Essays on the role of Banking and Finance in the South African Economy

by

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Abstract

The objective of the thesis is to analyse and understand the interaction between the banking sector and the South African (SA) economy. This rests on analysing the efficiency of the SA banking sector and the effects of changes in banking sector efficiency on the macroeconomy.

To do so, we evaluate the historical evolution of productivity in the banking industry in chapter 2, by calculating a measure of productivity through a descriptive exercise. In chapter 3, we introduce labour dynamics of the banking industry by developing a model that links the productivity of the banking sector and macroeconomic outcomes. In chapter 4, we analyse how banking sector regulation affects the relationship between the banking sector and the macroeconomy and the contribution of banking sector regulation in determining the efficiency of the sector.

In chapter 2, the measure of bank productivity is computed as the ratio of income share of the banking industry to quantity of intermediated assets by the industry and interpreted as the unit cost of creating and maintaining an intermediated asset. Our results indicate that there is no apparent trend in the unit cost of intermediation, signalling constant bank productivity. The unit cost of intermediation rises post 1999 until 2002, which is a period characterised by various mergers in the banking industry and the demise of various banks. Post 2008, the cost ratio declines and eventually flattens to almost similar levels in 1993.

In chapter 3, we link the productivity of the banking sector and macroeconomic outcomes by analysing the effects of bank productivity shocks and whether they influence the adoption of labour and physical capital in the banking industry, which are

key in influencing banking sector productivity and general effects on the macroeconomy. To do so, we develop a Dynamic Stochastic General Equilibrium model (DSGE) where banks use labour and physical capital to produce their respective output. We also introduce basic labour market heterogeneity by assuming that banks only use skilled labour to produce output. Our results indicate that negative productivity shocks hitting the banking industry, which we argue are akin to tightened regulation, prompts banks to invest in labour and physical capital that will implement the regulatory changes, as evident by rising physical capital and labour in banks in the model.

Lastly in chapter 4, we empirically estimate how banking sector regulation affects the relationship between the banking sector and the macroeconomy and the contribution of banking sector regulation in determining the efficiency of the sector. To capture regulatory changes in the SA banking industry, we introduce a narrative series of regulatory changes in the banking sector from 2001 to 2019. The narrative series is decomposed into drafting and announcement of regulation and eventual implementation of the regulation. Our results show evidence of anticipation effects where banks increase lending in anticipation of stringent regulatory requirements in future, as both corporate and household credit rise. Our results also show persistent and negative effects on both corporate and household lending following regulatory implementation, with the effects of regulatory changes more pronounced on household credit relative to corporate credit.

Acknowledgements

Goodness! where do I start? I firstly would like to thank the Almighty for strength and grace through the journey. I also express gratitude to my supervisor, Prof Nicola Viegi for the opportunity and guidance through the Ph.D. journey. I remember a specific instance where I contemplated quitting the Ph.D. due to personal reasons, but Prof Nicola gave me a ”gentle” reminder that this Ph.D. is bigger than me. For that, I am eternally grateful Prof! I also thank the South African Reserve Bank (SARB) Chair in Monetary Economics, under your leadership Prof, for the funding. To my partner, a big thank you for your support, understanding and sacrifices you have made to ensure I complete the Ph.D. To my Ph.D. colleagues, thank you for the random “counselling” sessions we had with each other. They certainly made the journey less lonely.

This Ph.D. journey has been long, challenging and often painful. I have however learned a lot, travelled to places I never thought I would go to and been in rooms with some very important decision makers in South Africa. Though this is the end of the Ph.D. journey, it is however the start of greater challenges and achievements to come.

Contents

[1]This chapter was published on December 26, 2023 as a special issue article in the South African Journal of Economics. Available at: https://doi.org/10.1111/saje.12364

List of Tables

List of Figures

Chapter 1

General Introduction

The objective of the thesis is to analyse and understand the interaction between the banking sector and the economy in SA. This rests on analysing the efficiency of the SA banking sector and the effects of changes in banking sector efficiency on the macroeconomy. In doing so, we: (1) calculate a measure of banking sector productivity in a bid to evaluate its historical evolution thereof; (2) develop a model linking the productivity of the banking sector and macroeconomy and investigate the effects of bank productivity shocks and their spill-over effects on the economy; and (3) estimate the macroeconomic effects of regulatory changes and movements in the SA banking industry. Our research questions and focus on the banking industry are significant as the industry is considered to be well developed, large and deep, further signalling its significance as a primary role player in financial intermediation. For instance, credit intermediated by the banking sector in SA to the private non-financial sector as a percentage of GDP is consistently over 60 percent, relative to only 58 percent in Middle East and North Africa (peak) and 55 percent in Sub-saharan Africa[1]. Assets of the banking sector as a percentage of GDP peaked at over 80 percent before the 2008 global financial crisis (GFC), relative to the United States (U.S) with bank assets as a percentage of GDP peaking at 60 percent before the 2008 GFC[2]. The banking sector in SA is also well capitalized with a tier 1 capital ratio of 11 percent, relative to the 6 percent minimum required under Basel III regulations (McKenzie et al., 2017).

These facts show the significance of the developed and deep banking sector in the SA economy. The opening chapter of the thesis undertakes a further descriptive exercise of the South African banking industry and investigates whether the well developed and deep banking sector in South Africa has translated into greater efficiency with respect to increased banking services and or lower cost of banking services. The descriptive exercise also documents some of the peculiarities with regards to relative remuneration, employment and physical capital investment in the banking industry. For instance, Fedderke (2012) documents how employment levels in major sectors in SA such as mining and manufacturing continue to decline despite relatively strong GDP performance post 2008, relative to international experiences. This is not the case however in the banking industry. For instance, panel (a) of Figure 1.1 shows that most industries in SA steadily expand their employment levels during 2002 to 2006; a period in which the country experienced robust economic growth. During

[1]Figures obtained from Bank for International Settlements (BIS), available at https://stats.bis.org/statx/srs/table/f2.4.

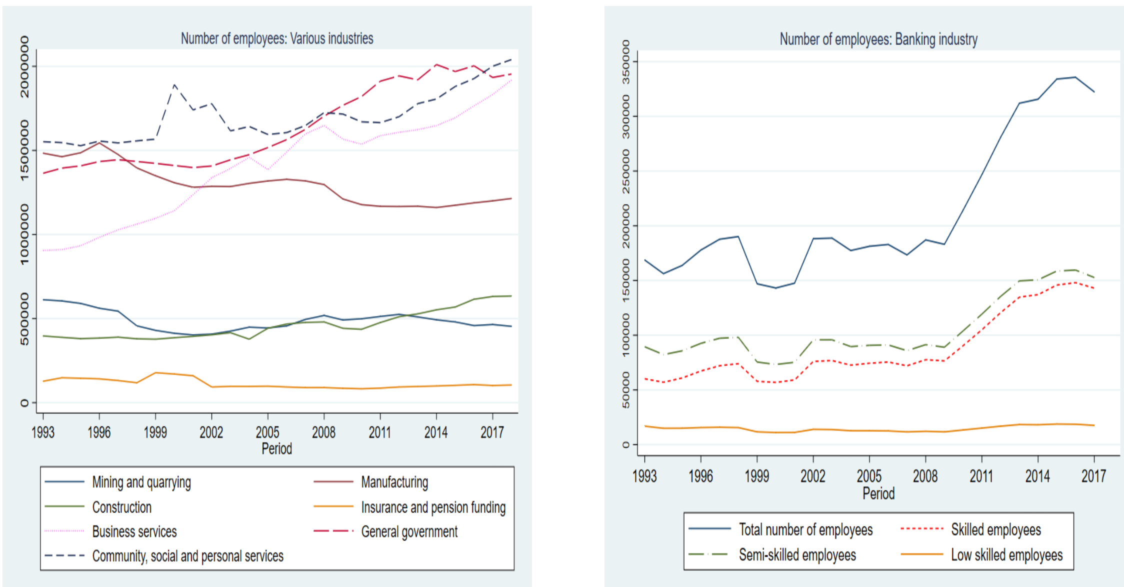
[2]Figure is obtained from World Bank, Deposit Money Bank Assets to GDP for South Africa [DDDI02ZAA156NWDB], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DDDI02ZAA156NWDB.

the same period, employment levels in banks is stagnant as shown by panel (b). Post 2008 where most industries shed jobs, the banking sector behaves differently as employment levels expand. Panel (b) of Figure 1.1 further shows that employment in banking expands across all skill levels.

Figure 1.1: Number of employees: Banking industry vs other industries

(a) Other industries

(b) Banking

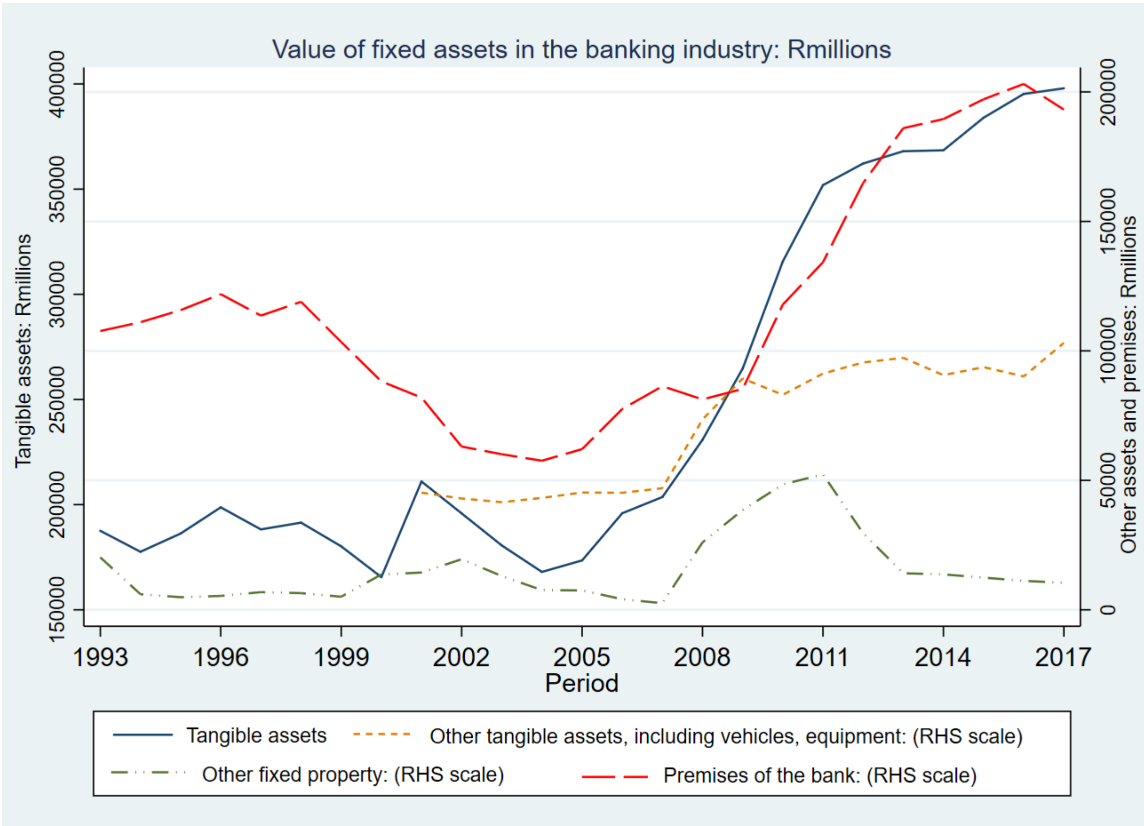


Note: This figure shows and compares the number of employees in the South African banking industry relative to other industries in the country. Source: Stats SA Quarterly Employment Statistics (QES).

The rise in employment is further complimented by the increasing adoption of physical capital. This is depicted in Figure 1.2 as tangible assets expand post 2008, driven by bank premises. As with employment levels, the expansion in physical capital post 2008 is preceded by declining and stagnant adoption during the 2002 to

2006 economic growth period in South Africa.

Figure 1.2: Physical capital in the banking sector

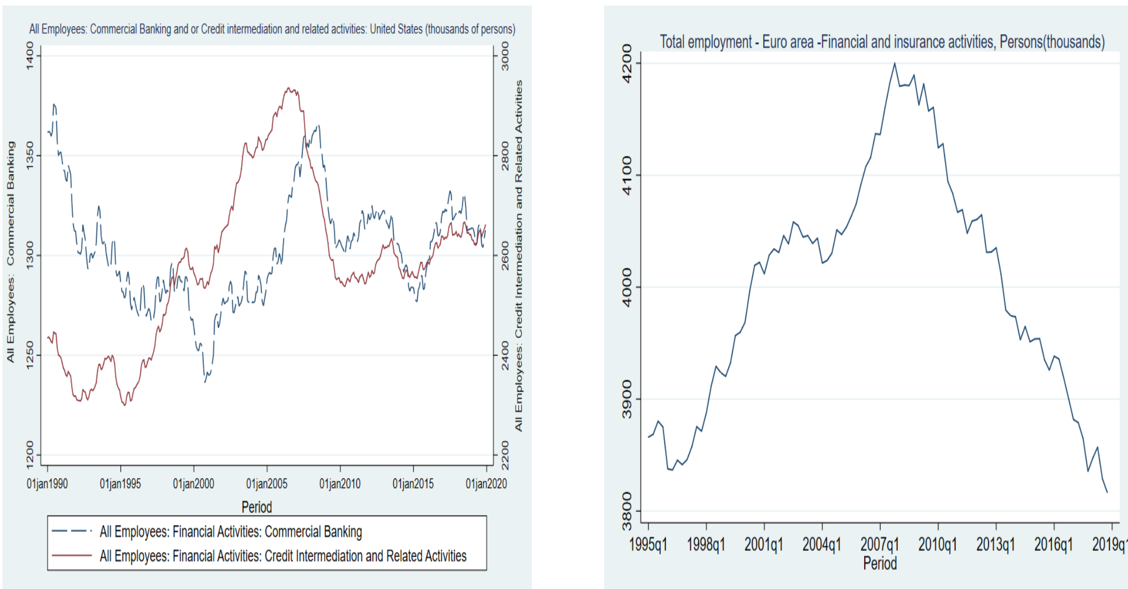


Note: This figure shows the value of physical capital or fixed assets in the South African banking industry. Source: South African Reserve Bank (SARB) Historical DI900 converted to BA900.

In comparison to international experiences, Figure 1.3 shows that employment dynamics in the South African banking industry remain peculiar. While employment levels expanded in the sector, both panel (a) and (b) of Figure 1.3 show that banking industries in the United States (U.S) and the European Union (EU) shed jobs in the aftermath of the 2008 GFC.

Figure 1.3: Employment in the U.S and European banking industries

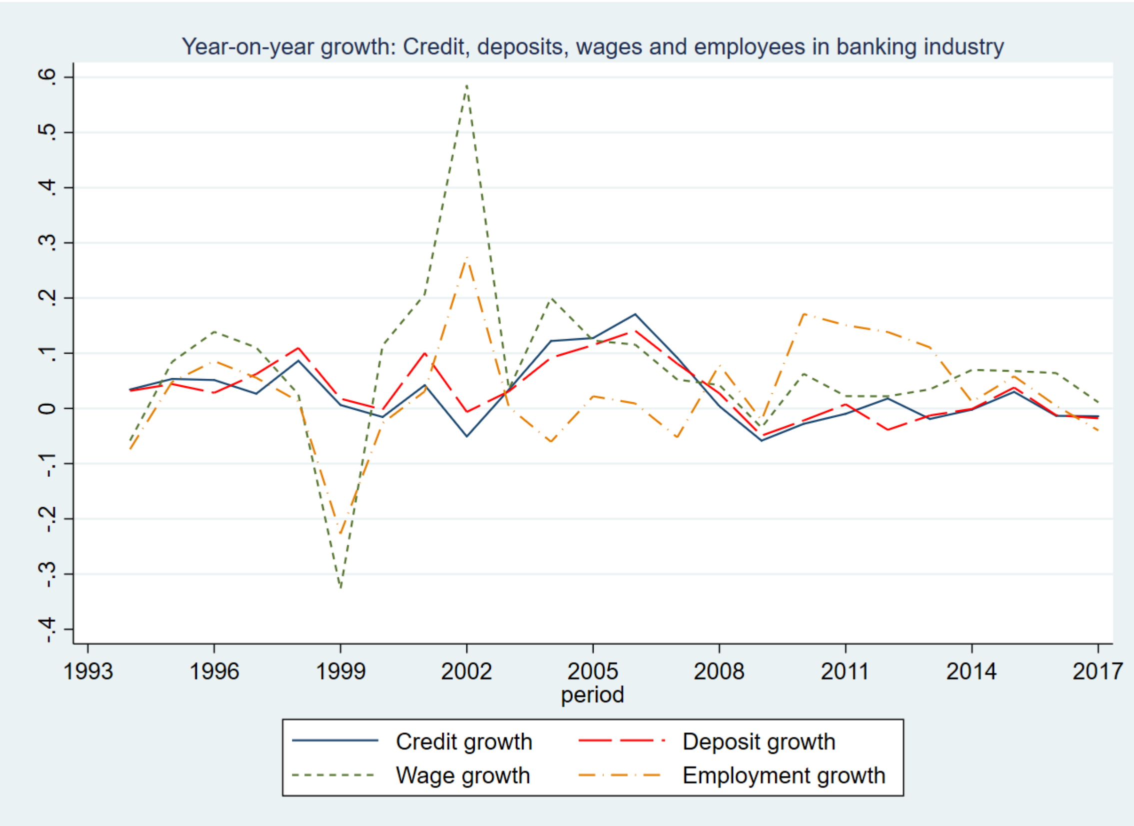
(a) U.S (b) EU



Note: This figure shows the number employees in the United States (U.S) banking industry and European Union (E.U) banking industry. Source: FRED.

A potential explanation behind the relatively peculiar behaviour of the increase in labour and physical capital in banking, is greater expansion in "bank output", such as credit and deposit intermediation. However, observations from Figure 1.4 show that during the 2000 to 2006 economic growth period, credit and deposit growth is robust relative to weak and stagnant employment growth in banking. Post 2008 however, growth in credit extension and deposit intermediation falls and eventually stagnates relative to year-on-year growth in employment, which grows to over 10 percent.

Figure 1.4: Credit, deposit, wage and employment growth



Note: This figure shows year-on-year growth in credit extension by banks, deposits, wages and employment in banks. Source: Quantec, SARB and authors' calculation.

Therefore, in an economy that contracts during and post 2008, with consequent declines in employment in almost all SA private sector industries as well as major banking industries globally, why does the banking industry in SA expand real resources in labour and physical capital?

With the foundation work we undertake in chapter 2, we aim to provide answers to the question by: (1) calculating a measure of banking sector productivity in a bid to evaluate its historical evolution; (2) developing a model linking the productivity of the banking sector and macroeconomy and investigate the effects of bank productivity shocks and their spill-over effects on the economy; and (3) building on the second research question to analyse and empirically estimate how banking sector regulation affects the relationship between the sector and the macroeconomy and the contribution of banking sector regulation in determining efficiency of the banking industry.

