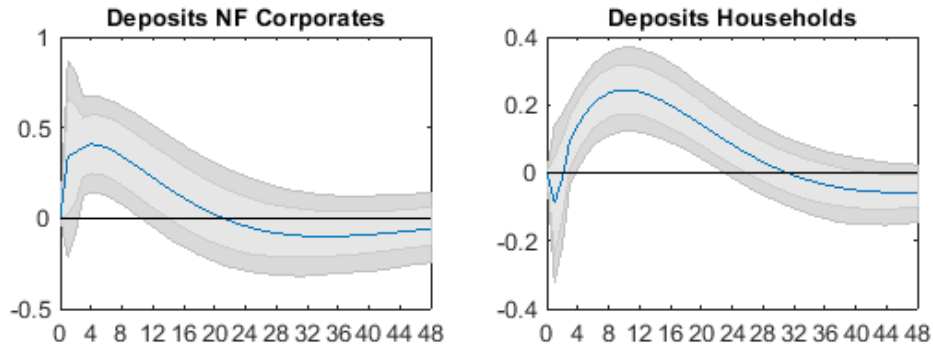
For the small banks, we see that deposits by nonfinancial sector decline. Household deposits increase in the first half of the year before declining. Unlike for the big banks, the response of deposits by financial sector is mainly significant and show that money market funds and unit trusts increase their deposits to the small banks⁴. Lastly, the response of short-term deposits is not significant while that of deposits longer than 6 months increase and reverts back to pre-shock level within a year. Taking the results in the context of the deposit channel, the results for cheque and long-term deposits for big banks are consistent to what the bank lending and deposit channel theory predict, that is an increase in monetary policy rate reduces deposits. Whether the results for financial corporates is supportive of the existence of the shadow banking channel by Xiao (2020) in South Africa is an empirical question for future research.

Testing for the bank-lending channel in the spirit of Kashyap and Stein (1995) required comparing the sensitivity of bank loan volume and security holding for the small and big banks. That is: (1) do small banks react more to monetary shock than the big banks? (2) do small banks reduce their security holdings more to monetary shock than that of the big banks? As we observed in the data, small banks hold less securities than big banks. Furthermore, the impulse response functions for securities for the small banks are not always consistent with predictions by Kashyap and Stein (1995). Therefore, while we do find cross-sectional differences between the small and big banks, we do not find outright support of the traditional credit channel. The main reason is that the two bank types operate in two different markets, and it is in these markets that they choose to adjust their risk-return behaviour. While a negative monetary policy shock induces risk-taking by big banks to corporates, for the small banks it is with household market. The behaviour of the small banks mimic that of retailers, extending credit to consumers during difficult financial times to smooth their consumption and passing on higher interest rates to consumers through higher risk premium, temporarily increasing their income. Indeed, the study by Falkena et al. (2004) indicate that profitability is high for the low-income “mass-market” and the observation that the households are willing to pay high fees indicate that demand is inelastic.

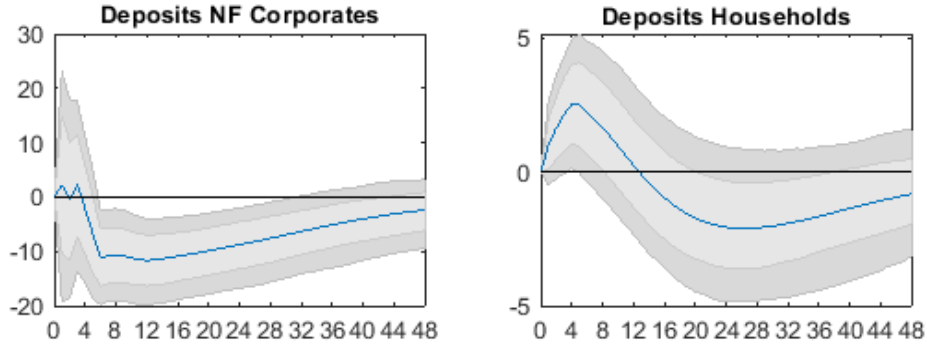
Overall, the results suggest that deposits for big banks, especially short-term, are not that sensitive to a contractionary monetary policy shock. This is not surprising given that these banks enjoy market power in the deposit market and there’s high interconnectedness in the financial sector. While long-term deposits are negatively affected by a contractionary monetary shock, since big banks rely more on short-term deposits, it appears that this insulates them from monetary policy shocks. In contrast,

⁴We find that running the VAR until the end of our sample produces unstable impulse responses. Therefore, we estimate the VAR until June 2018 to improve the impulse response functions. The results do not change the direction of the impulse response functions but only improves them.