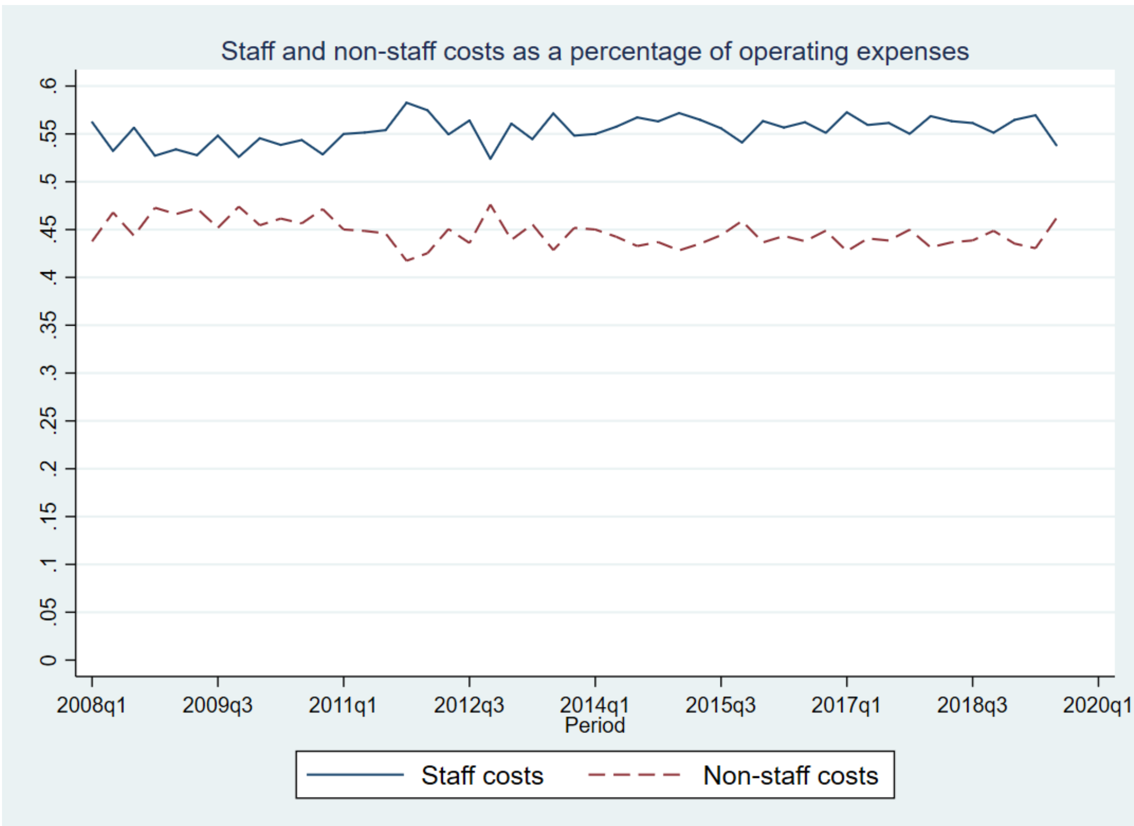
As outlined earlier, chapter 2 builds the foundation for the thesis due to its descriptive nature of the SA banking industry. We study the evolution and contribution of the banking industry, consistent with similar work in the literature, as with Haldane et al. (2010), Philippon and Reshef (2013) and Bazot (2017). In doing so, we calculate a measure of productivity for the banking industry. This is in a bid to understand whether the development, increased contribution and influence of the banking industry has translated into lower cost of intermediation or improved productivity. The measure is defined as the ratio of income share of the banking industry to quantity of intermediated assets. In essence, the measure is interpreted as the unit cost of creating and maintaining an intermediated asset. The productivity measure, by definition and computation, sheds light on whether income share of the industry defined by Philippon (2015) as broad fees, spreads and other income paid by the non-financial sector to the banking industry, has been matched by greater bank output defined by Philippon and Reshef (2013) as services provided by the banking sector to the private non-financial sector, which facilitate the creation of financial assets. Our results indicate that there is no apparent trend in the unit cost of intermediation, indicating constant bank productivity. The unit cost of intermediation rises post 1999 until 2002, driven by rising income share relative to bank output. This also indicates that how much society is paying for banking services is not matched by what society is obtaining from banks. Post 2008, the cost ratio declines and eventually flattens to almost similar levels in 1993.

We proceed in chapter 3 to investigate the effects of bank productivity shocks and their spill-over effects on the economy. To do so, we develop a Dynamic Stochastic General Equilibrium (DSGE) model calibrated for the SA economy, to link the productivity of the banking sector and macroeconomy. The model is along the lines of Dia and Menna (2016) and Dia and VanHoose (2017), where banks employ labour and physical capital to provide intermediary services or output such as credit and deposits, contrary to modelling strategies in Gertler and Karadi (2011)[3]. The model is further characterised by firms and households and we introduce labour market heterogeneity by assuming that banks only use skilled labour to produce output. The motivation in modelling the banking industry in a firm structure, where banks employ real resources in labour and physical capital, is that real resource costs play a major role in the cost structure of banks. Dia and Menna (2016) and Dia and VanHoose (2017) show that real resource costs are the most relevant share of banks' costs across different countries. This is also the case in SA. Figure 1.5 shows that staff costs account for over 50 percent of banks' operating expenses, peaking at 55 percent

[3]In the framework of Gertler and Karadi (2011), banks are not treated as firms. Therefore, real resource costs of banks do not play a role in the transmission of shocks.

relative to non-staff costs, which have been fairly constant. In addition, Figures 1.1 and 1.2 provided further evidence on the growing importance of real resources in the SA banking industry, especially post 2008.

Figure 1.5: Staff and non-staff costs in the South African banking industry



Note: This figure shows and compares staff costs and non-staff costs, as a percentage of operating expenses, in the South African banking industry. Source: SARB.

To interpret the model, we argue that bank productivity shocks potentially mimic tightened regulation in the banking industry in the case of negative bank productivity shocks. In the case of positive productivity shocks, they mimic improvements in the technology of bank intermediary services.

Our results show that positive productivity shocks hitting the banking industry, which are akin to shocks on the productivity of loan and deposit origination and monitoring, results in less labour and physical capital adoption in the banking sector. This resembles the consequences of banks' recent adoption and implementation of technological advances and digitisation, resulting in reduced bank branch networks. Conversely, negative bank productivity shocks result in increased labour and physical capital adoption. This mimics the consequences of tightened regulatory changes in the banking industry, where banks subsequently invest in regulation and compliance staff and systems needed to implement and meet new regulatory requirements. Our results further show that the loan interest rate and the interest margin rise following negative shocks. This implies that banks externalise and pass on the higher cost of labour and physical capital following tightened regulation, to end-users of banking services.

The closing chapter of the thesis analyses and empirically estimates the effects of banking sector regulation and the implied contribution of regulation in determining the efficiency of the sector. We also build the analysis on theoretical predictions from the model in chapter 3. Results from the model indicate that negative bank productivity shocks, which mimic tightened regulation, results in relatively greater adoption of labour and capital to implement the regulatory changes. This results in higher loan rates and interest spread as banks shift regulatory costs. Further evidence by Casu et al. (2013) shows that declining compliance costs or regulatory easing reduce the overall cost of producing bank output. To capture regulatory changes in the SA banking industry, we introduce a narrative series of changes and movements in banking sector regulation from 2001 to 2019. We use the series to estimate and analyse the macroeconomic effects of regulatory changes. The exogenous narrative series is constructed from documents containing regulatory records and is decomposed into drafting and announcement of regulation and eventual implementation of regulation. In application, we use the narrative regulatory series as exogenous variables in the Bayesian Vector Autoregression (BVAR) framework and Local-Projections (LP) framework. Both models allow us to estimate the effects of exogenous regulatory changes on macroeconomic variables. We further use the series in a Local-Projections Instrumental Variables (LP-IV) framework. The series of regulatory changes serve as instrumental variables (IVs) to the bank interest rate margin and thereby implicitly instrument for negative bank productivity shocks. To our knowledge, we are the first to study the relationship between bank regulation and bank productivity in South Africa, using narrative methods of identification.

The results show evidence of anticipation effects where banks increase lending in anticipation of stringent regulatory requirements in future, as both corporate and household credit rise. Results also show persistent and negative effects on both corporate and household lending following regulatory implementation, with the effects of regulatory changes more pronounced on household credit relative to corporate credit. In the LP-IV setting, our results further show the positive and immediate response of the interest margin (spread) to narrative regulatory shocks, which support and validate our story. The intuition is that negative productivity shocks mimic tightened regulation, which we implicitly instrument for using the interest rate margin. The regulation is captured by the narrative series and as such, the increase in the loan interest and interest rate margin imply that banks pass on the cost of regulatory changes.

Chapter 2

Measuring the Unit Cost of Financial Intermediation in South Africa: A Measure of Bank Productivity[1]

2.1 Introduction

In this chapter, we evaluate the historical evolution of productivity in the South African banking industry, by calculating a measure of productivity. We do so through a descriptive exercise. This is in a bid to understand whether the development, increased contribution and influence of the banking industry has translated into

[1]This chapter was published on December 26, 2023 as a special issue article in the South African Journal of Economics. Available at: https://doi.org/10.1111/saje.12364

lower cost of intermediation or improved productivity and efficiency of the banking sector. For instance, the banking sector in South Africa has grown twice as rapidly as the services sector and more than three times as fast as the manufacturing sector (Rashid, 2011). In addition, credit intermediated by the sector to the private non-financial sector as a percentage of Gross Domestic Product (GDP) is consistently around 60 percent, in line with many advanced economies.[2] Assets of the sector as a percentage of GDP peaked at over 80 percent before the 2008 global financial crisis (GFC), relative to the United States (U.S) with bank assets as a percentage of GDP peaking at 60 percent before the GFC.[3] These facts point to the importance of the banking sector in the South African economy.

At the same time, the increasing dimension and importance of the banking system is not in itself an indicator of efficiency of financial intermediation. The cost of financial intermediation is another important channel through which financial development enhances productivity and growth in the economy.[4]

This chapter therefore reviews evidence on productivity growth in the banking industry over the past thirty years and investigates whether the development, increased contribution and influence of the sector has translated into lower cost of intermediation, implying improved productivity and efficiency.

[2]Figures obtained from Bank for International Settlements (BIS) available at https://stats.bis.org/statx/srs/table/f2.4.

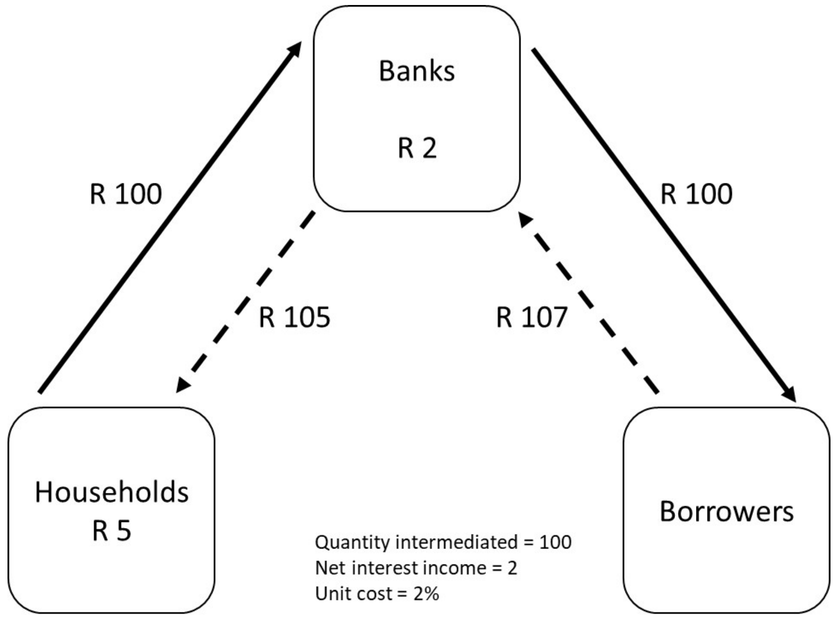
[3]Figure is obtained from World Bank, Deposit Money Bank Assets to GDP for South Africa [DDDI02ZAA156NWDB], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DDDI02ZAA156NWDB.

[4]The role that the cost of financial intermediation plays in the efficient allocation of resources and in favouring economic growth is well established in the literature, see for example Levine (1997) for a classic reference and Greenwood et al. (2010) and Buera et al. (2011) for more recent ones. The cost of financial intermediation plays an important role also in macroeconomic models of the business cycle as in Cúrdia and Woodford (2016).

In doing so, we aim to construct measures of income for the banking system, quantity of intermediated assets and of unit cost of financial intermediation. In this we follow the work of Philippon and Reshef (2013), Philippon (2015) and Bazot (2017) that present the same evidence for the U.S and several European countries.

To interpret our measures of bank productivity, we use a simple model of financial intermediation illustrated in Figure 2.1, adapted from Philippon (2015). In this model, banks provide lending and deposit services. To illustrate, we assume that depositors want to deposit R100 with a 5 percent deposit rate and obtain R105 in return, while borrowers want to borrow R100 at a 7 percent loan rate, thereby repay R107. Banks reduce information asymmetries and play an intermediary role between depositors and borrowers. The R100 is viewed as the quantity of the intermediated asset while the R2 difference accrued to the bank, is the interest income which compensates for the cost of intermediation such as the cost of monitoring and managing the risk of the loan. In essence, the unit cost of intermediation is R2 or 2 percent.

Figure 2.1: Simplified Model of Financial Intermediation



Note: This figure shows a simplified model of Financial Intermediation. Source: Philippon (2015)

Therefore, as the banking industry becomes more productive, it should cost less to maintain and create an intermediated asset.

Evidence from Philippon and Reshef (2013), Philippon (2015) and Bazot (2017) shows that the unit cost of intermediation has not declined since the 1950s in the U.S and European banking industries. In other words, despite the development and innovation in the finance industry, financial services remain expensive and in fact, the finance industry of 1900 was just as able as the finance industry of 2010 to produce loans, bonds and deposits, even cheaply.

Our results show three main stylized facts:

- Output, gross value added (GVA) and remuneration in the banking sector has grown significantly until the GFC. After 2007, remuneration and GVA have been stagnant against an increase in bank output, indicating a decline in the value of bank output.

- There is no apparent trend in our measure of bank productivity, the unit cost of intermediation.[5] The unit cost rises post 1999 until 2002, which is a period characterized by various mergers and consolidation in the banking industry, indicating a potential reduction in competition.[6] Post 2002, the cost ratio of core banking services (credit and deposits) declines back to the 1993 levels, as the overall cost of finance.

- Labour productivity increases significantly before the GFC but has since halved in the ten years following the GFC when the banking industry saw a large expansion in employee numbers, not matched by a contemporaneous increase in bank output. This is partly related to the increased investment in regulatory and compliance activities to satisfy the new regulatory environment developing after the GFC.

Therefore, despite major improvements in the South African banking industry with regards to technological advances, the cost of creating and maintaining intermediated assets has been constant. A further implication of the mixed trend in the cost ratio

[5]The terms unit cost of intermediation and cost ratio of finance are used interchangeably in the chapter.

[6]The banks that had liquidity problems and thereby placed under curatorship and those that were eventually liquidated include African Bank, Islamic Bank, Regal Treasury Bank and Saambou Bank among others. The biggest merger occurred in 1997 between First National Bank, Rand Merchant Bank, Southern Life assurance company and Momentum Life assurance company to form the First Rand Group.

is that the improvements have not been passed to the end users of banking services (i.e., households and firms) in the form of lower cost of intermediation.

Studies on the productivity and efficiency of the South African banking sector have focused on correlating productivity and efficiency with competition in the sector or with concentration and market power. For instance, Okeahalam (2006) analyzes the production efficiency of bank branches, in the context of a concentrated banking system such as in South Africa. Verhoef (2009) correlates bank concentration to the efficiency ratio of banks and finds that banks' efficiency declined post 2002, with the period correlating with increased concentration in the sector. Maredza and Ikhide (2013) measure the impact of the GFC on the efficiency and productivity of the banking sector, with their results indicating that total factor productivity (TFP) efficiency was 16.96 percent lower during the crisis period compared to the pre-crisis period. Mlambo and Ncube (2011) investigate the evolution of competition and efficiency in the sector and their results show that the number of efficient banks was falling between the 1999 to 2008 period. Notably, the approaches in the above works in determining and defining efficiency and productivity are based on econometric approaches, with the exception of Verhoef (2009).
The rest of the chapter is organized as follow. Section 2.2 discusses the data and measurement of income share and output of the banking industry. Section 2.3 discusses the results and an additional measure of labour productivity. Section 2.4 concludes and suggest further research analyzing the impact of prudential regulation in reducing the dynamism and efficiency of the sector.

2.2 Data and Methodology

2.2.1 Measuring Financial Income and Output

In this section, we describe the data used to construct the bank productivity measures. This is based on three correlated but different indicators of the size of the banking sector. The source of the data is in Appendix 2.5.

The first measure is the income share of the banking industry, which gives an idea of the economic weight of the sector over time. Following Philippon (2015), we use the ratio of GVA to GDP and the ratio of labour compensation in banking to aggregate compensation in the economy as measures of income share. As outlined by Haldane et al. (2010), GVA is the sum of profits and wages in the banking sector, which we divide by GDP to obtain a measure of income share. Similarly, labour compensation of employees captures wages, salaries and bonuses, which we divide by aggregate labour compensation in the economy.

We also describe the size of the banking sector in terms of output produced. According to Bazot (2017), bank output accounts for all services provided by banks, with an intermediated asset defined as an asset that provides a financial service to non-financial industry customers. Therefore, we define the proxy for bank output or quantity of intermediated assets [7] as the sum of credit to the private non-financial sector, liquidity services, equity intermediation and public sector marketable debt. Credit to the private non-financial sector includes overdrafts, loans and advances extended by banks to households and non-financial sector firms. These are measured

[7] The two terms are used interchangeably in the chapter.

on the asset side of banks' balance sheets. We use deposits to proxy for liquidity services, measured on the liabilities side of banks. Stock market capitalization is used as a proxy for equity intermediation while public sector marketable debt includes financial debt instruments of government institutions at all levels of general government and public sector corporations. It is worth noting that the development and evolution of banking industries has seen banks taking on other non-traditional banking services such as asset and wealth management. However, due to difficulties in measuring such services, we limit and define bank output as described above.

Having described income share and output of the banking sector, the measure of bank productivity is computed as income share divided by bank output.

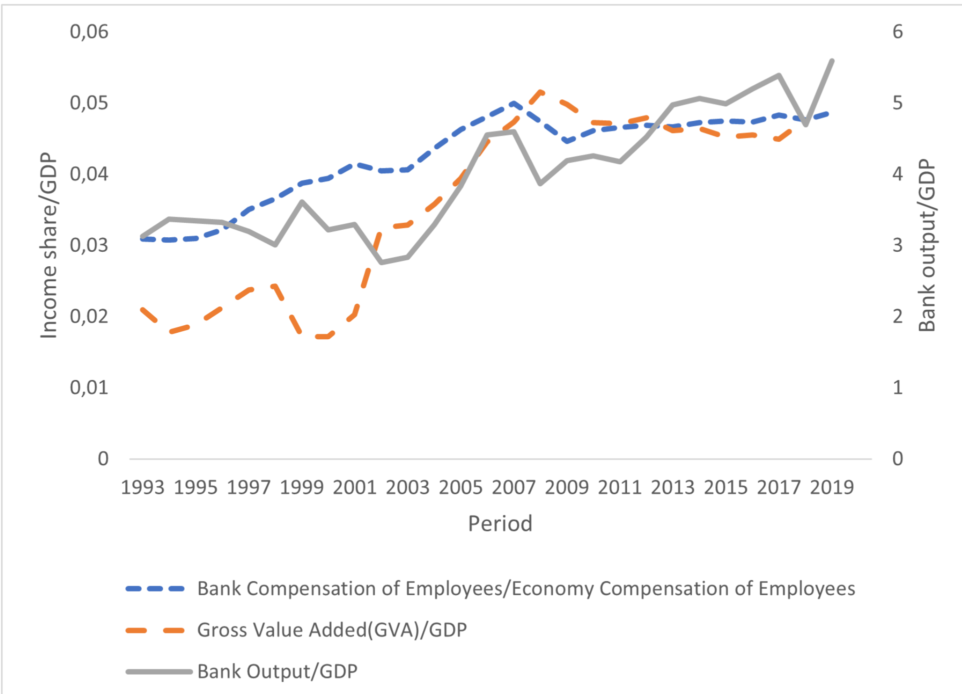
2.3 Results

2.3.1 Income Share and Bank Output

Figure 2.2 shows the evolution of the measures from 1993 to 2019. Income share notably declined between 1997 and 1999, which is a period of significant structural change in the banking sector as described earlier. Post 2002, the industry's contribution expands robustly reaching a peak of over 4 percent before declining and flattening post the GFC. This dynamic is highly correlated with the overall growth trajectory of the economy.

Figure 2.2 also shows that the relative remuneration measure follows the GVA path, with continuous growing importance until the GFC and stagnation afterwards. Philippon and Reshef (2013), Philippon (2015) and Bazot (2017) find similar increasing trends in income share of finance in the U.K, Japan, Canada and the U.S respectively.

Figure 2.2: Financial Income and Output



Note: This figure shows measures of income share of the South African banking industry (finance), which are Gross Value Added by the banking industry, as a percentage of GDP and relative remuneration, which is the ratio of compensation of employees in banks to overall compensation of employees in the economy. It also shows quantity of intermediated assets or bank output. Source: Quantec and authors' calculations.

Although it is not the objective of the chapter to outline reasons behind the upward trend of income share, it is worth noting an important aspect. The rise of income share post 2002, particularly the 2002 to 2006/07 period, coincides with robust economic growth, coupled with strong wage, credit and deposit growth. This suggests that rising income share of finance is linked to South Africa's economic growth.[8]

[8] GDP growth peaked at 5 percent in 2005, the highest to date, while wages in banking, credit

The evolution of bank output is also shown in Figure 2.2, with evident expansion post 2002, coinciding with the 2002 to 2006/07 economic growth period. After the crisis and a brief contraction of bank output, the sector has started growing again in proportion to the economy. It is noticeable how in the last ten years, the growth of bank total output is not matched by a similar growth in income share.