Figure 5: Response of the Household and NF Corporate sectors deposits



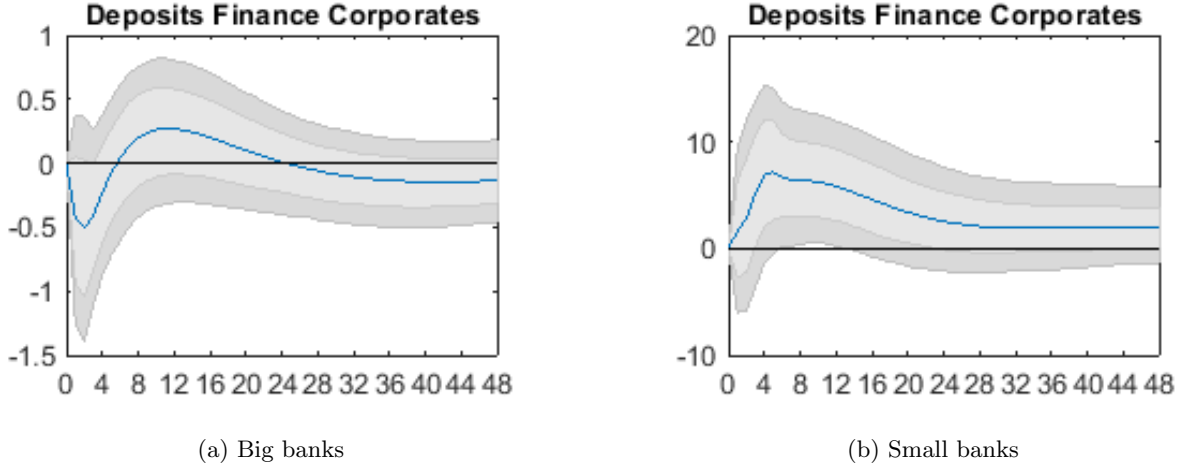
(a) Big banks



(b) Small banks

Note: The top and bottom panels shows the impulse response functions to a positive monetary policy shock for total deposits by the household and non-financial corporates for the big banks and small banks respectively. The results are obtained by re-estimating the VAR models from the benchmark results with total deposits by non-financial corporate and household deposits instead of total deposits (or total liabilities for the small banks) and total credit to the private sector. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

Figure 6: Response of the Financial Corporate sector deposits



Note: The top and bottom panels show the impulse response functions to a positive monetary policy shock for total deposits by the financial corporates (money-market funds and unit trusts) for the big banks and small banks respectively. The results are obtained by re-estimating the VAR models from the benchmark results with total deposits by the financial sector (money-market funds and unit trusts) instead of total deposits (or total liabilities for the small banks). The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

the response of total liabilities for the small banks indicate a possibility of overall funding constraints. Therefore the results do show how vulnerable the small banks business model is to monetary policy shock, whether via the interest rate or the credit channel. While these small banks might not be systematically important, their importance in filling in the gap in the low-income market and contributing towards financial inclusion makes them socially important. Therefore it is important for policy makers to consider the heterogeneity within the banking sector in achieving their monetary policy and financial stability objectives. The role of deposits by financial corporates and the operation of the shadow banking channel by Xiao (2020) in South Africa is an empirical question for future research. This is especially important for the small banks in order to understand and manage their financial stability.