2.3.2 Unit Cost of Intermediation

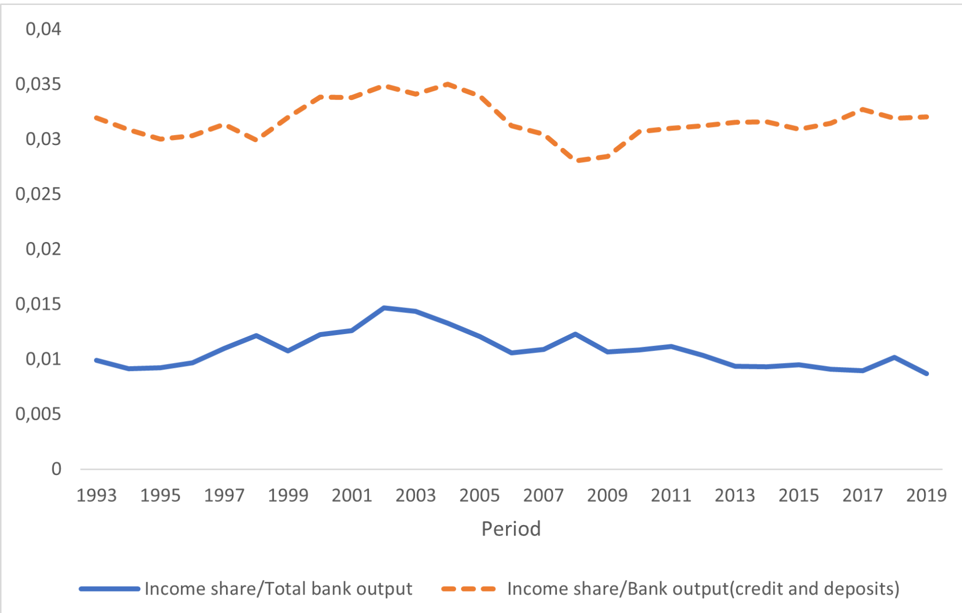
We proceed to calculate the measure of productivity, computed as income share divided by bank output. It measures the cost of creating and maintaining an intermediated asset, given a set of inputs (Philippon, 2015). Further and in line with Philippon and Reshef (2013) and Philippon (2015), we compare the unit cost of intermediation for different measures of bank output where we use credit to the non-financial private sector and deposits as bank output and an attempt to encompass a broader measure of bank output, as defined in section 2.2.

Figure 2.3 shows the evolution of the unit cost of financial intermediation. Notably, the cost ratio falls leading up to 1999 and thereafter rises to over 1 percent as a percentage of GDP. The rising cost ratio post 1999 is driven by rising income share relative to bank output, which is indicative of the notion that how much society is paying for banking services is not matched by what society is obtaining from banks. In addition, Philippon (2015) argues that a possible explanation for the rise in the cost of intermediation in the U.S is increased concentration in the banking sector from 1998. Therefore, a similar argument can be made for South Africa as the rise

and deposit growth all peaked at over 10 percent.

in the cost of intermediation occurs during a period of increased concentration in the banking sector. The finding is also complimentary to the work of Verhoef (2009) who shows that efficiency of banks in South Africa declined post 2001 until 2006.

Figure 2.3: Cost ratio of finance



Notes: This figure shows the evolution of the cost ratio of finance in South Africa, which is a measure of productivity in the banking sector. It is computed as income share, divided by bank output. Source: Authors' calculations, Quantec and Stats SA Quarterly Employment Statistics (QES).

Post 2002, the cost ratio declines until 2006, rises briefly until 2008 and eventually flattens post 2008 to almost similar levels in 1993. The declining cost ratio post 2002 signals improved productivity as the increase in bank output outpaces what society pays for such bank services.

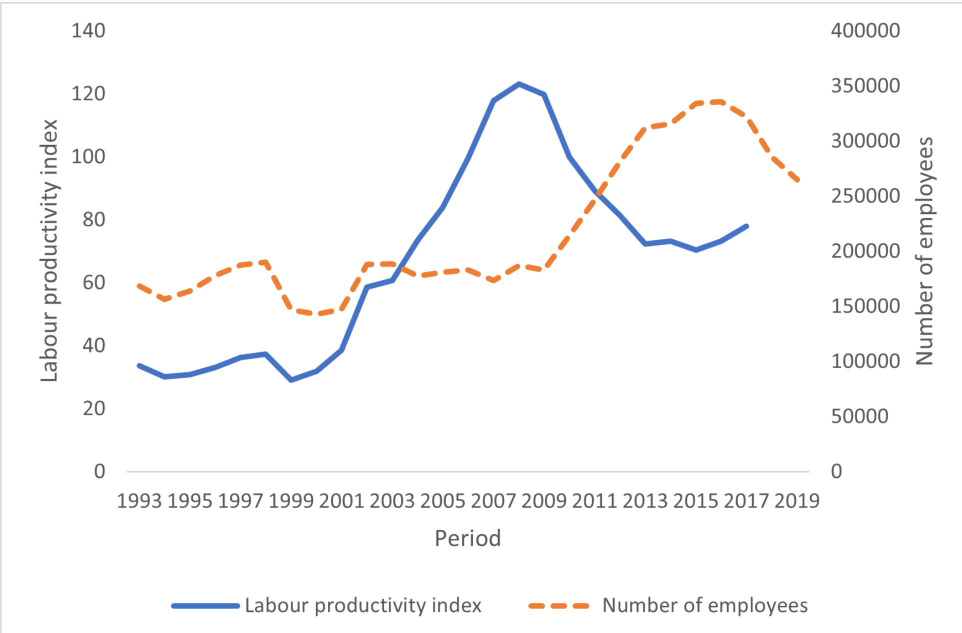
However, a puzzling implication of the flat cost ratio post 2008, is its similarity to levels almost experienced in 1993. This implies that improvements in the banking industry such as technological improvements have not been passed to the end users of banking services. The expectation is that such improvements and innovations would improve productivity and imply lower cost of banking services for customers. Despite using different measures of bank output and a longer period of analysis, Philippon and Reshef (2013) and Bazot (2017) find similar mixed trends in the cost ratio for the U.K, France and Germany. A similar finding is observed for the U.S when bank output is comprised of loans only.

We further relate the unit cost of intermediation to an existing measure of labour productivity, which is an index of labour productivity for banks. It is measured as output per unit of labour.[9] The measure is also used by Maredza and Ikhide (2013) in their analysis of the impact of the 2008 financial crisis on efficiency and productivity in the banking system. The intuition behind the correlation is as follow. Output per unit of labour analyzes the use of labour input to produce output, while the unit cost of intermediation considers income accruing to production factors. Therefore, as the banking industry becomes more productive, reflected by an increase in the labour productivity index, it should cost less to maintain and create an intermediated asset, reflected through a decline of the unit cost of intermediation.
Figure 2.4 shows an improvement in labour productivity from 2002 until 2007. In the same period, the cost ratio falls as described above and in Figure 2.3. Post 2008, labour productivity falls due to the expansion of labour input, as shown in Figure 2.4 by the rise in the number of employees in banks, relative to bank output.

[9] The definition is in line with the International Labour Organizations' definition of labour productivity.

Our measure of productivity, the unit cost of intermediation, is constant due to flat income share post 2008.

Figure 2.4: Labour productivity index and employees in banks



Notes: This figure shows the labour productivity index in the South African banking industry, defined as output per unit of labour. It also shows the number of employees in the banking industry. Source: Authors' calculations, Quantec and Stats SA Quarterly Employment Statistics (QES).

A further puzzling implication from our analysis is the rise in the number of employees as shown in Figure 2.4, that is not matched by a rise in bank output.[10]

Therefore, could the expansion in labour and subsequent decline in labour productivity, coupled with constant bank productivity as measured by the unit cost of intermediation, be explained by changes in bank regulation?

[10]The rise in bank output post 2008 shown in Figure 2.2, is attributed to the rise in the intermediation of equity. Credit extension and deposit services fall and flatten in the same period to levels experienced before the 2003/04 credit boom.

The post 2008 period is significant as further regulatory changes in the banking industry were introduced following the GFC. However, banks in South Africa and reports by other financial institutions raised concerns relating to the intrusive and costly nature of regulation. For instance, the PricewaterhouseCoopers (PWC) Major Banks' analysis report[11] and the Financial Services Sector Assessment Report[12] indicates that the introduction of regulation has seen banks in South Africa subsequently investing in regulation and compliance staff as well as system enhancements needed to implement and meet regulatory report requirements. Consequently, headcount staff and costs continue to increase, accounting for over 55 percent of major banks' total operating expenses.

Chief Executive Officers (CEO's) of major banks in South Africa have in addition, raised concerns relating to efforts spent on regulatory compliance, which requires significant time and focus to adapt to and implement.[13] Furthermore, the Financial Services Sector Assessment Report indicates that changes in bank regulation are occurring at a rapid rate, with concerns that they might be intrusive, further increasing costs for banks and have a negative impact on banks' ability to innovate.

It is against this background that the expansion of labour in the banking industry and subsequent decline in productivity, can be associated with regulatory changes. The response of banks to regulatory changes in the form of expansion in labour, are at the cost of reduced productivity in the sector. Put otherwise, regulatory changes

[11] Available at https://www.pwc.co.za/en/assets/pdf/major-banks-analysis-sept-2017.pdf.

[12] The report was prepared by the Department of Economic Development and Tourism and the University of Cape Town. Available at http://www.aifmrm.uct.ac.za/wp-content/uploads/AIFMRM-DEDT-Financial-Services-Sector-Assessment-Report-2014.pdf.

[13] The CEO's are quoted in article, available at: https://www.businesslive.co.za/archive/2012-12-13-local-banks-decry-onslaught-of-new-rules/.

that fostered greater employment of labour that is not matched by an equal or greater expansion in bank output, particularly credit extension,[14] has translated into reduced labour productivity and constant unit cost of intermediation in the sector.

2.4 Conclusion

This chapter analyzes bank productivity in South Africa and evaluates whether the development of the banking industry has translated into lower cost of intermediation or improved productivity and efficiency of the sector. Results from our computation shows that there is no apparent trend in the unit cost of intermediation between 1993 to 2019, which entails constant productivity. Therefore, despite major improvements in the sector with regards to technological advances, the cost of creating and maintaining intermediated assets has been constant. This can partly be associated with regulatory changes that occur post the GFC, which fostered an expansion of employment in the sector with the aim of implementing the regulatory changes. The expansion of employment is however not matched by an equal or greater expansion in bank output, which consequently translates into reduced labour productivity and constant unit cost of intermediation. Further research analyzing the impact of prudential regulation in reducing the dynamism and efficiency of the sector, is therefore suggested.

[14]The year on year growth in credit extension, which is a basic measure of bank output, peaks at just 2 percent post 2008 relative to a peak of 10 percent before 2008.

2.5 Appendix

2.5.1 Data Sources

Variable	Definition	Source
Credit to private sector (Overdrafts, loans and advances) ,	Sum Advances to financial corporate sector, non-fin corporate sector, unincorporated business enterprises of households, households and NPO's, factoring debtors & other loans & advances to above agents.	SARB Historical DI900 converted to BA900,181,187&188
Credit to households	Overdrafts, loans & advances to households	SARB Historical DI900 converted to BA900, 185&192
Credit to non-financial corporate sector	Overdrafts, loans & advances to non-financial corporate sector	SARB Historical DI900 converted to BA900, 183&190
Credit to public sector (government)	Overdrafts, loans & advances to public sector	SARB Historical DI900 converted to BA900, 171(172-179)
Gross Domestic Product at Market, Constant 2010 prices, R millions: Seasonally adjusted Prices		Statistics South Africa (Stats SA) P0441
Gross Value Added (GVA)	It is a measure of the contribution to GDP made by the finance sector: (Income earned by the relevant factors of production)	SARB Quarterly Bulletin (S110-137) and Quantec
Household deposits	Deposits by households denominated in Rand and foreign currency	SARB Historical DI900 converted to BA900, 27&35
Corporate deposits	Deposits by non-financial corporate sector (Rand and foreign currency)	SARB Historical DI900 converted to BA900, 25&37
Government deposits	Deposits by government (central, provincial, social security and local)	SARB Historical DI900 converted to BA900,34,6,7,10,11&14
Number of employees	Number of employees, full time in economy and banking	Stats SA Quarterly Employment Statistics (QES) P0277& Survey of Total Employment and Earnings, Household and Labour Surveys and Population Censuses
Gross earnings	Payments for ordinary-time, standard or agreed hours for all employees: Total sum of the earnings including performance and other bonuses	Stats SA Quarterly Employment Statistics (QES) P0277& Survey of Total Employment and Earnings, Household and Labour Surveys and Population Censuses
Real per capita average earnings	Gross earnings divided by number of employees	Stats SA Quarterly Employment Statistics (QES) P0277& Survey of Total Employment and Earnings, Household and Labour Surveys and Population Censuses
Labour remuneration	The amount paid to employees	Survey of Total Employment and Earnings, Household and Labour Surveys and Population Censuses
Remuneration per employee	It is equal to the total compensation of employees, divided by the number of employees	Survey of Total Employment and Earnings, Household and Labour Surveys and Population Censuses
Johannesburg Stock Market (JSE) market capitalization (shares)		SARB #KBP2024J
Public sector domestic marketable debt	Includes the financial debt instruments of all the institutions, at all levels of general government and in all resident public corporations	SARB #KBP4564J
Labour productivity index	Measured as output per unit of labour	Quantec

Chapter 3

Effects of Productivity Shocks on Firms and Banks: Importance of Real Resource Costs

3.1 Introduction

In an economy that contracts during and post 2008 with consequent declines in employment in almost all South African (SA) private sector industries, as well as major banking industries in the world, why does the labour force in the SA banking industry increase? The question is significant as the sector is considered to be well developed, big and well capitalised, further signalling its significance as a primary role player in financial intermediation. For instance, credit intermediated by the banking sector to the private non-financial sector as a percentage of the Gross Domestic Product (GDP) is consistently over 60 percent[1]. Assets of the sector as a percentage of GDP peaked at over 80 percent during the 2008 global financial crisis (GFC)[2]. The sector also has a tier 1 capital ratio of about 11 percent (McKenzie et al., 2017). However, the SA banking industry is peculiar in a sense that the well-developed industry has arguably not been accompanied by greater economic growth relative to other countries, as documented by Demirgüç-Kunt and Levine (2004). The peculiarity can be extended to employment dynamics in the sector relative to other private sector industries and other banking industries globally. For instance, aggregate employment fell by 6.7 percent due to the GFC, with private sector employment declining by 4.5 percent in the fourth quarter of 2008 (Fedderke, 2012). The decline proved to be sustained despite the rapid recovery of output. On the other hand, the banking industry behaves differently as employment in the industry expands, as shown by Figure 3.1. This phenomenon has proved to be historic as the average rate of employment growth in the banking sector was 6.8 percent per year, compared to only 0.5 percent for all other economic activities during the 1995 to 2008 period (McKenzie et al., 2017). Therefore, why is it that in an economy that contracts post 2008, with consequent declines in employment in almost all private sector industries, banks increase their labour force?

Panel (a) of Figure 3.1 for instance, shows that most industries such as community, social and personal services and business services amongst others, steadily increased

[1]Figures obtained from Bank for International Settlements (BIS), available at https://stats.bis.org/statx/srs/table/f2.4.

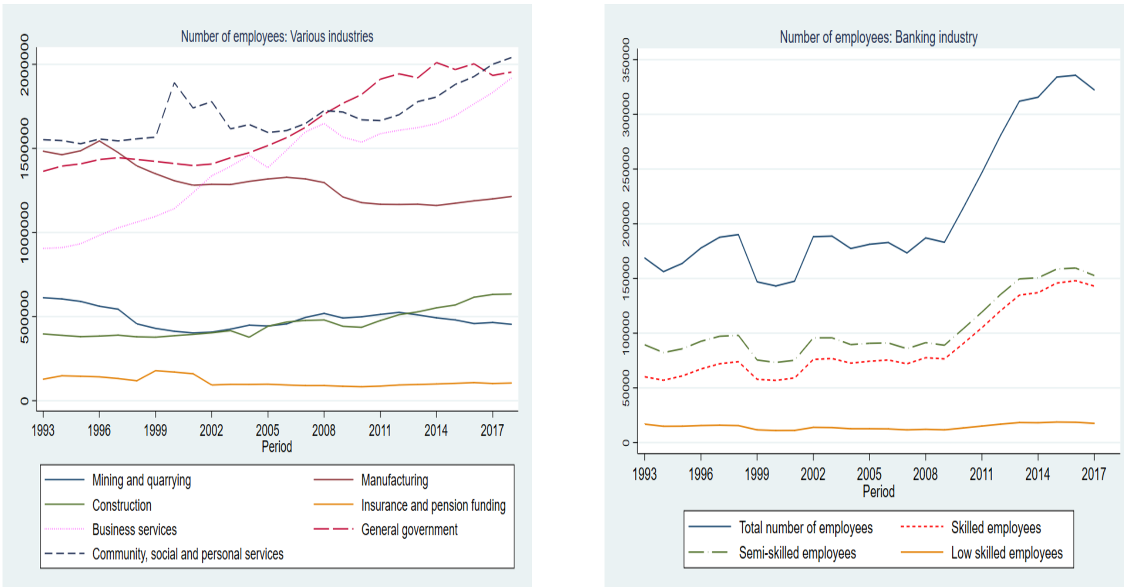
[2]Figure is obtained from World Bank, Deposit Money Bank Assets to GDP for South Africa [DDDI02ZAA156NWDB], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DDDI02ZAA156NWDB, March 4, 2021.

employment, particularly during the ‘2002 to 2006 growth” period. Interestingly for banks, employment levels declined and eventually flattened. The period post the 2008 financial crisis is perhaps the interesting case. Despite public sector employment generally exhibiting an upward trend (no major expansion), most private sector industries including business services reduce their labour force. On the other hand, panel (b) of Figure 3.1 shows that the banking sector behaves differently from other industries as the employment of labour expand. Panel (a) in Figure 3.2 further shows that quarter-on-quarter growth in employment in the banking sector outpaced growth rate of employment in the economy. Furthermore, while private sector employment decrease by 4.5 percent in the fourth quarter of 2008[3], the banking industry labour dynamics appear to be entirely different from the rest of the private sector and perhaps the rest of the economy.

[3]The data is reported by Statistics South Africa (Stats SA) Quarterly Employment Statistics (QES).

Figure 3.1: Number of employees: Banking industry vs other industries

(a) Other industries (b) Banking

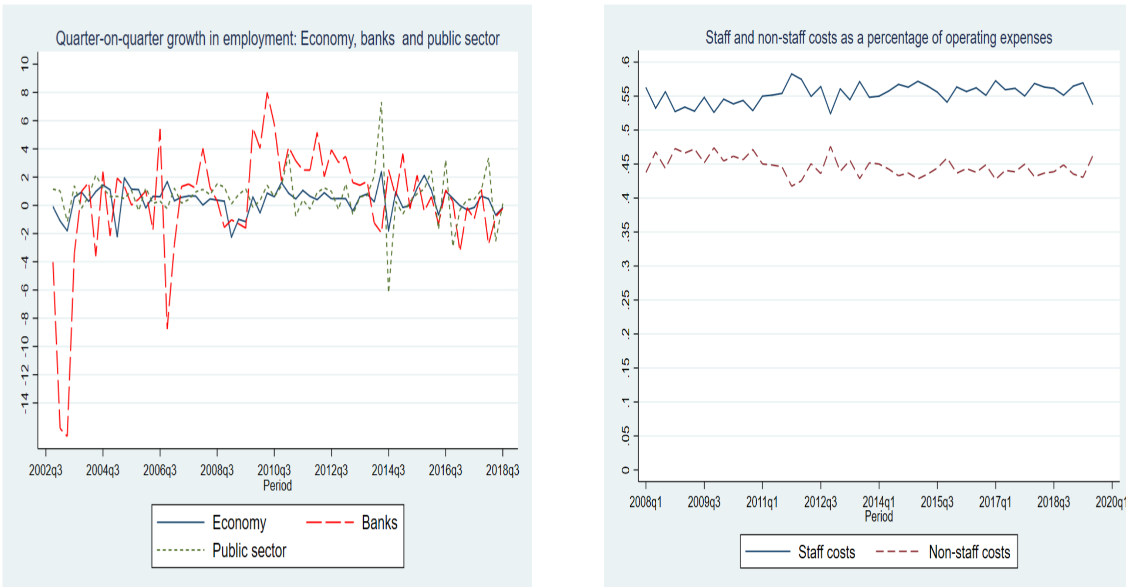


Note: This figure shows and compares the number of employees in the South African banking industry relative to other industries in the country. Source: Stats SA Quarterly Employment Statistics (QES).

Furthermore, Duncan (2013) reports that in the backdrop of the 2008 financial crisis, the public sector which is the biggest employer in SA added 314 000 jobs. However, panel (a) of Figure 3.2 shows that employment growth in banking outpaces that in the public sector, more especially post 2008. Panel (b) of Figure 3.2 further shows the importance of labour and staff costs in the banking industry. Staff costs account for over 50 percent of banks' operating expenses, peaking at 55 percent relative to non-staff costs, which have been fairly constant at 45 percent of banks' operating expenses.

Figure 3.2: Employment comparison: Economy, banks and public sector and Staff costs in banks

(a) Economy, banks and public sector (b) Staff and non-staff costs in banks



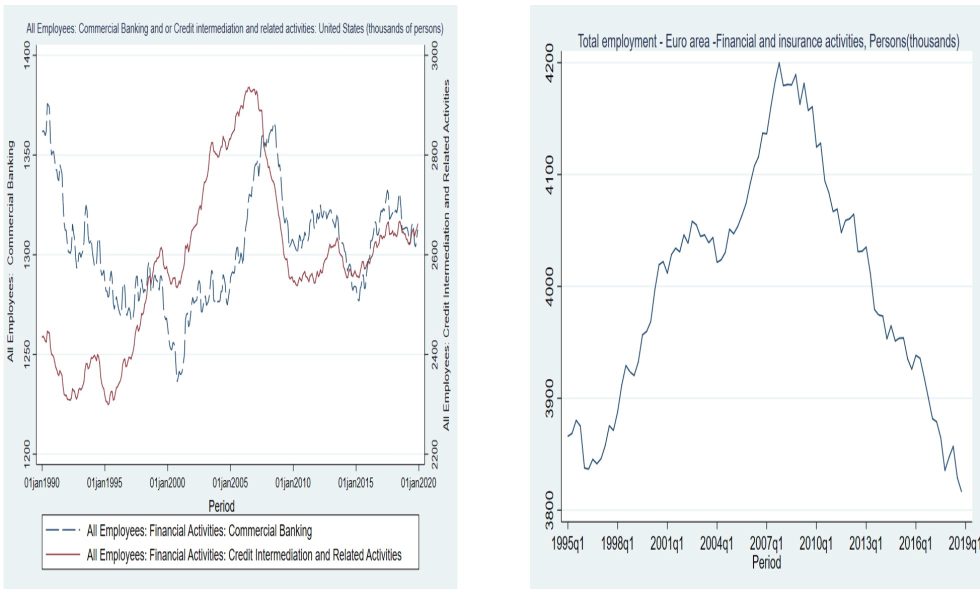
Note: Panel (a) of this figure shows and compares quarter-on-quarter growth in employment in the South African banking industry, economy and public sector. Panel (b) shows and compares staff costs and non-staff costs, as a percentage of operating expenses, in the South African banking industry. Source: Quantec, SARB and authors' calculations.

Further decomposition by panel (b) of Figure 3.1 shows that employment growth in the banking industry is robust even across all skill levels.

Employment dynamics in the SA banking sector appear to be peculiar not only relative other sectors but also relative to international experiences. This is shown by Figure 3.3 below, where banking industries in major economies such as the Unites States (US) and Europe (EU) shed jobs in the aftermath of the 2008 financial crisis.

Figure 3.3: Employment in the U.S and European banking industries

(a) U.S (b) EU



Note: This figure shows the number employees in the United States (US) banking industry and European Union (EU) banking industry. Source: FRED.

To this end, the peculiarities relating to employment dynamics in the SA banking industry are worth investigating. As such, the chapter aims to study how shocks affecting the industrial and the banking sector influence labour market dynamics and macroeconomic variables. To do so, we rely on work underpinned by Chari et al. (1995), Goodfriend and McCallum (2007) and more recently, Dia and Menna (2016), Dia et al. (2018) and Menna et al. (2019). Although the objectives of the papers differ to ours, the framework used in the papers, which we adopt to an extent, allow us to study how shocks affecting the industrial sector and the banking sector influence labour market dynamics and macroeconomic variables. The crucial aspect of the frameworks is that banks use real resources in labour and physical capital to produce loans and deposits. In essence, banks utilize labour and physical capital with a Cobb-Douglas production to provide loans to firms for their working capital needs and provide deposit services to households (Dia and VanHoose, 2017). In the same manner, we adopt a Dynamic Stochastic General Equilibrium (DSGE) model where the economy is characterised by households, firms (private sector or industrial sector) and banks.

We extend the modelling strategy by incorporating two heterogeneous households differentiated by skills level and investment decisions. In particular, we have high skilled households who invest in physical capital and supply their labour to banks. Firms or the industrial sector employ low-skilled labour supplied by low-skilled households who in turn, invest in deposits. The household saving decisions framework departs to an extent, from Freeman and Kydland (2000), where households can allocate savings to capital, bank deposits and flat money.
The introduction of heterogeneous households is done with the aim of documenting the heterogeneity of the SA labour market with specific regards to banks and the rest of the private sector firms. For instance, analysis of employment by occupation in the SA banking sector shows that the majority of employees are in the semi-skilled and skilled occupations (Duncan, 2013). Table 3.1 below further confirms that the banking sector predominantly comprises of high-skilled employees relative to the private sector. Over 40 percent of the banking sector workforce is characterised as

high-skilled. On the other hand, just under 20 percent of the private sector workforce possess high-skills. In fact, Table 3.1 shows that the proportion low-skilled workers exceed the proportion of high-skilled workers in the private sector. On the other hand, low-skilled workers in banking account for only 6 percent of banking sector workforce, between 2009 and 2019. The heterogeneity is also reflected by the year-on-year growth of employment by occupation as shown by Table 3.2. Employment growth of skilled workers is robust relative to employment of skilled workers in firms.

Table 3.1: Composition of employment by level of skills: Banks and firms

.

Banking industry			
		Skills level:	
Period	Skilled	Semi-skilled	Low-skilled
1993-2008	39.96%	51.98%	8.06%
2009-2019	44.66%	49.34%	6%

Firms			
		Skills level:	
Period	Skilled	Semi-skilled	Low-skilled
1993-2008	16.62%	56.75%	26.63%
2009-2019	19.16%	58.10%	22.74%

Source: Quantec and authors' calculations.

Table 3.2: Year-on-year growth in employment by level of skills: Banks and firms

.

Banking industry

Period	Skilled	*Skills level:* Semi-skilled	Low-skilled
1993-2008	2.21%	0.67%	-1.54%
2009-2019	4.76%	3.64%	1.97%

Firms

Period	Skilled	*Skills level:* Semi-skilled	Low-skilled
1993-2008	1.46%	0.91%	-0.55%
2009-2019	2.22%	1.07%	0.92%

Source: Quantec and authors' calculations.

Table 3.3 further shows the decomposition of employment heterogeneity in the SA banking sector, particularly post the 2008 GFC. Semi-skilled workers comprising of admin and clerical workers account for 49 percent of banking industry labour force in 2008, increasing to 55 percent in 2009. Skilled workers comprising of managers and professionals account for 17 percent of banking industry labour force in 2008, increasing to 20 percent in 2009. In overall, skilled and semi-skilled workers account for over 80 percent of banking sector labour force post the 2008 GFC. Growth in employment of these workers is also robust post 2008 relative to the period before 2008, as shown in Table 3.2.

We therefore capture and introduce basic labour market heterogeneity more formally. We depart from the frameworks adopted by Lee (2010, 2014), Ko (2015), Ravenna and Walsh (2012) and Gornemann et al. (2012). Although the objectives of the papers mostly explore the relationship between inequality and monetary policy in a

Table 3.3: Composition of employment by occupation in banking industry: Number of employees

Major occupation group	2008		2009		2010		2011	
Managers	27 232	17%	30 323	20%	29 679	19%	30 730	20%
Professionals	28 707	18%	28 471	18%	26 879	18%	28 774	18%
Technicians and trade workers	2 186	1%	1 854	1%	1 741	1%	2 586	2%
Community and personal service workers	2 723	2%	3 084	2%	2 985	2%	3 299	2%
Clerical and administrative workers	77 350	49%	85 090	55%	81 148	53%	83 215	53%
Sales workers	8 136	5%	2 379	2%	5 042	3%	6 098	4%
Machinery operators and drivers	669	0%	2 318	1%	3 533	2%	381	0%
Elementary workers	1 498	1%	1 538	1%	1 877	1%	1 635	1%
Other	8 316	5%	0	0%	0	0%	0	0%

Source: Banking Sector Skills Plan 2013-2012.

DSGE setting, with an explicit labour market captured by search and matching frictions in some cases, parts of their frameworks are useful to capture the heterogeneity of the SA labour force. Notably and in the case of SA, Dadam (2017) adopts a DSGE model with search and matching frictions and heterogeneous workers to analyse labour market effects of public sector employment. In a similar manner, we ask whether productivity shocks hitting the private sector and importantly, the banking industry in SA, matter in the adoption and employment of labour and physical capital.

Consequently, results from our analysis indicate that productivity shocks hitting the industrial sector have an impact on the market for labour and capital, similar to results in a standard Real Business Cycle (RBC) setting. On the other hand, positive productivity shocks hitting the banking industry, which are akin to shocks on the productivity of loan and deposit origination and monitoring, resemble the consequences of banks' recent adoption and implementation of technological advances and digitisation. Conversely, results from negative productivity shocks hitting the banking industry resemble and are akin to regulatory changes in the banking industry.

Post 2008, banks subsequently invested in regulation and compliance staff needed to implement and meet new regulatory requirements. Notably, the adoption of heterogeneous households framework yields results similar to the works of Lee (2010, 2014), Ko (2015) and Kaplan and Violante (2018). The results indicate that households' consumption and saving decisions are sensitive to changes in their income relative to changes in the returns from holding assets.

3.2 Related Literature

The objective of the chapter is to analyse the impact of shocks hitting the industrial sector and the banking industry, on particular labour market dynamics. Put differently, we aim to identify shocks that would generate and resemble the phenomenon observed in SA, where employment in the banking industry behaves differently from the rest of private sector employment. This is particularly peculiar post the 2008 GFC where most banking industries globally as well the rest of the private sector in SA shed jobs. On the other hand, employment expanded in the SA banking industry. The work done by Dadam (2017) in analysing the labour market effects of public sector employment is similar to our objective, with the exception of the modelling framework adopted. Dadam (2017) adopts a DSGE model incorporated with search and matching frictions to capture a labour market with two set workers; skilled and unskilled and different bargaining powers. Results from his analysis show that an increase in private sector productivity produces an increase in employment for both skilled and unskilled workers. In addition, when productivity efficiency is lower in the public sector compared to the private, a public wage shock leads to more skilled individuals queuing for public sector jobs.

In contrast, we adopt the frameworks used by Dia and Menna (2016), Dia et al. (2018), Menna et al. (2019) and Dia and VanHoose (2017). The crucial aspect from the framework is that banks utilize labour and physical capital to produce or provide services such loans and deposits. Consequently, results from Dia and Menna (2016), Dia and VanHoose (2017) and Dia et al. (2018) yield standard RBC results following productivity shocks, where worked in both the industrial and banking sector expand. Most importantly, their results suggest that labour and physical capital and their intensities in providing banking services, play a role in explaining changes in banking sector variables such as interest margins in some advanced economies (Dia and Menna, 2016) and in China (Dia et al., 2018) and the loan-deposit ratio in the US (Menna et al., 2019). Their work and consequently ours, rest on earlier work by Goodfriend and McCallum (2007), who reconsider the role of money and banking in monetary policy analysis, by including a banking sector in a standard RBC model. Despite differences in objectives with the above authors, parts of their frameworks are applicable and adopted for our analysis. The modelling frameworks allow for the banking sector to adopt a production function in producing loans and deposits, with labour supplied by households. As such, we also adopt a similar modelling framework that allows us to analyse the effects of shocks hitting the banking sector and the industrial sector, on aggregates such as physical capital, employment and aggregate output.

We however extend the modelling strategy by incorporating two heterogeneous households differentiated by skills level and investment decisions. This is done with the aim of capturing some aspects of the South African labour market observed from the data. To this end, we depart from Freeman and Kydland (2000), Lee (2010, 2014), Ko (2015), Ravenna and Walsh (2012), Gornemann et al. (2012) and Kaplan and Violante (2018). In Freeman and Kydland (2000), households can allocate savings to capital, bank deposits and flat money whereas in our framework, households can allocate savings to either deposits or physical capital. In particular, high-skilled households supply high-skilled labour to banks and can invest in physical capital while low-skilled households supply low-skilled labour to firms and can invest in deposits. Ko (2015) introduces heterogeneity into a standard New Keynesian DSGE (NKDSGE) model characterised by high-skilled labourers that are financially included and low-skilled labourers that are limited in their access to financial markets. In essence, findings by Ko (2015) show that high and low skilled households respond differently to productivity and monetary shocks, with demand for skilled labour and therefore returns to labour and financial assets, increasing more relative to the demand for low-skilled labour, following the shocks.

Lee (2010, 2014) adopts a similar heterogeneous household framework, where households are differentiated by a distinct labour skill. High-skilled households for instance specialize in the production of a certain good and therefore employed in the high-skilled industry only. Similarly, a household possessing low-skills supplies labour to the low-skilled labour industry and produces only the good requiring low-skilled labour. In the same manner, Ravenna and Walsh (2012) construct a model with search and matching frictions where workers are heterogeneous with regards to their efficiency and productivity is worker-specific. Their results indicate that a negative productivity shock reduce output and employment and is likely to increase job separation for low-efficiency workers relative to high-efficiency workers. The negative productivity shock also disproportionately lowers the quality of low-efficient workers as they experience greater inflow into unemployment. In essence, high-efficiency workers are likely to benefit more in boom times relative low-efficient workers and during recessions, low-efficient workers are likely to be worse-off relative to high-efficiency workers. Amplifying the results is the idea that firms can screen and observe worker's efficiency levels and as such, firms become more selective during recessions and thereby reduce their vacancy yields.

Gornemann et al. (2012) also analyses how productivity shocks and importantly, monetary policy affect households differentiated by employment status. Their findings suggest that while a positive total factor productivity (TFP) shock is beneficial for all type of households, a contractionary monetary policy shock on the other hand results in increased earnings and wealth. This in turn, results in higher consumption for households in the top 5 percent who are employed. On the other hand, earnings of the lower top 5 percent that are unemployed decline, resulting in lower consumption as well.

Kaplan and Violante (2018) analyse the role of heterogeneity for the response of the macroeconomy to aggregate shocks, calibrated to the US economy. Similar to the framework we adopt, households modelled by Kaplan and Violante (2018) either have access to low-return liquid assets, which are held by poor hand-to-mouth households or high-return illiquid assets represented as being held by wealthy hand-to-mouth households. The similarity with our framework rests on the assumption that low-skilled households who in turn earn low-skilled wages, invest in low return deposits (liquid asset). As a results, they earn relatively low returns on deposits, which can be likened to poor hand-to-mouth households in Kaplan and Violante (2018). On the other hand, high-skilled households earn high-skilled wages and invest in physical capital. This is similar to illiquid assets held by wealthy hand-to-mouth households in Kaplan and Violante (2018), yielding relatively higher returns. In essence, utilizing heterogeneous agent models has the advantage of making predictions about how the effect of an aggregate shock varies across the distribution of households or across the distribution of workers (Kaplan and Violante, 2018).

3.3 Model

The modelling strategy follows Dia and Menna (2016), where the economy is characterised by households, firms and banks. We however extend the modelling strategy to incorporate two heterogeneous households differentiated by skills level and saving decisions.

To do so, we follow the work of Lee (2010, 2014), Ko (2015), Ravenna and Walsh (2012) and Gornemann et al. (2012). We consider households characterised by members possessing high-skills and those possessing low-skills. Members of high-skilled households supply labour to the banking industry and invest in physical capital while members in low-skilled households supply labour to firms and invest in deposits. More formally, the model is as follow:

3.3.1 Households

High-skilled households

Households whose members possess high-skilled labour maximise their expected utilities by deciding on their optimal consumption c_t^H and labour supply h_t^b choices. Therefore, the same good can be used for consumption c_t^H or for investment where savings can be allocated to physical capital k_t. The high- skilled household solves the following problem:

$$\max \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{H,1-\sigma} - 1}{1-\sigma} + \theta \frac{\left(1 - h_t^H\right)^{1-\gamma} - 1}{1-\gamma} \right],$$

s.t.

$$c_t^H + k_t - (1-\delta) k_{t-1} = w_t^b h_t^b + r_t k_{t-1} + \Pi_t^b, \tag{3.1}$$

where $w_t^b h_t^b$ is the high-skilled wage income, r_t is the net rental rate for capital and Π^b are dividends paid banks. β is the subjective discount factor, σ is the inverse elasticity of intertemporal substitution, γ governs the Frisch elasticity of labour supply and θ is the utility weight on leisure.

The first order conditions are given as:

$$\frac{\partial}{\partial k_t}:\ c_t^{H,-\sigma} = \beta E_t\left[c_{t+1}^{H,-\sigma}\left(r_{t+1}+1-\delta\right)\right], \tag{3.2}$$

and

$$\frac{\partial}{\partial h_t^b}: w_t^b = \theta\frac{\left(1-h_t^b\right)^{-\gamma}}{c_t^{H,-\sigma}}, \tag{3.3}$$

Equation (3.2) is the Euler condition for capital while equation (3.3) governs the labour supply to banks.

Low-skilled households

Similarly, low-skilled households maximise their expected utilities by deciding on their optimal consumption c_t^L and labour supply h_t^f choices. Contrary to high-skilled households, the good can be used for consumption c_t^L or for investment where savings can be allocated to deposits d_t^s. They solve the following problem:

$$\max\ \sum_{t=0}^{\infty}\beta^t\left[\frac{c_t^{L,1-\sigma}-1}{1-\sigma}+\theta\frac{\left(1-h_t^f\right)^{1-\gamma}-1}{1-\gamma}\right],$$

s.t.

$$c_t^L + d_t^s = w_t^f h_t^f + r_{t-1}^d d_{t-1}^s + \Pi_t^f, \tag{3.4}$$

where $w_t^f h_t^L$ is the low-skilled wage income, $r_t^d d_{t-1}^s$ are deposit earnings with r_t^d the gross interest rate on deposits, and Π^f are dividends paid firms.

The first order conditions are given as:

$$\frac{\partial}{\partial d_t^s}: c_t^{L,-\sigma} = \beta E_t\left[c_{t+1}^{L,-\sigma}\right] r_t^d. \tag{3.5}$$

and

$$\frac{\partial}{\partial h_t^f} : w_t^f = \theta \frac{\left(1 - h_t^f\right)^{-\gamma}}{c_t^{L,-\sigma}}, \tag{3.6}$$

Equation (3.5) is the Euler condition for deposits while equation (3.6) governs the labour supply to firms.

3.3.2 Banks

We assume a continuum of symmetric banks in the interval $[0, 1]$. The banking sector is perfectly competitive and banks are owned by high-skilled households. Banks use capital k_t^b and high-skilled labour h_t^b to supply loans l_t^s from deposits d_t^d. The production function for loans is given as:

$$l_t^s = \min\left[d_t^d, z_t \left(h_t^b\right)^{1-\kappa} \left(k_t^b\right)^{\kappa}\right], \tag{3.7}$$

where h_t^b are worked hours in banks by high-skilled labour and k_t^b is the amount of capital rented by banks. κ governs the contribution of capital to the production of loans. z_t is the banks' total factor productivity, which we assume to be stochastic. The objective of the bank is to maximise discounted dividend payments (Π^b) to high-skilled households. In each period, funds available for dividend payment are given as:

$$\Pi_t^b = d_t^d + r_{t-1}^l l_{t-1}^s - r_{t-1}^d d_{t-1}^d - l_t^s - w_t^b h_t^b - r_t k_t^b, \tag{3.8}$$

where r_t^l is the gross interest rate on loans. Households require banks to maximise their current marginal value of profits subject to the discount factor $\beta^t(c_t^H)^{-\sigma}$ and optimality implies that $l_t^s = d_t^d = \left(h_t^b\right)^{1-\kappa}\left(k_t^b\right)^{\kappa}$

Therefore, the problem for the representative bank can be rewritten as

$$\max \sum_{t=0}^{\infty} \beta^t c_t^{-\sigma}\left[r_{t-1}^l z_{t-1}\left(h_{t-1}^b\right)^{1-\kappa}\left(k_{t-1}^b\right)^{\kappa} - r_{t-1}^d z_{t-1}\left(h_{t-1}^b\right)^{1-\kappa}\left(k_{t-1}^b\right)^{\kappa} - w_t^b h_t^b - r_t k_t^b\right],$$

Cost minimisation, together with the zero profit condition, yields the following banks' demand for high-skilled labour and physical capital:

$$\beta E_t(c_{t+1}^H)^{-\sigma} z_t(1-\kappa)\left(\frac{k_t^b}{h_t^b}\right)^{\kappa}\left(r_t^l - r_t^d\right) = (c_t^H)^{-\sigma} w_t^b, \tag{3.9}$$

and

$$\beta E_t(c_{t+1}^H)^{-\sigma} z_t \kappa\left(\frac{k_t^b}{h_t^b}\right)^{\kappa-1}\left(r_t^l - r_t^d\right) = (c_t^H)^{-\sigma} r_t. \tag{3.10}$$

Equation (3.9) is the banks' demand for high-skilled labour where the marginal cost in utility terms of hiring skilled labour at time t, $(c_t^H)^{-\sigma} w_t^b$, is equal to the physical marginal product of high-skilled labour, $z_t(1-\kappa)\left(\frac{k_t^b}{h_t^b}\right)^{\kappa}$ times the discounted interest rate margin, $\beta E_t(c_{t+1}^H)^{-\sigma}\left(r_t^l - r_t^d\right)$

Similarly, equation (3.10) governs the banks' demand for physical capital where the marginal cost in utility terms of renting physical capital at time t, $(c_t^H)^{-\sigma} r_t$ is equal to the marginal product of capital, $z_t\kappa\left(\frac{k_t^b}{h_t^b}\right)^{\kappa-1}$ times the discounted interest rate margin, $\beta E_t(c_{t+1}^H)^{-\sigma}\left(r_t^l - r_t^d\right)$.