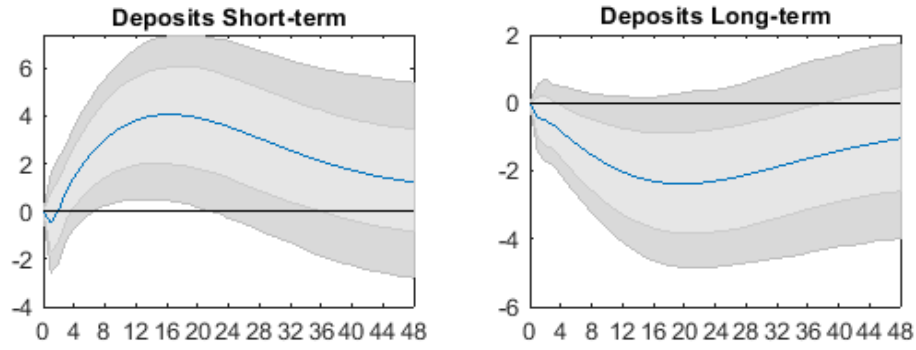
Table 2 shows the correlation between growth of credit granted by industries and interest rate and GDP during the period 2008Q4 and 2019Q1 together with the t-stats. We also include the correlations between interest rate and GDP growth with the change in mortgage loans approved. While correlation does not mean causation, the credit register data confirms some of our results. We see that mortgage loans, which are mainly by big banks, and interest rate are negatively correlated. Except for retailers, credit growth from banks and other non-bank institutions is also negatively correlated with interest rate.

5 Robustness checks

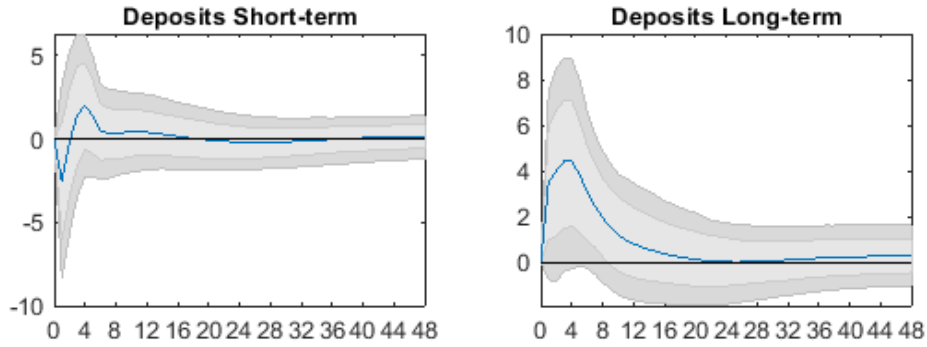
In addition to the benchmark specifications reported in section 4, we also provide two robustness checks. The first robustness check entails using an alternative measure of securities. For this, we use acceptances, commercial papers, bills and similar debt purchased by the banks. The second robustness check entails controlling for the collapse of one of the small banks in your sample. The bank was placed under curatorship in August 2014, Myburgh (2016). Therefore, we run model for the small banks until June 2014. The results are presented in Appendix 7.2.

The results for other investments are presented in Figure 9 and 10 for the big and small banks respectively. The results show that other investments for both the small and the big banks decline, with