3.3.3 Firms

We assume a continuum of symmetric firms in the interval $[0,1]$. The goods market is perfectly competitive and firms are owned by low-skilled households. The representative firm uses capital $\left(k_t^f\right)$ and low-skilled labour $\left(h_t^f\right)$ to produce output (y_t) using a standard Cobb-Douglas production function:

$$y_t = a_t \left(k_t^f\right)^{\alpha} \left(h_t^f\right)^{1-\alpha}, \tag{3.11}$$

with technology a_t assumed to be stochastic. The representative firm also issues one period loans to pay a share μ of its low-skilled labour and capital costs in advance, where:

$$\left(w_t^f h_t^f + r_t k_t^f\right) \mu = l_t^d. \tag{3.12}$$

and l_t^d is firm loan demand to finance real resource expenses.
The objective of the firm is to maximise discounted dividend payments (Π^f) to households. In each period, funds available for dividend payments: are

$$\Pi_t^f = l_t^d + y_t - r_{t-1}^l l_{t-1}^d - w_t^f h_t^f - r_t k_t^f. \tag{3.13}$$

Equations (3.12) and (3.13) imply that dividends can be rewritten as:

$$\Pi_t^f = y_t - r_{t-1}^l \left(w_{t-1}^f h_{t-1}^f + r_{t-1} k_{t-1}^f\right) \mu - \left(w_t^f h_t^f + r_t k_t^f\right)(1-\mu). \tag{3.14}$$

Therefore, using equations (3.11) and (3.14), the problem of the representative firm can be written as

$$\max \sum_{t=0}^{\infty} \beta^t (c_t^L)^{-\sigma} \left[a_t \left(k_t^f\right)^{\alpha} \left(h_t^f\right)^{1-\alpha} - r_{t-1}^l \left(w_{t-1}^f h_{t-1}^f + r_{t-1} k_{t-1}^f\right) \mu - \left(w_t^f h_t^f + r_t k_t^f\right) (1-\mu) \right],$$

Cost minimisation, together with the zero profit condition, yields the following expressions for firms' demand of low-skilled labour and capital:

$$(c_t^L)^{-\sigma} \left[(1-\alpha)\, a_t \left(k_t^f\right)^{\alpha} \left(h_t^f\right)^{-\alpha} - w_t^f (1-\mu) \right] = \beta c_{t+1}^{-\sigma} r_t^l w_t^f \mu, \tag{3.15}$$

and

$$(c_t^L)^{-\sigma} \left[\alpha a_t \left(k_t^f\right)^{\alpha-1} \left(h_t^f\right)^{1-\alpha} - r_t (1-\mu) \right] = \beta c_{t+1}^{-\sigma} r_t^l r_t \mu. \tag{3.16}$$

Equations (3.15) and (3.16) collapse to standard low-skilled labour demand and capital demand functions.

3.3.4 Market Clearing Conditions

Equations (3.17) to (3.20) define the market clearing conditions for the capital market, the labour market, the market for deposits and the market for loans.

$$k_{t-1} = k_t^f + k_t^b, \tag{3.17}$$

$$h_t = h_t^f + h_t^b, \tag{3.18}$$

$$d_t^d = d_t^s, \tag{3.19}$$

$$l_t^d = l_t^s. \tag{3.20}$$

The aggregate resource constraint is given as:

$$c_t^H + c_t^L + k_t - (1-\delta)\,k_{t-1} = y_t$$

and

$$c_t = c_t^H + c_t^L$$

The aggregate resource constraint is obtained by combining equations (3.1), (3.4), (3.8), (3.13) and (3.17) to (3.20).[4]

3.4 Calibration

3.4.1 Calibration strategy

Our calibration strategy rests on implied steady state values defined by equations in Appendix 3.7.2, with some calibrated parameters taken from the literature. The time unit is a year, with the discount factor β set to 0.96 consistent with the literature. This implies that the steady state annual deposit rate earned by low-skilled workers is equal to 4.17 percent as shown by Table 3.5[5]. The physical capital depreciation rate, δ is set to 5 percent annually, implying an annual rental rate of capital earned by high-skilled workers of 9 percent. Feenstra et al. (2015) estimates that the average depreciation rate of capital stock in SA increased from 4 percent in 1970 to 5 percent in 2017, growing at an average annual rate of 55 percent. The higher investment

[4]Derivation in the appendix 3.7.1.

[5]The return on deposits is slightly higher relative to return on fixed deposit of up to a year from the data which averaged at 3 percent between 1993 and 2017.

return earned by high-skilled workers relative to low-skilled workers is significant to our assumption that high-skilled workers who supply labour to banks earn higher wages and are therefore able to invest in relatively expensive and high return investment relative to low-skilled workers who invest in risk-less investment. This is also the differentiating factor of our model relative to Dia and Menna (2016). We assume a logarithmic utility in both consumption and leisure where $\sigma = \gamma = 1$. The parameter α is set equal to the capital share in GDP, while the labour share in GDP is given as the ratio of private sector remuneration to Gross Value Added (GVA) at basic prices in the private sector. Consequently, α is given as $1 - labourshare$. Alternatively, we calculate the capital share in GDP as the ratio of gross operating surplus (GOS) in private sector to GVA at factor costs.[6] The two methods yield similar labour and capital shares.

Bank credit to non-financial corporations as a share of GDP is governed by μ. It measures total credit to non-financial corporations (core debt) or the share of firms' resource costs financed by loans. It is taken from the Bank for International Settlements (BIS) and is set at 0.38, implying that total credit to non-financial corporations as a percentage of GDP sits at 38 percent[7]. Total factor productivity (TFP) of firms, a is normalised to one. We further assume that shocks to the log-deviation of TFP of firms and banks from their respective steady-states follow a first-order autoregressive process. The standard deviation for both shocks is assumed to be 1 percent, with an

[6]The manner in which we calculate α using the two methods is documented by a report from the International Labour Organization, available at https://www.oecd.org/g20/topics/employment-and-social-policy/The-Labour-Share-in-G20-Economies.pdf, Gomme and Rupert (2004) and Giandrea and Sprague (2017).

[7]This is 2017 value obtained from the BIS: https://stats.bis.org/statx/srs/table/f4.1.

autocorrelation of 0.8, on an annual basis.

Importantly, our calibration strategy rests on the manner in which we ensure that the loan rate r_t^l and banks' total factor productivity is z_t is obtained endogenously. Once the two variables are obtained, the steady wage rate in banks, high-skilled and low-skilled consumption can importantly be obtained as well. Since we also obtain data on the labour share in firms, thereby enabling us to obtain the capital share, we assume that capital share in banks κ is the same as capital share in firms α. The assumption enables us to solve the model for two equations in two unknowns, in the loan rate r^l and banks' total factor productivity z endogenously[8]. Table 3.4 shows the calibrated parameters.

Since our calibration enables us to determine the steady state loan rate r^l and banks' total factor productivity z endogenously, this has implications for steady state high-skilled consumption (c^H) and the wage rate in banks (w^b) as well as resource costs for the industrial sector[9]. This is also the differentiating feature of our calibration relative to Dia and Menna (2016) and Dia et al. (2018). For instance, the steady state loan rate, wage rate in banks and high-skilled consumption is given as; $r^l = \left(\frac{1}{\beta\kappa z\left(\frac{k^b}{h^b}\right)^{\kappa-1}}\right) r + r^d$, $w^b = \beta z\left(1-\kappa\right)\left(\frac{k^b}{h^b}\right)^{\kappa}\left(r^l - r^d\right)$ and $c^H = \left(\theta\frac{(1-h^{H,b})^{-\gamma}}{w^b}\right)^{\frac{1}{-\sigma}}$, respectively. Therefore, any change in the loan rate is passed on to the wage rate in banks. It is also passed on to firms' working capital needs as they issue one-period loans to finance their working capital needs. It also has implications high-skilled workers' consumption.

[8]Further technical details are contained in Appendix 3.7.2.
[9]See full details in Appendix 3.7.2.

‘

Table 3.4: Calibrated parameters

$\beta = 0.96$	$\sigma = 1$	$\gamma = 1$	$\mu = 0.38$	$\alpha = 0.346$	$\kappa = 0.346$
$\theta = 1.96$	$\delta = 0.05$				

Notes: α and κ are the capital compensation share in output and the production of loans respectively. β is the discount factor, σ is the inverse elasticity of intertemporal substitution and γ governs the Frisch elasticity of labour supply. θ is the utility weight on leisure, μ governs bank credit to non-financial corporations as a share of GDP, while δ is the average depreciation rate of capital stock.

Consequently, the calibration yields a risk free annual loan rate of 6.22 percent as shown in Table 3.5. Furthermore, since the model is characterised by two classes of workers, total hours worked in the steady state is set at 0.3. This implies that both low-skilled and high-skilled workers spend 30 percent of their time working or approximately 7 hours working in a 24 hour day, in the steady state. In addition, our assumption that both sets of workers work the same hours is based on the notion that we are not aware of evidence suggesting that low-skilled workers in South Africa work on average, more hours than high-skilled workers. However, to ensure that total hours is set at 0.3, we assume that 5 percent of the total labour force comprise of high-skilled bank workers while the remaining 95 percent are the low-skilled in firms. This also ensures that the variables in the steady state are expressed as a proportion and share of hours worked by the respective worker. For instance, low-skilled consumption in the steady state is expressed in terms of hours worked in firms, which is weighted by the share of low-skilled workers. Similarly, high-skilled consumption is expressed in terms of hours worked in banks, weighted by the share of high-skilled workers. The same intuition holds for the wage rates and capital in the respective sectors. Therefore, the crucial differentiating factors between the two classes of workers is their investment decisions and the sectors they supply their labour to,. This also implies different wage rates for the two types of workers in the steady state as shown in Table 3.5.

Table 3.5: Implied steady state values, per share of hours worked.

$r^d = 1.0417$	$r = 0.09$	$r^l = 1.0622$	$h^b = 0.3(0.05)$	$h^f = 0.3(0.95)$	$h = 0.3$
$\frac{\bar{c}}{h} = 8.939$	$\frac{\bar{c^L}}{h^f} = 1.667$	$\frac{\bar{c^H}}{h^b} = 7.270$	$\frac{\bar{w^f}}{h^f} = 4.577$	$\frac{\bar{w^b}}{h^b} = 14.470$	$\frac{\bar{k}}{h} = 8.531$
$\frac{\bar{k^f}}{h^f} = 7.517$	$\frac{\bar{k^b}}{h^b} = 0.2467$				

Notes: r^d and r^l are the annual gross deposit and annual gross loan rates respectively, r is the rental rate of capital. h^b, h^f and h are the steady state hours worked in banks, firms and the economy, respectively. $\frac{\bar{c}}{h}$, $\frac{\bar{c^L}}{h^f}$ and $\frac{\bar{c^H}}{h^b}$ are steady-state total consumption, low-skilled and high-skilled consumption, respectively. Similarly, $\frac{\bar{k}}{h}$, $\frac{\bar{k^b}}{h^b}$ and $\frac{\bar{k^f}}{h^f}$ are the steady-state total capital, capital in banks and capital in firms, per share of hours worked, respectively while $\frac{\bar{w^b}}{h^b}$ and $\frac{\bar{w^f}}{h^f}$ are the steady-state wage rate per hours in banks and firms, respectively.

3.4.2 Data

Data on capital stock for firms and banks, real GDP and data on the calculation of capital shares in GDP is obtained from Statistics South Africa (StatsSA) National Financial Survey and Quarterly Financial Survey and South African Reserve Bank (SARB) Quarterly Bulletin. Capital stock consists of buildings and construction works, transport equipment, machinery and other equipment and transfer costs. Data on the number of workers is obtained from StatsSA Survey of Total Employment and Earnings, Household and Labour Surveys and Population Censuses, Department of Labour Manpower Surveys and Development Bank of South Africa Standardised Employment Series. It is also worth noting that the data is collected in collated form from Quantec. The value of μ which measures total credit to non-financial corporations (core debt) is taken from the Bank for International Settlements (BIS). Data on loans, which is measured by total loans and advances to the non-financial corporate sector in Rands (millions) is obtained from the SARB's Economic Historical DI900 converted to BA900 database, which contains data on banks' balance sheets. Total assets of banking institutions in Rands (millions) are obtained from the SARB Quarterly Bulletin. The data is in turn used to calculate the capital intensity of banks, the ratio of loans to workers and the ratio of assets to workers. The data is collected in millions of Rands and in some cases, converted to thousands in U.S dollars for comparability purposes with other studies such as Dia and Menna (2016).

3.4.3 Some properties of the model

Table 3.6 reports the results generated by the model. They indicate that in the presence of technological shocks in the industrial sector, the volatility of total capital and capital in banks and firms generated by the model fits the observed volatility from the data relatively well. In the presence of technology shocks in the banking sector however, the volatility of total capital, both capital in banks and firms understate the volatility observed in the data. For variables influencing households' saving decisions, the volatility of total consumption in the presence of both technology shocks in banks and firms, understate the observed volatility from the data. Regarding total hours, observed volatility from the data fits the volatility in the presence of technological shocks in the industrial sector. The model also understates the volatility of wage rates in firms and banks relative to the data.

Table 3.6: Standard deviation of selected variables in the data and model.

		Standard deviation	
Variable	Data	Banking sector TFP shock	Industrial sector TFP shock
Consumption	0.034	0.014	0.015
Capital in Banks	0.038	0.012	0.035
Capital in Firms	0.032	0.022	0.028
Total Capital	0.032	0.011	0.035
Total Hours	0.010	0.007	0.016
Wage rate in Banks	0.197	0.013	0.036
Wage rate in Firms	0.042	0.017	0.014

Notes: This table shows and compares the standard deviation of the variables from the model and from real data. We use yearly data from 1993 to 2017. All variables are in logs.

3.5 Impulse Responses

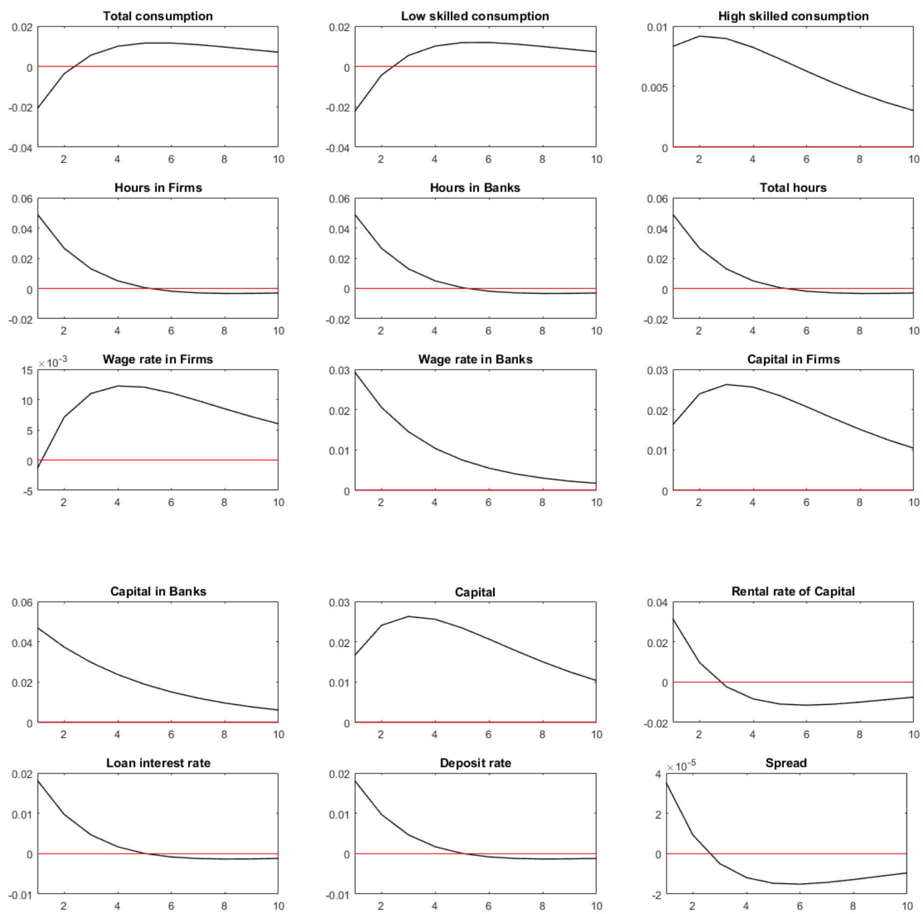
Figure 3.4 below shows the response of variables following a 1 percent standard deviation shock to the TFP of firms. The responses are log-deviations, in percentage points from the steady state. The TFP shock generates a positive response of hours worked in both sectors, while capital in banks and firms rise on impact. Capital in banks however, increase more than capital in firms. The interesting cases are the response of returns to labour, capital and deposits, which influence the two classes of workers' optimal paths of consumption and investment (saving). Despite hours worked in both sectors responding similarly to the productivity shock, wages of high-

skilled workers in banks rise more on impact relative to wages of low-skilled workers in firms. In fact, the wage rate in firms falls on impact. Figure 3.4 further shows that despite both the deposit rate and rental rate of capital rising on impact, the impact on the rental rate of capital is more pronounced relative to the deposit rate. This suggests that high-skilled workers benefit more in boom times with regard to returns on their labour and investment earnings relative to low-skilled workers. This is a similar result as with Ravenna and Walsh (2012).
The rise in the wage rate of high-skilled workers and the rental rate of capital, enable high-skilled workers to smooth out their path of consumption as evident by the increase in high-skilled consumption. For low-skilled workers, consumption falls on impact, perpetuated by the fall in the wage rate. Results from Figure 3.4 also suggest that both low and high-skilled workers' optimal paths of consumption are predominantly driven by wages rather than their saving/ investment decisions. In fact, correlations generated by the model indicate that consumption of high-skilled workers is positively and strongly correlated with hours and the wage rate in banks, but weakly correlated with the rental rate of capital. On the other hand, the consumption of low-skilled workers is negatively correlated with hours in firms and the deposit rate but positively and strongly correlated with the wage rate in firms.

Since both classes of workers or households have access to investment markets, our results also resemble the results in Ko (2015). Their findings show that low-skilled households' labour supply is more sensitive to changes in their wages due to their limited access to financial markets. On the contrary, high-skilled households have a superior capacity to offset the fluctuations in their wages as a result of their access to financial markets. In essence, our results are in line with similar findings in the literature incorporating Heterogeneous Agent New Keynesian (HANK) models. Heterogeneous agents' consumption responds more to and is dominantly driven by disposable income (wage income) relative to returns or income from holding assets[10]. Results from Figure 3.4 further show and suggest that as banks face higher wage and capital rental costs, the loan rate rises more than the deposit rate as reflected by the positive response of the interest margin. The rise in the loan rate also reflects that higher wage and capital rental costs incurred by banks are passed on to borrowers (firms).

[10] This is discussed extensively by (Kaplan and Violante, 2018).

Figure 3.4: Impulse response functions following a positive one standard deviation shock to the TFP of the industrial sector.



According to Dia and Menna (2016), in countries where banks are large relative to the rest of the economy, the expectation is that shocks hitting banks' TFP may have some impact on the economy. However, their results show that even in countries where banks play a major role in the economy, they are in aggregate, simply too small to matter n the market for labour and capital. In the case of SA, where the banking industry is also regarded as being large relative to the economy, it is worthwhile to analyse whether shocks hitting the banking industry matter in the adoption and employment of labour and physical capital. As a result, Figure 3.5 shows the response of variables following a negative productivity shock hitting the banking industry. This we argue, is akin to shocks that may hinder the productivity of loan and deposit origination and monitoring such as tightened regulation. Following the shock, hours and physical capital in banks rise, subsequently increasing the wage rate in banks as well as the rental rate of capital.

As banks face higher real resource costs, the loan rate also increase. Despite the deposit rate also increasing, banks are able to generate positive margins from the loans as the increase in the loan rate is more pronounced relative to the increase in the deposit rate. The increase in the loan rate also indicate that higher resource costs faced by banks are passed on to firms. Consequently, wages in firms decline, perpetuated by the higher cost of financing capital and labour. The increase in hours worked in firms, possibly reflects the labour market dynamics of the sector characterised by low-skilled workers where, the increase in hours worked is not matched by higher wage rates. In essence, following a negative productivity shock hitting the banking industry, firms are faced with relatively higher cost of financing working capital needs.

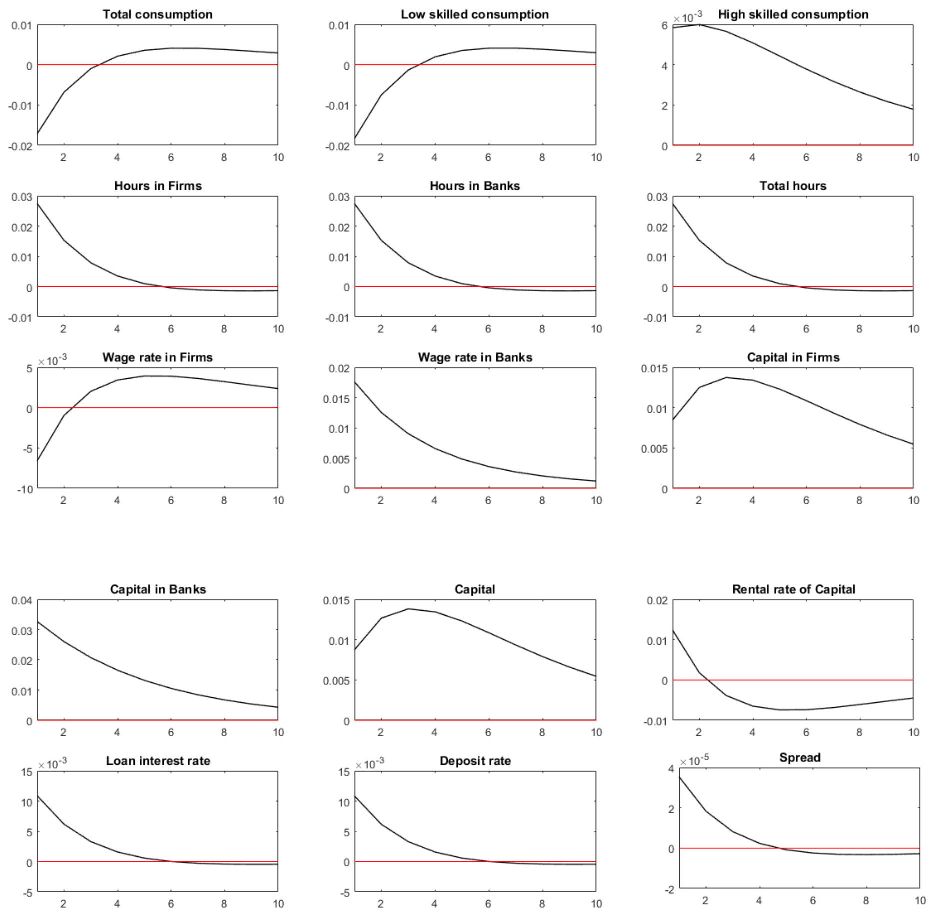
Figure 3.5 further shows that the rise in the wage rate in banks and rental rate of capital, translates into increased high-skilled consumption. For low-skilled households, their consumption falls due to a decline in their wage rate. The result further signify the importance and dominance of wage income in driving household consumption.

Results from Figure 3.5 also reflect the potential consequences of regulatory changes in the banking industry. For instance, the PricewaterhouseCoopers (PWC) Major banks analysis report[11] and the Financial Services Sector Assessment Report (2014), by the Department of Economic Development and Tourism and the University of Cape Town[12] found that the introduction of regulation resulted in banks subsequently investing in regulation and compliance staff, as well as system enhancements needed to implement and meet regulatory report requirements. This is following the impact of the 2008 GFC. Consequently, headcount staff and costs continue to increase, accounting for 55 percent of major banks' total operating expenses as shown earlier. Therefore, results from Figure 3.5 indicate that a negative TFP shock hitting banks, is akin to tightened banking regulation. This is evident by the expansion of the banking industry with respect to labour and capital and the costs associated with labour and physical capital.

[11] Available at https://www.pwc.co.za/en/assets/pdf/major-banks-analysis-sept-2017.pdf.

[12] Available at http://www.aifmrm.uct.ac.za/wp-content/uploads/AIFMRM-DEDT-Financial-Services-Sector-Assessment-Report-2014.pdf.

Figure 3.5: Impulse response functions following a negative one standard deviation shock to the TFP of the banking sector.



Despite the increase in employment in the banking industry, post the 2008 GFC, recent periods have seen banks reduce their labour force and physical capital base, particularly bank branch networks. For instance, the Major bank analysis report by PWC indicates that the rightsizing of physical infrastructure and branch networks in order to achieve efficiencies are a high strategic priority for banks in SA. In addition, reports by BankSeta (2014, 2019)[13] indicate that banks' aim of delivering cost efficiencies has seen them usher in mobile and branchless banking, further aimed at providing financial services to lower income groups. As such, the reports highlight that further research is necessary to determine if digitisation is the determining factor to the recent reduction in employment. Consequently, we analyse the effects of a positive productivity shock hitting the banking industry which is akin to technological advances in the banking industry. From standard RBC literature, productivity shocks make production factors efficient, where the marginal productivity of factors (labour and capital) increase, which further induce an increases in the returns to labour (wages) and capital (rental rate). Results from Figure 3.6 indicate that similar productivity shocks in the banking sector mimic a contraction in the sector. Following the positive one standard deviation shock to the TFP of banks, results from Figure 3.6 suggest that banks substitute labour and capital with more efficient labour and capital as hours and capital in banks fall. The impact on capital is more pronounced relative to hours worked. Consequently, the wage rate in banks as well as the rental rate of capital decline.

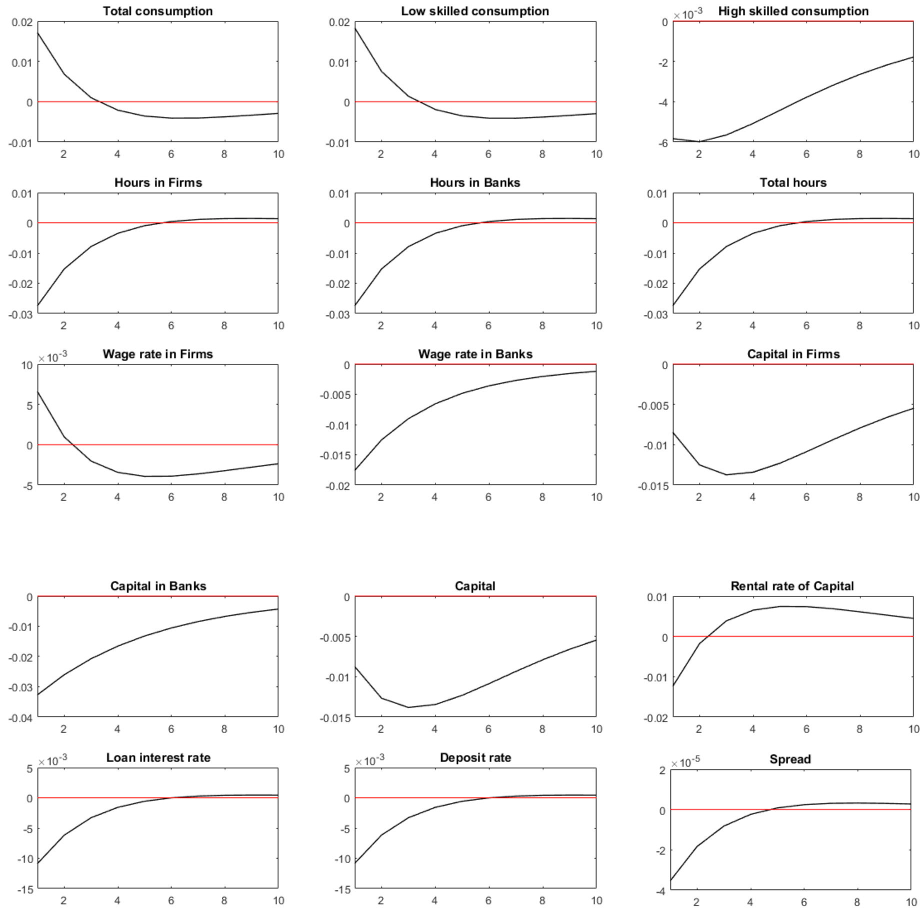
The productivity shock also results in the reduction of the loan interest rate and subsequently, a fall in revenues from loans as reflected by the decline in the interest margin. The decline in the loan rate implies that firms face lower cost of financing

[13]Banking Sector Education and Training Authority (BankSeta) Banking Sector Skills Plan.

working capital needs. However, the lower loan rate, coupled with a decline in the rental rate of capital fails to induce a demand for capital by firms as capital in firms fall. Despite wages in firms increasing, the lower loan rate influencing wage costs does not induce the demand for low-skilled labour as hours in firms decline, contrary to Dia and Menna (2016).

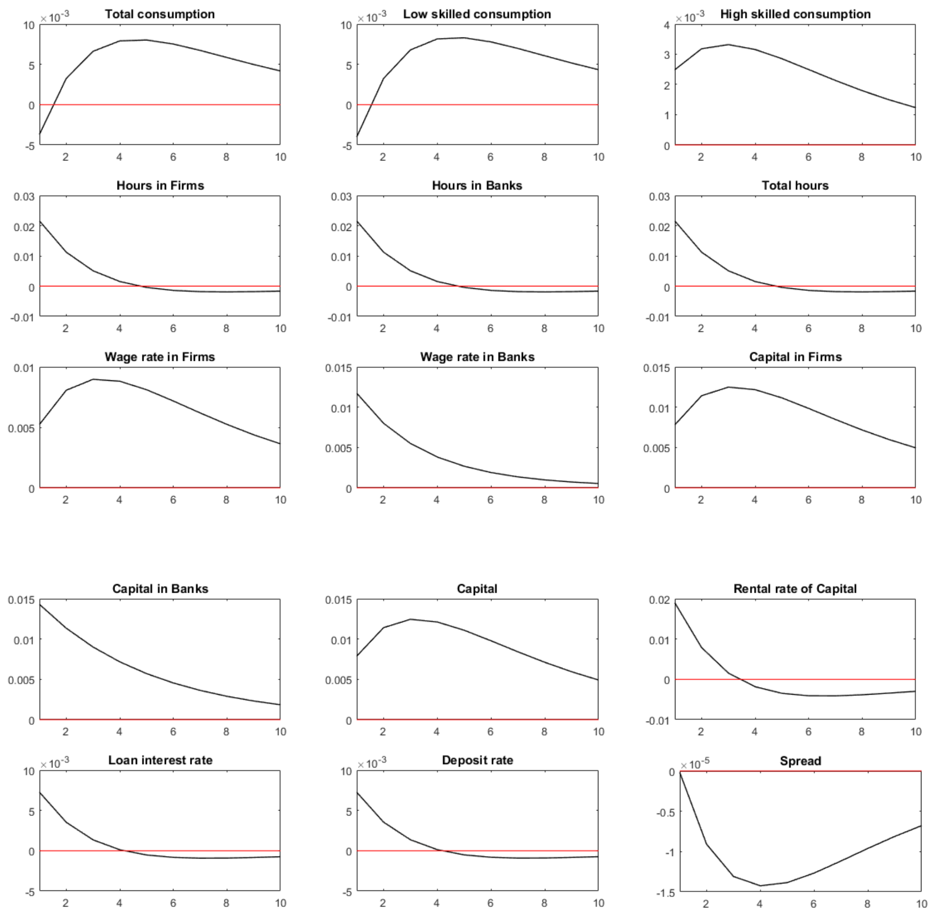
Notably, results from Figure 3.6 also signify the dominance and importance of disposable income (wage rate) in driving household consumption relative to returns from asset holdings. Consumption by low-skilled households rise due to the increase in the wage rate. Similarly, high-skilled consumption falls due to a decline in their wage rate.

Figure 3.6: Impulse response functions following a positive one standard deviation shock to the TFP of the banking sector.



The next of results shown by Figure 3.7 shows the response of variables following a positive symmetric one standard deviation shock to the TFP of firms and the banking sector. Following the shock, hours in firms and banks increase in a similar manner. Capital in banks and firms rise on impact, with the rise in bank capital more pronounced relative to the rise in firm capital. This possibly reflects the capital intensive nature of the banking industry relative to the private sector. Consequently, returns to real resources are also pushed up, with the increase in the wage rate in banks more pronounced relative to the increase in the wage rate in firms. The increase in the rental rate of capital and the deposit rate are short-lived. Consumption by both classes of households increase, further indicating that households' consumption is driven by wage income, despite the delayed rise in low-skilled consumption. As the returns to labour in banks and capital increase, the loan rate is pushed up, reflecting the response of banks in passing the increase in their real resource costs, to firms.

Figure 3.7: Impulse response functions following a positive symmetric one standard deviation shock to the TFP of the industrial and banking sector.



3.5.1 Transmission Mechanisms: Aligning my results with the results and intuition in the literature

In a bid to understand the transmission mechanisms behind Figures 3.4 to 3.7, we further place and relate our results with conclusions made from other works. For instance and similar to our results, work by Goodfriend and McCallum (2007) show that a positive productivity shock increase labour productivity, which is reflected by the rise in wages. The increase in the rental rate of capital reflects persistent increase in the marginal product of capital. Contrary to our results however, hours worked in firms/goods-producing sector decline and in fact, insensitive to the productivity shock. This is offset by an increase in hours worked in banks. This result reflect an increase in the demand for deposits by households and not the supply of loans as the marginal cost of loan production (external finance premium) increase. To extend with our results, the increase in the deposit rate possibly reflect the observations by Goodfriend and McCallum (2007), while the higher loan rate reflect greater demand for loans by firms due to rising capital and labour costs. It also indicates that the higher wage and capital costs that banks incur are potentially passed on to the borrowers (firms) as well.

In Ko (2015), the demand for high and low-skilled labour is induced by almost the same amount due to no variation in the relative marginal productivity across sectors. This is following a positive productivity shock under optimal monetary policy. Consequently, wages for both high-skilled and low-skilled workers increase, resulting in rising consumption for both classes of workers. Driving the mechanism behind the results are the findings that wages for low-skilled workers are sticky and as such, the employment of low-skilled workers is more volatile relative to the employment of high-skilled workers. On the other hand, wages for high-skilled workers are more volatile than those of low-skilled workers. As such, high and low skilled households respond differently following productivity and monetary shocks. Therefore, despite differences in the objectives and framework used, results from Figure 3.4 to 3.7 resonate with the conclusions from Ko (2015).

Similarly, Gornemann et al. (2012), through a search and matching framework, finds that following a positive TFP shock, demand for labour services and capital increase, along with their prices (wage rate and rental rate). The increase in the demand for labour services is manifested through more vacancies posted, which increase the job finding rate. Regarding consumption and saving dynamics, our results resonate with Kaplan and Violante (2018) as well. For instance, they show that the response of consumption to TFP shocks is dominantly driven by disposable income (wage rates). This is because households cut or increase consumption following lower or higher disposable income, perpetuated by the fall (or increase) in hours worked, as output and firm profits fall (or increase).

In Goodfriend and McCallum (2007), results from a positive productivity shock on the loan monitoring effort emanating from the banking industry show a decline in hours worked in banking; a result similar to ours. The wage rate increases but with a negligible impact, while the rental rate of capital decline. The notable effect is that the improved productivity in loan monitoring reduces the external finance premium (for households), which reflects a decline in the marginal cost of loan production. Similarly in our case, improved productivity (positive TFP shock) in the banking sector reduces the cost of financing working capital needs for firms in the form of a decline the loan rate.

Ravenna and Walsh (2012) show that following a negative productivity shock, low-efficiency workers experience a pronounced fall in average hours worked relative to high-efficiency workers in the US and EU. This is because the negative productivity shock is likely to increase job separation for low-efficiency workers relative to high-efficiency workers and disproportionately lower the quality of low-efficient workers as they experience greater inflow into unemployment. In essence, negative TFP shocks have more pronounced effects on hours worked by low-efficiency workers relative to high-efficiency workers. Amplifying the results is the idea that firms can screen and observe worker's efficiency levels and as such, firms become more selective during recessions and thereby reduce their vacancy yields. It is this notion of firms' ability to screen heterogeneous workers based on their productivity, that plays a central role in determining flows into and out of employment and unemployment.

3.6 Conclusion

The chapter has sought to determine whether productivity shocks hitting the private sector and importantly, the banking industry in SA, matter in the adoption and employment of labour and physical capital (real resources) as well as other macroeconomic variables. We use a DSGE model where, both firms and banks employ labour and capital to produce their respective outputs. Our results show that productivity shocks hitting the banking industry in SA, are akin to tightened regulation and/or improvements and advances in the technology of loan origination and monitoring. For instance, a negative productivity shock in the banking industry induces banks to invest in labour and physical capital as evident by rising physical capital and labour/ hours worked in banks. However, this appears to be an inefficient employment of resources and in fact, a costly exercise for banks as evident by the higher wage rate in banks and an increase in the loan rate. This also reflects that bank supply of loans becomes limited or loans become expensive. This further implies that real resource costs that banks incur are passed on to firms. Similarly, advances in technology and reduced bank branch networks, which are akin to positive productivity shocks in banking have implications for the employment of labour and capital in banks and importantly, on the loan rate. Advances in technology are in line with SA banks' strategies of mobile and branchless banking. This however, implies that labour and capital employment in banks decline. As this is akin to improved productivity, the cost of providing loans on the margin falls.

Lastly, analysis reports by BankSeta indicate that further research is necessary to determine if digitisation is the determining factor in the reduction of employment in banks. Our analysis therefore sheds light on the potential effects of such policy and strategy changes in the banking industry.

3.7 Appendix

3.7.1 Derivation of the Aggregate Resource Constraint

$$c_t^H + k_t - (1-\delta)\, k_{t-1} = w_t^b h_t^b + r_t k_{t-1} + \Pi_t^b + \Pi_t^f, \tag{3.21}$$

$$c_t^L + d^s = w_t^f h_t^f + r_{t-1}^d d_{t-1}^s + \Pi_t^b + \Pi_t^f, \tag{3.22}$$

$$\Pi_t^b = d_t^d + r_{t-1}^l l_{t-1}^s - r_{t-1}^d d_{t-1}^d - l_t^s - w_t^b h_t^b - r_t k_t^b, \tag{3.23}$$

$$\Pi_t^f = l_t^d + y_t - r_{t-1}^l l_{t-1}^d - w_t^f h_t^f - r_t k_t^f. \tag{3.24}$$

Since

$$c_t = c_t^H + c_t^L \tag{3.25}$$

we have:

$$c_t^H + k_t - (1-\delta)\, k_{t-1} + c_t^L + d_t^s = w_t^b h_t^b + r_t k_{t-1} + w_t^f h_t^f + r_{t-1}^d d_{t-1}^s + \Pi_t^b + \Pi_t^f, \tag{3.26}$$

Now, replacing (3.23) in (3.26) yields the following:

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L + d_t^s = w_t^b h_t^b + r_t k_{t-1} + w_t^f h_t^f + r_{t-1}^d d_{t-1}^s + (d_t^d + r_{t-1}^l l_{t-1}^s - r_{t-1}^d d_{t-1}^d - l_t^s - w_t^b h_t^b - r_t k_t^b) + \Pi_t^f \tag{3.27}$$

Canceling terms using (3.18) and (3.19) yields the following:

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L = r_t k_{t-1} + w_t^f h_t^f + r_{t-1}^l l_{t-1}^s - l_t^s - r_t k_t^b + \Pi_t^f \tag{3.28}$$

Replacing (3.24) in (3.28) above yields the following:

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L = r_t k_{t-1} + w_t^f h_t^f + r_{t-1}^l l_{t-1}^s - l_t^s - r_t k_t^b + (l_t^d + y_t - r_{t-1}^l l_{t-1}^d - w_t^f h_t^f - r_t k_t^f) \tag{3.29}$$

Canceling terms using (3.20) yields the following:

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L = r_t k_{t-1} - r_t k_t^b + y_t - r_t k_t^f \tag{3.30}$$

By (3.17), we have:

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L = r_t k_{t-1} - r_t(k_t^b + k_t^f) + y_t \tag{3.31}$$

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L = r_t k_{t-1} - r_t k_{t-1} + y_t \tag{3.32}$$

Therefore;

$$c_t^H + k_t - (1-\delta)\,k_{t-1} + c_t^L = y_t \tag{3.33}$$

3.7.2 Steady state

Households

The rental rate of capital earned by high-skilled households is obtained from equation (3.2)

$$r = \frac{1-\beta\left(1-\delta\right)}{\beta} \tag{3.34}$$

Similarly, the interest rate on deposits earned by low-skilled households is obtained from equation (3.5)

$$r^{d} = \frac{1}{\beta} \tag{3.35}$$

Firms

Using equations (3.15) and (3.16), we obtain the following

$$\frac{k^{f}}{h^{f}} = \left(\frac{\beta r^{l} r\mu + r\left(1-\mu\right)}{\alpha a}\right)^{\frac{1}{\alpha-1}} \tag{3.36}$$

$$w^{f} = \frac{\left(1-\alpha\right)a\left(\frac{k^{f}}{h^{f}}\right)^{\alpha}}{\left(\beta r^{l}\mu + 1-\mu\right)} \tag{3.37}$$

Simplified as:

$$w^{f} = \frac{\left(1-\alpha\right)a\left(\frac{\beta r^{l} r\mu + r\left(1-\mu\right)}{\alpha a}\right)^{\frac{\alpha}{\alpha-1}}}{\left(\beta r^{l}\mu + 1-\mu\right)}$$

Banks: Steady state and calibration

Using equations (3.9) and (3.10), we obtain the following

$$\frac{k^b}{h^b} = \left(\frac{r}{(r^l - r^d)\,\beta z \kappa}\right)^{\frac{1}{\kappa-1}} \tag{3.38}$$

$$w^b = \beta z\,(1-\kappa)\left(\frac{k^b}{h^b}\right)^{\kappa}\left(r^l - r^d\right) \tag{3.39}$$

Equation (3.38) represents banks' capital intensity while equation (3.39) is the wage rate in banks.