Figure 7: Response of deposits by maturities



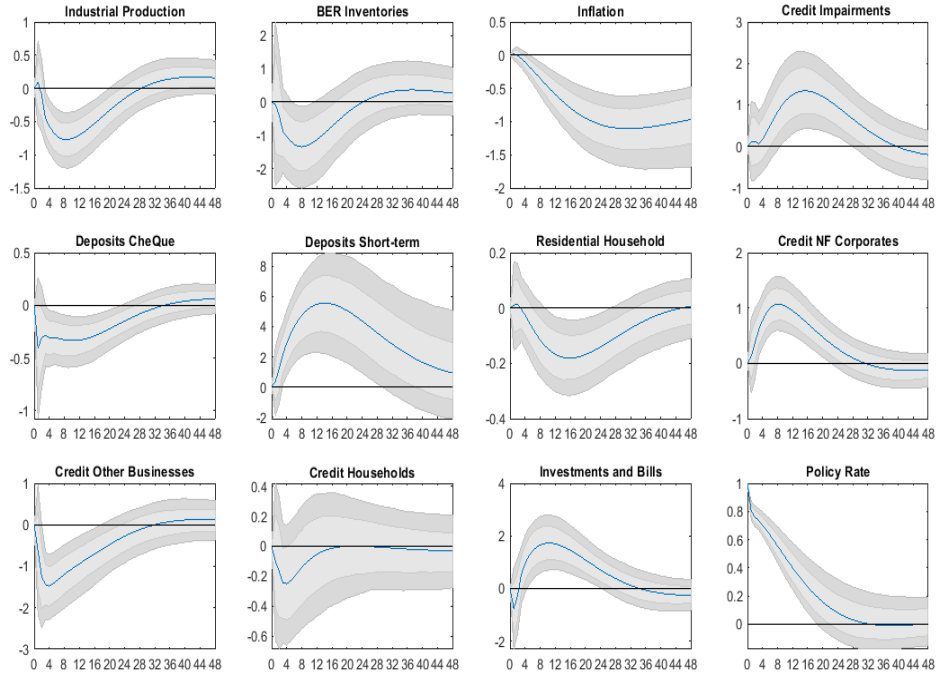
(a) Big banks



(b) Small banks

Note: The top and bottom panels shows the impulse response functions to a positive monetary policy shock for total deposits by the household and non-financial corporates for the big banks and small banks respectively. The results are obtained by re-estimating the VAR models from the benchmark results with short-term (1 to 6 months) and long-term (more than 6 months) total deposits instead of total deposits (or total liabilities for the small banks) and total credit to the private sector. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

Figure 8: Response of big banks balance sheet - Cheque vs. Short-term deposits



Note: The figure shows the impulse response functions to a positive monetary policy shock for the big banks. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

Table 2: Correlations with GDP growth and interest rate

	GDP growth	Interest rate	NB financiers	Other providers	Retailers
Interest rate	-0.68 -5.89				
NB financiers	0.68 5.82	-0.61 -4.81			
Other providers	0.61 4.85	-0.66 -5.62	0.49 3.51		
Retailers	0.06 0.36	0.06 0.35	0.06 0.38	-0.03 -0.19	
Banks	0.79 8.19	-0.52 -3.83	0.63 5.11	0.60 4.76	0.21 1.33
Mortgage loans	0.71 6.35	-0.52 -3.80			

Note: Correlations of credit by banks, retailers, non-bank financiers (NB financiers) and other service providers. Mortgage loans are by all providers, with most of it by banks.

that of the big banks being insignificant. The response of other variables is still consistent with our benchmark results. Lastly, Figure 11 shows the results for small banks for the period January 2002 to June 2014. From the results, we see that the impulse response functions are consistent with that of the benchmark results, with some slight improvement in the significance of total credit to the private sector.

6 Conclusion

This paper re-visits the bank lending channel in South Africa to investigate its existence at both the aggregate and disaggregated bank level using Bayesian structural VAR methods. We cover the period January 2002 to September 2019. We observe cross-sectional differences between bank sizes on both the assets and liabilities side. On the assets side, we observe that a contractionary monetary policy reduces all loan types extended to the household sector and increases loans extended to the “big” nonfinancial corporations for the big banks whereas we find the opposite for the small banks. Unlike for “big” nonfinancial corporations, credit extended to “small” or single-person unincorporated businesses declines. The increase in corporate lending amid declining inventories is consistent with the hypothesis of “hedging and safeguarding the capital adequacy ratio” rather than funding business inventories. While our data does not enable us to separate demand and supply effects, the sharp contrast between credit extended to big vs small corporates within the banking sector lend support to the possibility of a monetary policy induced credit crunch to the small businesses.

On the liabilities side, the results suggest that deposits for big banks, especially short-term, are not that sensitive to a contractionary monetary policy shock. In contrast, long-term deposits are negatively affected by a contractionary monetary shock. However, since big banks rely more on short-term deposits, it appears that this insulates them from monetary policy shocks. The impulse response functions for securities for the small banks are not always consistent with predictions by Kashyap and Stein (1995). Therefore, while we do find cross-sectional differences between the small and big banks, we do not find outright support of the traditional bank lending channel.

This paper highlights the importance of heterogeneity in customers, market power and business models in the banking sector, which characterises the socio-demographics dynamics in South Africa and similar emerging markets. Therefore it is important for policy makers to consider this heterogeneity within the banking sector in achieving their monetary policy and financial stability objectives. The role of deposits by financial corporates and the operation of the shadow banking channel by Xiao (2020) in South Africa is an empirical question for future research. This is especially important for the small banks in order to understand and manage their financial stability.