Simplified as:

$$w^b = \beta z\,(1-\kappa)\left(\frac{r}{(r^l - r^d)\,\beta z \kappa}\right)^{\frac{\kappa}{\kappa-1}}\left(r^l - r^d\right)$$

Contrary to Dia and Menna (2016) and Dia et al. (2018), the two sectors have different wages and as such, it is the rental rate of capital which connects the two sectors rather than the wage rate. Importantly as well, equation (3.39) depends on three unknown variables; the loan rate r^l, capital intensity $\frac{k^b}{h^b}$ and bank total factor productivity z.

To get the loan rate, equation (3.38) can be written as :

$$\beta \kappa z \left(\frac{k^b}{h^b}\right)^{\kappa-1} = \frac{r}{r^l - r^d}$$

implying that the loan rate is given as:

$$r^l = \left(\frac{1}{\beta \kappa z \left(\frac{k^b}{h^b} \right)^{\kappa - 1}} \right) r + r^d \tag{3.40}$$

In equation (3.40), we remain with z and $\frac{k^b}{h^b}$ as the unknowns. However, since we have data available on the capital intensity of banks, $\frac{k^b}{h^b}$ is fixed from the data. This leaves us with one more equation needed to obtain a system of two equations for two unknowns, r^l and z

Using the fact that the loan market equilibrium condition is $l^s = l^d$ and $y = a(k^f)^\alpha (h^f)^{1-\alpha}$, loan-to-output ratio is given as

$$\frac{l}{y} = \frac{\mu}{(\beta r^l \mu + 1 - \mu)} \tag{3.41}$$

Now, substituting the production functions, we have

$$\frac{z \left(\frac{k^b}{h^b} \right)^{\kappa} h^b}{a \left(\frac{k^f}{h^f} \right)^{\alpha} h^f} = \frac{\mu}{(\beta r^l \mu + 1 - \mu)} \tag{3.42}$$

Re-arranging equation (3.42) and using capital intensity of firms from equation (3.36), we have that;

$$z = \frac{a\mu \left(\frac{\beta r^l r \mu + r(1-\mu)}{\alpha a} \right)^{\frac{\alpha}{\alpha - 1}} h^f}{(\beta r^l \mu + 1 - \mu) \left(\frac{k^b}{h^b} \right)^{\kappa} h^b} \tag{3.43}$$

Finally, by assuming that $\kappa = \alpha$ and $\frac{k^b}{h^b}$ fixed from the data, we are able to obtain a system of two equations, equation (3.40) and (3.43) in the two unknowns, r^l and z

Now, again assuming that,

$$h^b = 0.3(0.05) \tag{3.44}$$

and

$$h^f = 0.3(0.95) \tag{3.45}$$

which implies that total hours worked in the steady state h is equal 0.3

Using equation (3.36) and (3.45), capital in firms is recovered as :

$$k^f = \left(\frac{\beta r^l r \mu + r\left(1-\mu\right)}{\alpha a} \right)^{\frac{1}{\alpha-1}} h^f \tag{3.46}$$

Similarly, capital in banks is recovered using equations (3.38) and (3.44) as :

$$k^b = \left(\frac{r}{\left(r^l - r^d\right) \beta z \kappa} \right)^{\frac{1}{\kappa-1}} h^b \tag{3.47}$$

Therefore;

$$k = k^f + k^b \tag{3.48}$$

Alternatively, we derive total capital k from high-skilled budget constraint:

$$c^H + \delta k = w^b h^b + rk$$

Therefore, total capital k is derived as:

$$k = \frac{c^H - w^b h^b}{r - \delta} \tag{3.49}$$

Importantly, high-skilled budget constraint only holds when we use total capital defined by (3.49) compared to (3.48)

High-skilled consumption is given as:

$$c^H = \left(\theta \frac{(1-h^b)^{-\gamma}}{w^b}\right)^{\frac{1}{-\sigma}} \tag{3.50}$$

Similarly, low-skilled consumption is given as:

$$c^L = \left(\theta \frac{(1-h^f)^{-\gamma}}{w^f}\right)^{\frac{1}{-\sigma}} \tag{3.51}$$

Therefore

$$y = c^L + c^H + \delta k \tag{3.52}$$

with

$$c = c^H(0.05) + c^L(0.95) \tag{3.53}$$

3.7.3 Calculations for ratio of capital stock between banks and firms: $\frac{k^b}{k^f}$

Using the fact that :

$$\frac{l}{y} = \frac{z\left(k^b\right)^{\kappa}\left(h^b\right)^{1-\kappa}}{a\left(k^f\right)^{\alpha}\left(h^f\right)^{1-\alpha}}$$

which can be written as

$$\frac{l}{y}\frac{a\left(h^f\right)^{1-\alpha}}{z\left(h^b\right)^{1-\kappa}} = \frac{\left(k^b\right)^{\kappa}}{\left(k^f\right)^{\alpha}}$$

Now, dividing the left hand side and multiplying the right side of the above equation by $\left(k^f\right)^{\kappa-\alpha}$, yields the following:

$$\frac{\left(k^b\right)^{\kappa}}{\left(k^f\right)^{\alpha}\left(k^f\right)^{\kappa-\alpha}} = \left(k^f\right)^{\kappa-\alpha}\frac{l}{y}\frac{a\left(h^f\right)^{1-\alpha}}{z\left(h^b\right)^{1-\kappa}}$$

which pins down as:

$$\frac{\left(k^b\right)^{\kappa}}{\left(k^f\right)^{\kappa}} = \left(k^f\right)^{\kappa-\alpha}\frac{l}{y}\frac{a\left(h^f\right)^{1-\alpha}}{z\left(h^b\right)^{1-\kappa}}$$

which essentially pins down the ratio of physical capital between the two sectors

$$\frac{k^b}{k^f} = \left(\left(k^f\right)^{\kappa-\alpha}\frac{l}{y}\frac{a\left(h^f\right)^{1-\alpha}}{z\left(h^b\right)^{1-\kappa}}\right)^{\frac{1}{\kappa}} \tag{3.54}$$

where $k^f = h^f\left(\frac{k^f}{h^f}\right)$, are obtained from relations in equation (3.45) and (3.46). h^b is from equation (3.44) while $\frac{l}{y}$ is from equation (3.41).

3.7.4 Loglinear Model

The competitive equilibrium in log-linear form is defined by the following system of equation[14]

High skilled households

$$-\sigma\widetilde{c}_t^H = -\sigma\widetilde{c}_{t+1}^H + \frac{r}{r+1-\delta}\widetilde{r}_{t+1},$$

$$\widetilde{w}_t^b = \gamma\frac{h}{1-h}\widetilde{h}_t^H + \sigma\widetilde{c}_t^H,$$

Low skilled households

$$-\sigma\widetilde{c}_t^L = -\sigma\widetilde{c}_{t+1}^L + \widetilde{r}_t^d,$$

$$\widetilde{w}_t^f = \gamma\frac{h}{1-h}\widetilde{h}_t^L + \sigma\widetilde{c}_t^L,$$

Banks

$$-\sigma\widetilde{c}_{t+1}^H + \widetilde{z}_t + \kappa\left(\widetilde{k}_t^b - \widetilde{h}_t^b\right) + \frac{r^l}{r^l - r^d}\widetilde{r}_t^l - \frac{r^d}{r^l - r^d}\widetilde{r}_t^d = -\sigma\widetilde{c}_t^H + \widetilde{w}_t^b,$$

$$-\sigma\widetilde{c}_{t+1}^H + \widetilde{z}_t + (\kappa-1)\left(\widetilde{k}_t^b - \widetilde{h}_t^b\right) + \frac{r^l}{r^l - r^d}\widetilde{r}_t^l - \frac{r^d}{r^l - r^d}\widetilde{r}_t^d = -\sigma\widetilde{c}_t^H + \widetilde{r}_t,$$

[14]Variables without the time subscript are steady state values, while those in tilde represents its log-deviation from the steady state

Firms

$$-\sigma\widetilde{c}_t^L + \frac{(1-\alpha)\,a\left(\frac{k^f}{h^f}\right)^{\alpha}}{(1-\alpha)\,a\left(\frac{k^f}{h^f}\right)^{\alpha} - w^f\,(1-\mu)}\left(\widetilde{a}_t + \alpha\widetilde{k}_t^f - \alpha\widetilde{h}_t^f\right) - \frac{w^f\,(1-\mu)}{(1-\alpha)\,a\left(\frac{k^f}{h^f}\right)^{\alpha} - w^f\,(1-\mu)}\widetilde{w}_t^f = -\sigma\widetilde{c}_{t+1}^L + \widetilde{r}_t^l + \widetilde{w}_t^f,$$

$$-\sigma\widetilde{c}_t^L + \frac{\alpha a\left(\frac{k^f}{h^f}\right)^{\alpha-1}}{\alpha a\left(\frac{k^f}{h^f}\right)^{\alpha-1} - r\,(1-\mu)}\left(\widetilde{a}_t + (\alpha-1)\,\widetilde{k}_t^f - (\alpha-1)\,\widetilde{h}_t^f\right) - \frac{r\,(1-\mu)}{\alpha a\left(\frac{k^f}{h^f}\right)^{\alpha-1} - r\,(1-\mu)}\widetilde{r}_t = -\sigma\widetilde{c}_{t+1}^L + \widetilde{r}_t^l + \widetilde{r}_t,$$

Market clearing conditions

$$\frac{c}{y}\widetilde{c}_t^H + \frac{c}{y}\widetilde{c}_t^L + \frac{k}{y}\widetilde{k}_t - (1-\delta)\,\frac{k}{y}\widetilde{k}_{t-1} = \widetilde{a}_t + \alpha\widetilde{k}_t^f + (1-\alpha)\,\widetilde{h}_t^f,$$

$$\widetilde{k}_t = \frac{k^f}{k}\widetilde{k}_t^f + \frac{k^b}{k}\widetilde{k}_t^b,$$

$$\widetilde{h}_t = \frac{h^f}{h}\widetilde{h}_t^f + \frac{h^b}{h}\widetilde{h}_t^b,$$

$$\frac{w^f h^f}{w^f h^f + r k^f}\left(\widetilde{w}_t^f + \widetilde{h}_t^f\right) + \frac{r k^f}{w^f h^f + r k^f}\left(\widetilde{r}_t + \widetilde{k}_t^f\right) = \widetilde{z}_t + (1-\kappa)\,\widetilde{h}_t^b + \kappa\widetilde{k}_t^b.$$

Chapter 4

Can Regulatory Movements and Changes in Banking Explain Aggregate Fluctuations? A Narrative Approach

4.1 Introduction

This chapter explores and estimates the macroeconomic effects of regulatory movements and changes in the South African (SA) banking industry. We build on the work done in chapter 3 where we investigate the effects of bank productivity shocks, using a Dynamic Stochastic General Equilibrium (DSGE) framework. Predictions from the model indicate that bank productivity shocks, which mimic regulatory changes, have implications for bank performance and the adoption of labour and physical capital. For instance, negative bank productivity shocks result in relatively greater adoption of labour and capital. This results in higher loan rates and interest spread as banks shift regulatory costs. On the other hand, positive bank productivity shocks, which mimic the easing of regulation or improvements in technology in the banking industry, result in less labour and physical capital adoption. This further implies lower costs for banks and in turn, reduced loan rate and interest margin.

Further evidence on the impact of regulatory reforms on the technology of producing bank output, suggest that declining compliance costs or regulatory easing reduce the overall cost of producing (loan extension) at a given level of output (Casu et al., 2013).

In the case of SA, the PricewaterhouseCoopers (PWC) Major Banks' analysis report[1] highlight that the introduction of regulation has seen banks in SA subsequently investing in regulation and compliance staff, as well as system enhancements needed to implement and meet regulatory report requirements following effects of the 2008 Global Financial Crisis (GFC). Consequently, headcount staff and costs continue to increase, accounting for over 55 percent of major banks' total operating expenses. Further, Chief Executive Officers (CEO's) of major banks in SA have raised concerns relating to efforts spent on regulatory compliance which requires significant time and focus to adapt to and implement[2]. The Financial Services Sector Assessment Report by the Department of Economic Development and Tourism and University of Cape

[1] Available at https://www.pwc.co.za/en/assets/pdf/major-banks-analysis-sept-2017.pdf.

[2] The CEO's were quoted in an article available at:https://www.businesslive.co.za/archive/2012-12-13-local-banks-decry-onslaught-of-new-rules/.

Town[3] indicate that Basel regulations have brought major regulatory changes for banks, as they are occurring at a rapid rate, with concerns that they might be intrusive. In addition, the regulation has had cost implications for banks and have negatively impacted banks' ability to innovate.

It is against this background that we aim to investigate and estimate the effects of regulatory changes in the SA banking industry. To capture and identify regulatory changes, we use the narrative approach in the spirit of Romer and Romer (2004) to build exogenous (narrative) regulatory changes in the SA banking industry. The narrative approach documents historical regulatory changes. This involves documenting dates of events relating to the announcement of regulation intended to be implemented and drafting of such regulation and dates of events involving the implementation of the regulations. As described by Ramey (2016), the narrative method of identification involves constructing a series from historical documents to identify the reason associated with a particular change in a variable. Therefore in our case; (1) the narrative instruments or indicators serve as exogenous regulatory changes and (2); they serve as instruments or instrumental variables (IVs) to the interest rate margin and thereby implicitly instrumenting for (negative) bank productivity shocks.

We adopt the use of Bayesian Vector Autoregression augmented with exogenous variables (BVAR(X)), Local Projections (LP) and Local Projections-Instrumental Variables (LP-IV). In the BVAR(X) and LP settings, we are interested in the response of macroeconomic variables to the exogenous regulatory changes. In essence, the

[3]Available at http://www.aifmrm.uct.ac.za/wp-content/uploads/AIFMRM-DEDT-Financial-Services-Sector-Assessment-Report-2014.pdf.

exogenous regulatory changes serve as instruments to shocks to the bank credit line. For instance, Deli and Hasan (2017) show that higher capital requirements, which fall under macroprudential regulations, would lead to banks shifting their lending downwards in order to meet the requirements. Conti et al. (2023) also show that banks could curtail the supply of lending and charge higher interest rates in order to meet the regulatory requirements.

Our results show that corporate and household credit rise following the drafting and announcement of regulation shock, in the BVAR(X) setting. Banks are also able to achieve better margins on the loans as the interest rate margin or spread, rises as well. The result potentially captures the anticipatory nature of regulation during drafting stages where banks have information on the proposed regulation and dates which they will be implemented. As such, they can act (expand credit for instance) before implementation dates and thereby take advantage of less stringent requirements on credit extension due to regulation, before tighter requirements are introduced. When we consider implementation shocks, results are uniform across LP-IV and BVAR(X). We find negative and persistent effects on both corporate and household credit. Our results are consistent with the work of Eickmeier et al. (2018), Budnik and Rünstler (2020), Fang et al. (2022), Mokas and Giuliodori (2023), Conti et al. (2023) and Fernández-Gallardo Romero and Lloyd (2023), who use narrative methods to identify the effects of macroprudential regulatory changes.

There are also instances where the effect of regulatory implementation is more pronounced on household credit relative to corporate credit. Importantly in the LP-IV setting, the positive and immediate response of the interest rate margin (spread) to narrative regulatory shocks further support and validate our story. The intuition is that negative productivity shocks mimic tightened regulation, which we implicitly instrument for using the interest rate margin. The regulation is captured by the narrative series and as such, the increase in the loan interest and interest rate margin imply that banks pass on the cost of regulatory changes.

We also motivate the exogeneity of our narrative regulatory indicators through the use of probit estimation and graphical evidence. Results indicate that our narrative regulatory indicators are unrelated to business and financial cycles. In effect, regulatory changes, particularly those before 2008 GFC were introduced to address underlying vulnerability of financial systems revealed by shocks and not the shock itself and therefore structural in nature (Eickmeier et al., 2018).

The remainder of the chapter is as follows. Section 4.2 describes the literature. This encompasses the literature on the effects of bank regulation and the relation between bank regulation and bank productivity, as well as literature on the use of narrative indicators or narrative instruments as an identification method. Section 4.3 describes the construction of our narrative regulatory instruments or indicators, while section 4.4 describes the econometric methodologies we apply. In section 4.5 and 4.6, we discuss our results and provide concluding remarks.

4.2 Literature Review

The examination of the effects of regulatory changes and movements in the SA banking industry encompasses various strands of the literature. The first encompasses the relationship between (changes in) bank regulation and bank performance, particularly bank regulation and credit extension and bank productivity. The second strand encompasses the use of narrative approaches to analyse and identify policy changes.

Much of the work on bank productivity in SA has largely focused on measuring productivity and efficiency of SA banks. For instance, Maredza and Ikhide (2013) measure bank efficiency and productivity changes during the period of the GFC. This is achieved through an analysis of bank performance over the period 2000 to 2010, using the Hicks-Moorsteen total factor productivity (TFP) index approach and censored Tobit model. Their results indicate that total factor productivity efficiency was 16.96 percent lower during the crisis period compared to the pre-crisis period. Gumata and Ndou (2017) study the impact of financial regulation on credit extension post the GFC. Through a historical decomposition approach, they find that financial regulation policy uncertainty (FRPU) contributed significantly to the reduction in credit extension as banks had to reassess the risks associated with different loans and advances to different customers. Furthermore, they assess the impact of Basel III in the form of the liquidity coverage ratio and net stable funding ratios on credit growth. Their decomposition exercise shows that Basel III is the second biggest contributor to credit contraction. On the contrary, this chapter studies the effects of bank regulatory changes, using narrative regulatory instruments. The narrative series of bank regulation serve as instruments and exogenous shocks to credit supply and in turn, bank productivity. To our knowledge, we are the first to study the relationship between bank regulation, bank credit extension and productivity in SA, using narrative methods of identification.

The relationship between bank regulation or financial reforms and bank productivity rests on the notion that the overall cost of producing at a given level of output is reduced by declining compliance costs (Casu et al., 2013). Secondly, regulatory reforms reduce restrictions on activities and thereby offer opportunities for banks to take advantage of economies of scale and scope. As such, analysis by Tirtiroğlu et al. (2005) show that deregulation in the United States (US) intrastate banking industry have positive long-run impacts on bank TFP growth. Further evidence of improved bank productivity following financial reforms or deregulation and technological progress is found in Turkey (Aysan and Ceyhan, 2008) and India (Casu et al., 2013).

However, our analysis of the relationship between bank regulation and bank productivity differs with the existing work in the literature. We analyse the relation between bank productivity and bank regulation by building on DSGE frameworks. As outlined earlier, bank productivity shocks in a DSGE setting mimic regulatory changes, which have implications for bank performance and adoption of labour and physical capital. This is also shown in Dia and Menna (2016), Dia and VanHoose (2017) and Dia et al. (2018). In particular, bank productivity shocks have implications for bank interest rate margins. Therefore, we use our narrative series of regulatory changes as exogenous productivity shocks. This is achieved by using our narrative series as instruments (IVs) for the interest rate margin, which in turn serve as implicit instruments for bank productivity.

Ramey (2016) describes the narrative method of identification as constructing a series from historical documents to identify the reason and/or the quantities associated with a particular change in a variable. Earlier application of the method involve the work of Hoover and Perez (1994) with the aim of identifying oil shocks. Recent and existing work on the narrative approach has largely focused on identifying monetary and fiscal shocks. As outlined by Angelopoulou et al. (2007), the aim of the narrative approach is to exclusively isolate shocks or effects of policy intervention. In addition, the shocks in a narrative VAR are identified using information independent from the VAR (Favero and Giavazzi, 2012).

Earlier application by Romer and Romer (1989) adopt the approach to identify monetary policy shocks. They construct a dummy variable for periods when the Federal Reserve contracted the funds rate to offset inflationary pressures. Resting on their earlier work, Romer and Romer (2004) develop a new measure of monetary policy shocks to exclusively isolate the effects of monetary policy. The measure is constructed from the narrative records of the Federal Open Market Committee (FOMC) meetings. The records capture changes in Federal Reserve's intentions for the federal funds rate around scheduled FOMC meetings and removes policy actions that are endogenous to Federal Reserve's anticipations of future developments. Importantly, their measure produce superior effects of monetary policy on output and inflation relative to traditional measures of monetary policy such as the federal funds rate.

In the same spirit, Romer and Romer (2010) use the narrative record of Presidential speeches and Congressional reports to construct a narrative series of shocks to government revenues. The narrative record allows them to identify the size, timing and motivation for all major post-war tax policy actions. They in turn, measure the effects of such shocks on output. Ramey (2011) builds on Ramey and Shapiro (1998) to identify government spending shocks using the narrative approach, with greater emphasis placed on the timing of the shocks. The narrative record is based on episodes where the Business Week began to forecast large rises in defence spending, induced by political events or military episodes unrelated to the U.S economy. The narrative variable takes a value of unity during dates of military episodes.