7 Appendices

7.1 Model and data

Consider the following VAR (p) model:

$$Y_t = c + B_1 Y_{t-1} + \dots + B_p Y_{t-p} + \nu_t \quad (4)$$

where $Y_t = (y_{1,t}, y_{2,t}, \dots, y_{n,t})'$ is an $N \times 1$ vector of random variables, $c = (c_1, c_2, \dots, c_n)'$ is a $N \times 1$ vector of the constants terms and ν_t' is a $N \times 1$ vector of the error terms with a covariance matrix of $E(\nu_t \nu_t') = \Psi$. Given the large dimension of the matrix Y_t , the VAR model is estimated using the Bayesian VAR (BVAR), Bańbura et al. (2010). The Bayesian VAR imposes prior restrictions on the parameters to

be estimated, thereby reducing the the curse of dimensionality. The approach followed in this literature is to set the prior distribution using the “non-strict” Minnesota prior. The Minnesota prior assumes that the variables in Y_t follow an AR (1) process or a random walk. The prior assumes a random walk if the diagonal elements of the B_1 matrix = 1 and an AR (1) process if the variables in the vector Y_t are stationary. Making \tilde{B}_0 the mean of the prior for the VAR coefficients, then the prior distribution is, $p(B) \sim N(\tilde{B}_0, H)$, where the variance H is given by the following relations for the VAR coefficients b_{ij} : $(\frac{\lambda_1}{l^{\lambda_3}})^2$ if $i = j$, $(\frac{\sigma_i \lambda_1 \lambda_2}{\sigma_j l^{\lambda_3}})^2$ if $i \neq j$ and $(\sigma_1 \lambda_4)^2$ for the constant.

The subscript i refers to the dependent variable in the i^{th} equation and j to the independent variables in the equation. The variances of the error terms from the AR regressions are estimated via the ordinary least squares and their ratio, $\frac{\sigma_i}{\sigma_j}$, accounts for the differences in the units of measurement of different variables. The parameter l is the lag length and the λ 's are parameters that control the tightness of the prior as follows. λ_1 controls the standard deviation of the prior of own lags, where $\lambda_1 \rightarrow 0$ has the effect of shrinking the diagonal elements of the B_1 matrix towards 0 and all other coefficients to zero. $\lambda_2 \in (0, 1)$ controls the standard deviation of the prior on lags of variables other than the dependent variable where $\lambda_2 \rightarrow 0$ shrinks the off-diagonal elements to 0. If $\lambda_2 = 0$, there is no difference between own lag and the lags of other variables. λ_3 controls the the degree to which lags higher than 1 are likely to be zero where as $\lambda_1 \rightarrow \infty$ coefficients on lags higher than 1 are shrunk to 0. Lastly, λ_4 controls the prior variance of the constant. The constant is shrunk to 0 as $\lambda_4 \rightarrow 0$.

The strict Minnesota prior assumes that the covariance of the residuals of the VAR is diagonal with the diagonal elements fixed using the error variance from AR regressions σ_i . The current practice is to replace the Minnesota prior with the Normal inverse Wishart prior. The prior assumes a normal prior for the VAR coefficients and an inverse prior for the covariance matrix. This prior allows the random walk aspect of the Minnesota prior on the coefficients to be used without having to impose a fixed and diagonal error covariance matrix. The prior for the VAR parameters are:

$$p(B_0|\Psi) \sim N(\tilde{B}_0, \Psi \otimes \tilde{H}) \quad (5)$$

$$p(\Psi) \sim IW(\tilde{S}, \alpha) \quad (6)$$

The matrix \tilde{H} is a diagonal matrix where the diagonal elements are defined as

$$(\frac{\lambda_0 \lambda_1}{\sigma_i l^{\lambda_3}})^2 \quad (7)$$

for the coefficients on lags, and

$$(\lambda_0 \lambda_4)^2 \quad (8)$$

for the constant. The matrix \tilde{S} is defined as a $N \times N$ diagonal matrix with diagonal elements given by

$$(\frac{\sigma_i}{\lambda_0})^2 \quad (9)$$

where λ_0 controls the overall tightness of the prior on the covariance matrix. All other priors are already explained. However, with the normal inverse wishart, $\lambda_2 = 0$, which implies that the lags of dependent variable and of other variables are treated the same. Following the literature, we also

implement the normal inverse Wishart prior using dummy variable. The advantage of this method is that it helps to incorporate the prior that the variables have unit root, Blake and Mumtaz (2012). Using T_d dummy variables Y_d and X_d , we regress Y_d on X_d to get the prior mean of the VAR coefficients b_0 and the sum of the squared residuals gives the prior scale matrix for the error covariance matrix S :

$$\begin{aligned} b_0 &= (X_d' X_d)^{-1} (X_d' Y_d) \\ S &= (Y_d - X_d b_0)' (Y_d - X_d b_0) \end{aligned} \quad (10)$$

The regression is equivalent to imposing the normal inverse Wishart prior

$$\begin{aligned} p(B|\Psi) &\sim N(\tilde{b}_0, \Psi \otimes (X_d' X_d)^{-1}) \\ p(\Psi) &\sim IW(S, T_d - K) \end{aligned} \quad (11)$$

where K is the number of regressors in each equation. We generate the dummy variables by:

$$Y_d = \begin{pmatrix} \text{diag}(\xi_1 \sigma_1, \dots, \xi_N \sigma_N) / \lambda \\ 0_{N \times (P-1) \times N} \\ \text{diag}(\sigma_1, \dots, \sigma_N) \\ \dots \\ 0_{1 \times N} \end{pmatrix}, X_d = \begin{pmatrix} J_P \otimes \text{diag}(\sigma_1, \dots, \sigma_N) / \lambda & 0_{NP \times 1} \\ 0_{N \times (NP)} & 0_{N \times 1} \\ 0_{1 \times N} & c \end{pmatrix} \quad (12)$$

where ξ_1 are the prior means for the coefficients on the first lags of the dependent variables (which can be different from 1) and $J_P = \text{diag}(1 \dots P)$. Appending the data with the dummy variables we get $Y^* = [Y; Y_d]$ and $X^* = [X; X_d]$ with length $T^* = [T; T_d]$. We can now re-write equation (13) as:

$$Y_t^* = c + B_1 Y_{t-1}^* \dots + B_p Y_{t-p}^* + \nu_t^* \quad (13)$$

Now the conditional posterior distribution of the appended data is:

$$\begin{aligned} p(B|\Psi) &\sim N(\text{vec}(B^*), \Psi \otimes (X^{*'} X^*)^{-1}) \\ p(\Psi) &\sim IW(S^*, T^*) \end{aligned} \quad (14)$$

where $B^* = (X^{*'} X^*)^{-1} (X^{*'} Y^*)$ and $S^* = (Y^* - X^* B^*)' (Y^* - X^* B^*)$. Furthermore, additional priors are imposed on the sum of coefficients to improve the forecasting performance, (Bańbura et al. (2010)). This is called “inexact differencing”. To do this, we re-write equation 13 in an error-correction form:

$$\Delta Y_t = c + (I_n - B_1 - \dots - B_p) Y_{t-1} + A_1 \Delta Y_{t-1} + \dots + A_{p-1} \Delta Y_{t-p+1} + \nu_t \quad (15)$$

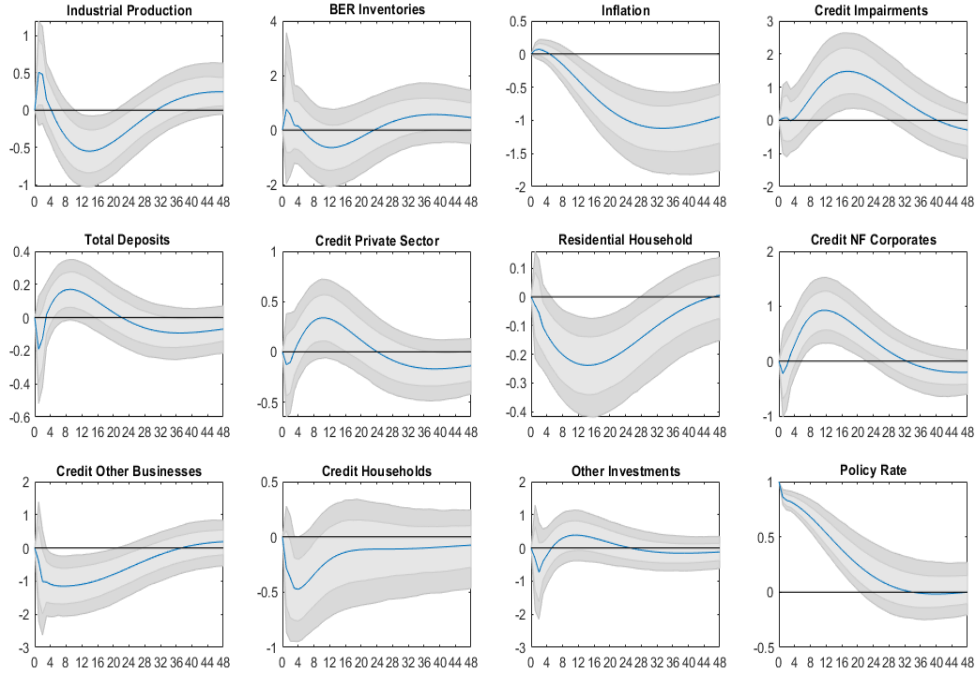
A VAR in first difference requires $(I_n - B_1 - \dots - B_p) = 0$. Letting $\Pi = (I_n - B_1 - \dots - B_p)$, we set a prior that shrinks Π to zero. To achieve this, “inexact differencing”, we augment the first lines of equation 16 with the following:

$$Y_d = \begin{pmatrix} \text{diag}(\xi_1 \sigma_1, \dots, \xi_N \sigma_N) / \tau \end{pmatrix}, X_d = \begin{pmatrix} J_P \otimes \text{diag}(\sigma_1, \dots, \sigma_N) / \lambda & 0_{NP \times 1} \end{pmatrix} \quad (16)$$

where the hyperparameter τ controls the degree of shrinkage - shrinkage decreases as τ approaches inf. Following Bańbura et al. (2010), we set τ , which controls the degree of shrinkage, to a loose prior of 10λ . The overall shrinkage λ is set to match the fit of the simple three-VAR model estimated by the ordinary least squares method.

7.2 Robustness checks results

Figure 9: Response of big banks balance sheet (other investments)



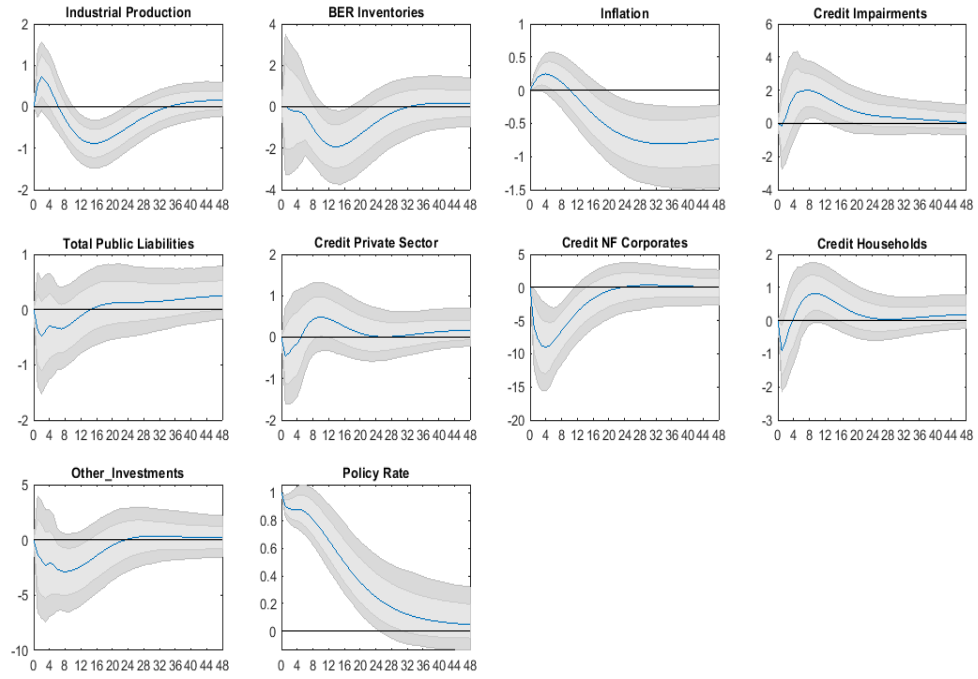
Note: The figure shows the impulse response functions to a monetary policy shock for the big banks. The results are obtained by re-estimating the benchmark VAR with an alternative measure of security holdings. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

Table 3: Medium BVAR data transformation and ordering

BVAR name	Description	Unit	S/F	Log	RW
Inflation	CPI Headline	Index: 2016=100	S	X	X
Industrial production	Manufacturing: Total volume of production; s.a.	Index: 2010=100	F	X	X
Credit impairments	Credit impairments in respect of loans and advances for domestic assets	Millions of Rand	S	X	X
Deposits	Total Rand-denominated deposits by all sectors or household sector, non-financial or finance sector (finance sector includes money market funds and unit trusts)	Millions of Rand	S	X	X
Total public liabilities	Liabilities including Rand and foreign-denominated deposits from all sector, other borrowed funds	Millions of Rand	S	X	X
Residential household	Residential mortgage loans extended to the household sector	Millions of Rand	S	X	X
Credit	Overdrafts, loans and advances either to the private sector, household sector, non-financial sector or unregistered businesses	Millions of Rand	S	X	X
Investments and Bills	Investments and bills including trading portfolio assets	Millions of Rand	S	X	X
Other investments	Acceptances, commercial paper, bills, promissory notes and other related debt	Millions of Rand	S	X	X
Policy Rate	Bankrate (lowest rediscount rate at SARB)	Percent	MPV		X

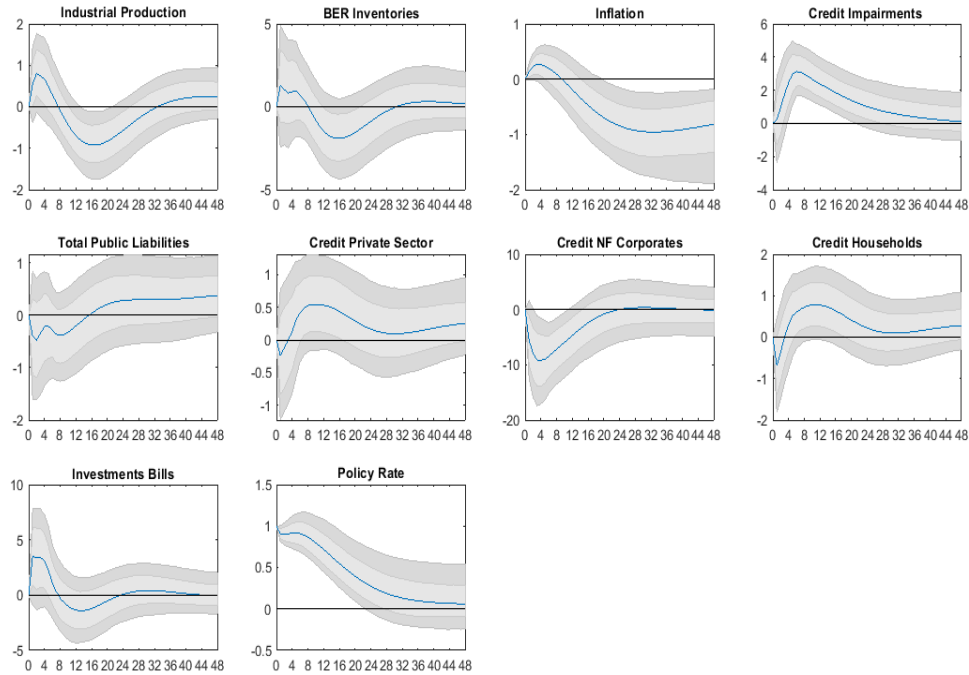
Note: This table provides the list of the variables included in the BVAR model. The variables in the model are in the same order as in the table. The first column shows the code of the data by the source. The second and third columns shows (respectively) the short names and description of the variables used in the BVAR model estimation. The fourth column shows the unit of measure where Rand is the South African currency. The fifth column indicate whether the variable is slow moving (S), fast moving (F), or a monetary policy variable (MPV). Column six indicate if the variable is in logarithms and column seven if the variable is a Random Walk.

Figure 10: Response of small banks balance sheet (other investments)



Note: The figure shows the impulse response functions to a monetary policy shock for the small banks. The results are obtained by re-estimating the benchmark VAR with an alternative measure of security holdings. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

Figure 11: Response of small banks balance sheet - January 2002 to June 2014



Note: The figure shows the impulse response functions to a monetary policy shock for the small banks, controlling for the collapse of one of the small banks in our sample. The light and dark shaded-areas are for the 68% and 90% posterior coverage intervals respectively.

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