Close to our objective of building a narrative record of Basel regulations, Budnik and Rünstler (2020) analyse the dynamic effect of US macroprudential policies by a identifying Structural VAR (SVAR) from narrative instruments. They construct a set of policy measures related to capital requirements following the Basel III Accords. The narrative instruments take a value of -1 and 1 in the case of tightening and easing of capital requirements, respectively and 0 otherwise. Results from their analysis show that the tightening of capital requirements induce a persistent decline in corporate and household lending. Furthermore, the impact of a change in capital requirements is concentrated more on corporate credit relative to household credit. Eickmeier et al. (2018) also assess the dynamic effects of bank capital regulation in the US. They use the narrative approach to construct an exogenous capital regulation index that captures exogenous changes in bank capital regulation. Their results show persistent declines in corporate and investment loans and real estate loans, following changes in the capital regulation index. Mokas and Giuliodori (2023) study the effects of announcements of macroprudential policies related to tightening of borrower-based measures, the loan-to-value (LTV) ratio. Their findings show that announcements of LTV tightening policies can have a sizeable negative impact on household credit. Conti et al. (2023) show that shocks to capital requirements reduce loan supply, while the analysis by Fang et al. (2022) find that higher capital requirements are associated with lower credit growth in Peru.

The impact of regulatory changes and reforms took centre stage more especially post the 2008 GFC, which resulted in improvements to Basel Accords in the form of Basel 2.5 and Basel III. However, effects of earlier regulatory reforms have also been studied.

For instance, Kashyap et al. (2004) argue that the requirements of Basel II Accords prompting banks to hold more capital during economic downturns, exacerbate business cycle fluctuations. Consequently, banks have to raise capital, which in turn affects their ability to extend credit. However, the upside to such tight capital requirements is that more stringent capital requirements aid bank recapitalisation and in turn facilitate smooth loan path (Baum et al., 2002). Following the 2008 GFC, Angelini et al. (2015) assess the long-term economic impact of the Basel III reforms. In line with Kashyap et al. (2004), the intuition is that capital and liquidity regulation, which is encompassed and enhanced under Basel III, affect economic activity through increased costs of bank intermediation, as banks must hold more capital. This implies less lending activity or increased lending costs in the form of higher loan rates, for a given level of lending.

4.3 The Narrative Indicators

This section presents actions and events that we use to identify and construct our narrative indicators. The actions and events are listed in Appendix 4.7 and tabulated in table 4.8 to 4.9. The construction is based on historical documents that contain actions and events that lead to the implementation of Basel regulations, from 2001 to 2019. Although there are other banking regulation in SA such as the Financial Intelligence Centre Act (38 of 2001) that fall under our period of construction, the majority of the regulations we consider are Basel regulations.

Due to the wide variety of information contained in the documents, we impose a criteria with which we use to identify actions and events that are most important in the construction of our narrative indicators. As outlined earlier, the narrative instruments serve as exogenous (implicit negative) bank productivity shocks. Therefore in the documents we consult, we consider; (1) actions and events that are specific in their intentions and (2), actions and events that might imply a change in bank behaviour with respect to bank productivity, credit extension and the reallocation of physical resources such as physical capital and labour. From this, we are able to build a series of two narrative indicators decomposed as; (1) announcements and communication of regulation intended to be passed and the drafting of such regulation which we call $Draft$. The indicator takes a value of 1 during such events and 0 otherwise. Second is the eventual implementation of the regulation, which we call $Implementation$, taking a value of 1 during implementation dates and 0 otherwise. Contrary to Eickmeier et al. (2018) and Budnik and Rünstler (2020), who are able to use their narrative series to track the tightening or easing of capital requirements, the documents we consult have limited information regarding tightening or easing of capital requirements. Therefore, using the criteria described above, we consider Basel macroprudential regulations in their entirety and not individual regulations under the Basel Accords. This enables us to extract a richer set of information relative to considering only capital requirements. To illustrate some actions the may imply a change in bank behaviour with respect to bank productivity, reallocation of physical resources and credit extension, we highlight an event listed in Appendix 4.7. The event occurs in 2004 February the 20th where the South African Reserve Bank (SARB) issued Circular 1 of 2004, announcing that "banks would have to increase their capital holdings ahead of Basel II implementation on January 1st 2008". As noted by Deloitte (2014), the potential implication is that banks can increase the cost of lending, for a given level of credit extension in order to keep up with the capital requirements.

The documents we consult include circulars issued by the SARB to commercial banks in SA, annual reports of commercial banks and SARB and risk and capital management reports of commercial banks. We consider reports of only the big 4 commercial banks in South Africa as they account for over 90 percent of banking industry assets.[4] We also consider documents published and issued by the Basel Committee on Bank Supervision (BCBS), containing communication between the BCBS and the SARB. The communications relates to the implementation of Basel regulations.

Therefore, announcement and communication of regulation involves communication

[4]The big 4 banks include Standard Bank, ABSA, NEDBANK and First Rand.

between the BCBS and the SARB on intended Basel framework to be drafted and implemented. There is also announcements and communication the between SARB and commercial banks through circulars. The actions and events announced and drafted eventually lead to the implementation of the regulations. Therefore where possible, we also track the actions and events from the date they are communicated and or announced, issued or published ($Draft$), until the date they are introduced or implemented ($Implementation$).

Importantly, we do not identify the impact of individual regulations and requirements under Basel Accords and Agreements. We consider Basel regulations in their entirety. Although different Basel regulations such as the capital and liquidity requirements target different instruments, the entirety of Basel regulations, which both capital and liquidity requirements fall under, is aimed at creating resilient and robust banking systems (Cohen and Scatigna, 2016) (Cerutti et al., 2018). Therefore, relevant for our analysis is the actions and events that might imply a change in bank behaviour with respect to bank productivity, credit extension and reallocation of physical resources such as physical capital and labour.

For instance, the implementation of Basel regulations impacts the cost of funding for banks and consequently, the rate at which they are prepared to lend (Deloitte, 2014). Secondly, banks may need to employ labour and capital needed to implement the regulatory changes. For instance, the PricewaterhouseCoopers (PWC) Major banks' analysis report[5] highlight that the introduction of regulation has seen banks subsequently investing in regulation and compliance staff as well as system enhancements

[5] Available at https://www.pwc.co.za/en/assets/pdf/major-banks-analysis-sept-2017.pdf.

needed to implement and meet regulatory report requirements, following the effects of the 2008 GFC. Consequently, headcount staff and costs continue to increase, accounting for 55 percent of major banks' total operating expenses. Further, Chief Executive Officers (CEO's) of major banks in South Africa have raised concerns relating to efforts spent on regulatory compliance which requires significant time and focus to adapt to and implement[6]. The Financial Services Sector Assessment Report by the Department of Economic Development and Tourism and University of Cape Town[7] also indicate that Basel has been a major regulatory change for banks as it occurring at a rapid rate, with concerns that it might be intrusive, further increasing costs for banks and have a negative impact on banks' ability to innovate.

As also documented by Angelini et al. (2015), bank regulation, particularly capital and liquidity regulation, affect economic activity through an increase in the cost of intermediation or lower productivity. Further work by Berka et al. (2018), indicates that banks can limit loans they offer due to regulatory constraints as it requires holding more liquid capital. This further implies that less capital is available for credit extension. Therefore, following the above mentioned reports and latter literature, coupled with the predictions of DSGE models, our objective of documenting the effects of regulatory changes in the SA banking industry, is justified.

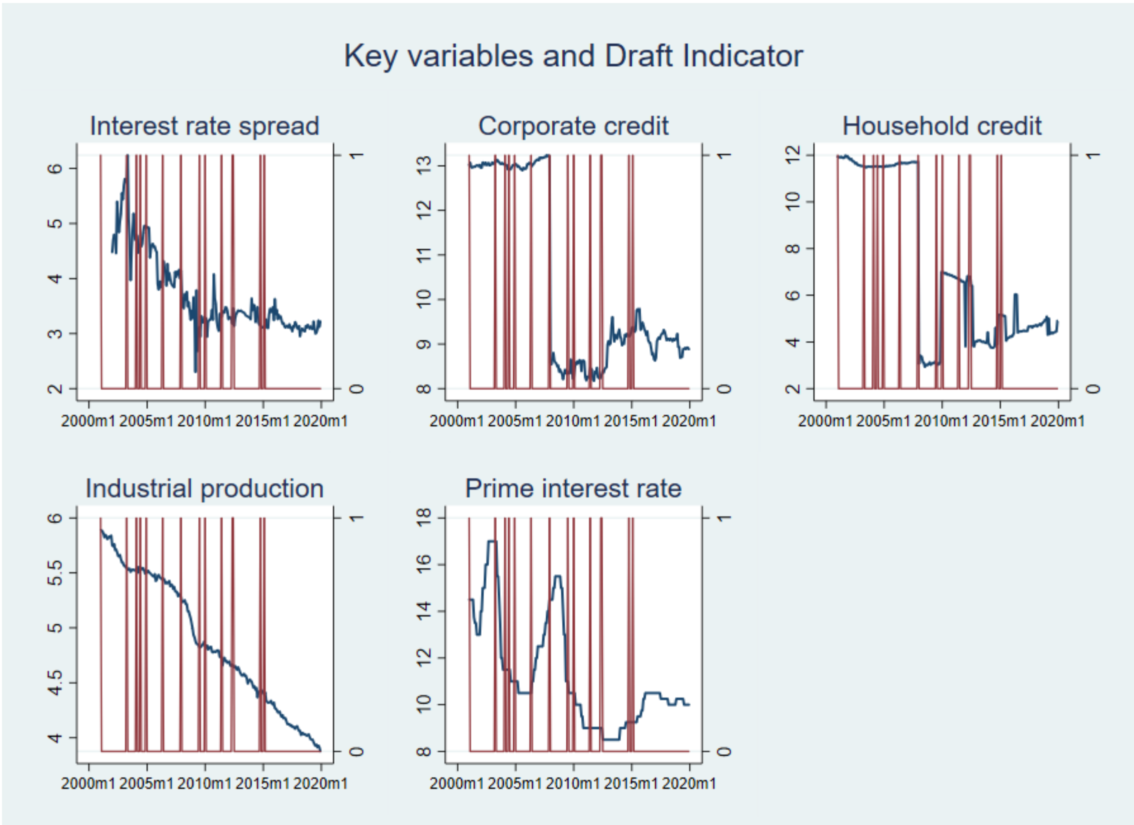
[6]The CEO's were quoted in an article available at:https://www.businesslive.co.za/archive/2012-12-13-local-banks-decry-onslaught-of-new-rules/.

[7]Available at http://www.aifmrm.uct.ac.za/wp-content/uploads/AIFMRM-DEDT-Financial-Services-Sector-Assessment-Report-2014.pdf.

4.3.1 Exogeneity of our Narrative Indicators

Are changes to bank regulation, captured by our narrative indicators unrelated to business and financial cycles? That is, do the regulatory bodies make regulatory changes in response to some business or financial shocks? A tentative answer to both questions lies with Figures 4.1 and 4.2. Figure 4.1 plots the narrative indicator $Draft$ against key variables. The observation that emerges is that there is no clear pattern or correlation that is evident between the variables and $Draft$. Despite incidences where the interest rate spread increase following announcement and drafting of regulation, there are also incidences where the interest rate spread falls following announcement and drafting of regulation.

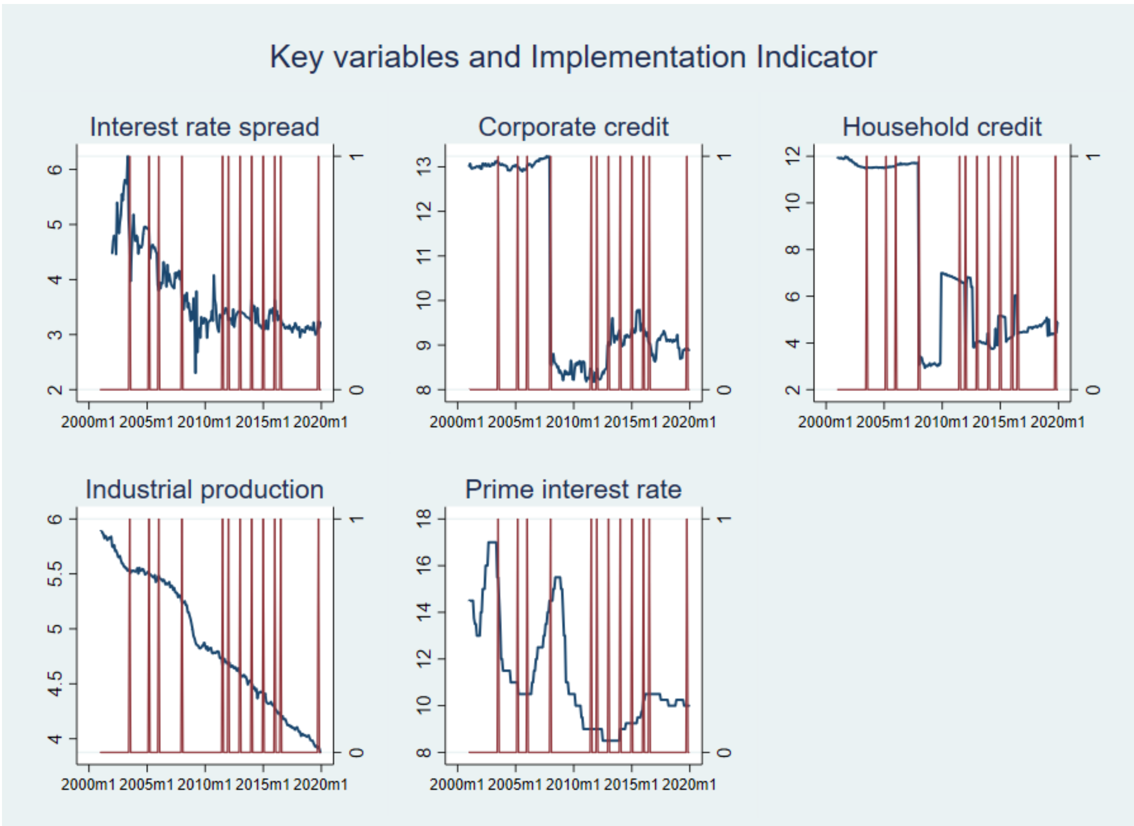
Figure 4.1: Selected variables and narrative events



Notes: This Figure plots the narrative indicator, announcements an draft of regulation (Draft) against key variables. Draft indicator is scaled on the right hand side of each plot. The variables, with the exception of prime interest rate and interest rate spread are in logs. Source: Authors' calculation.

Similarly, Figure 4.2 plots the narrative indicator *Implementation* against key variables. There is apparent pattern or correlation emerges between the variables and the narrative instrument. For instance, both corporate and household credit extension is stagnant following the first three implementation dates. However, during regulatory implementation dates post 2009, there are instances where both corporate and household credit fall and rise. As such and also argued by Eickmeier et al. (2018), the nature of banking regulatory changes under Basel are broad and structural in nature. There is also considerable time between announcements and drafting of rules and eventual date with which the rules and regulations are implemented. Put otherwise, the regulatory changes, particularly those before 2008 GFC are introduced to address the underlying vulnerability of financial systems revealed by shocks and not the shock itself (Eickmeier et al., 2018).

Figure 4.2: Selected variables and narrative events



Notes: This figure plots the narrative indicator, implementation of regulation against key variables. Implementation indicator is scaled on the right hand side of each plot. The variables, with the exception of prime interest rate and interest rate spread are in logs. Source: Authors' calculation.

More formally, we statistically test the exogeneity of our narrative indicators. In the spirit of Eickmeier et al. (2018) and Budnik and Rünstler (2020) we estimate probit regressions on lags (one and four lags) of the interest rate margin ($Spread$) corporate credit ($FirmCredit$), household credit ($HouseCredit$), industrial production ($Ouput$) and the prime overdraft rate ($Primerate$). In essence, we analyse whether the variables in our analysis have some predictive power on our narrative indicators. Table 4.1 shows that none of the variables, with the exception of output, have predictive power on the $Draft$ indicator. In addition, Table 4.2 show that none of the variables have predictive power on the $Implementation$ indicator.

Table 4.1: Probit estimation results: Variables on Draft

	(1) Draft	(2) Draft	(3) Draft	(4) Draft	(5) Draft	(6) Draft
$FirmCredit_{t-1}$	-0.19					-0.46
	(-1.36)					(-1.08)
$HouseCredit_{t-1}$		-0.02				0.19
		(-0.27)				(0.90)
$Output_{t-1}$			-6.44*			-7.86*
			(-2.01)			(-2.21)
$Primerate_{t-1}$				0.25		0.28
				(0.13)		(0.13)
$Spread_{t-1}$					0.02	-0.19
					(0.06)	(-0.58)

Notes: This table reports probit estimation results. The dependent variable is the narrative indicator, announcement and drafting of regulation (Draft). The control variables are detrended using the Hodrick–Prescott filter, with a constant entering the regressions as well. $FirmCredit$ is Corporate Credit, $HouseCredit$ is Household Credit, $Output$ is Industrial Production, $Primerate$ is Prime overdraft rate and $Spread$ is the Interest rate spread. t statistics are in parentheses. Significance at: * $p < 0.1$, sym** $p < 0.05$, *** $p < 0.01$. Estimation method is Maximum Likelihood.

Table 4.2: Probit estimation results: Variables on Implementation (Impl)

	(1)	(2)	(3)	(4)	(5)	(6)
	Impl	Impl	Impl	Impl	Impl	Impl
$FirmCredit_{t-1}$	0.18					-0.06
	(0.74)					(-0.15)
$HouseCredit_{t-1}$		0.10				0.08
		(0.96)				(0.40)
$Output_{t-1}$			7.77			6.81
			(1.82)			(1.64)
$Primerate_{t-1}$				-0.85		0.31
				(-0.44)		(0.12)
$Spread_{t-1}$					-0.29	-0.21
					(-1.00)	(-0.62)

Notes: This table reports probit estimation results. The dependent variable is the narrative indicator, implementation of regulation (Impl). The control variables are detrended using the Hodrick–Prescott filter, with a constant entering the regressions as well. $FirmCredit$ is Corporate Credit, $HouseCredit$ is Household Credit, $Output$ is Industrial Production, $Primerate$ is Prime overdraft rate and $Spread$ is the Interest rate spread. t statistics are in parentheses. Significance at: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Estimation method is Maximum Likelihood.

We also include 4 lags of the variables as robustness checks to identify whether the variables have some predictive power at higher lags. A similar conclusion is made, where our narrative indicators are unrelated to or react to business and financial cycles even at higher lags[8]. This therefore motivates our case of the narrative indicators being exogenous.

Following Fang et al. (2022), Mokas and Giuliodori (2023) and Fernández-Gallardo Romero and Lloyd (2023), we however acknowledge that there is a limitation to using implementation dates to identify macroprudential effects due to their anticipatory nature. For instance, Mokas and Giuliodori (2023) focus on announcements to the tightening of the loan-to-value (LTV) ratio to identity macroprudential policy shocks. They ignore implementation dates due to their anticipatory nature, which may pose identification issues. Similarly, Fang et al. (2022) and Fernández-Gallardo Romero and Lloyd (2023) control for possible anticipation effects by distinguishing between macroprudential policies with and without implementation. As with Mokas and Giuliodori (2023), announcement dates are used to identify the effects of macroprudential policies. Secondly, they identify macroprudential policies with and without implementation lags. Policies without implementation lags are captured by the announcement date, while policies with implementation lags are defined as policies with significant delay between the announcement and enforcement or implementation date of at least 90 days following, Mertens and Ravn (2012).

4.4 Econometric Methodology

The narrative instruments documenting regulatory changes result in 14 actions and events that are regarded as the announcement and passing of regulation between 2001 and 2019 ($Draft$), while 12 actions and events result in the implementation

[8]The results are shown by Tables 4.8 and 4.9 in Appendix 4.7.2.

of the regulations (*Implementation*). In order to estimate the effects of regulatory changes, we rely on various econometric techniques. We use Bayesian Vector Autoregression (BVAR) augmented with exogenous variables, BVAR(X), Local Projections (LP) and Local Projections-Instrumental Variables (LP-IV). In the BVAR(X) and LP settings, we are interested in the response of macroeconomic variables to the exogenous regulatory indicators. In the LP-IV setting, we extend on the LP and rest on the work of Owyang et al. (2013), Fieldhouse et al. (2018) among others, and use the narrative regulatory indicators as instrumental variables. The indicators serve as instruments to the bank interest margin and thereby implicitly instrument for bank productivity. Stock and Watson (2018) highlight differences and similarities between LP-IV and structural VAR-IV (SVAR-IV). Although we are interested in the response of macroeconomic variables to the exogenous regulatory indicators using BVAR(X), similarities and differences highlighted by Stock and Watson (2018) are also applicable in our case. First, they highlight that impulse responses from SVAR-IV estimation are generated from VAR dynamics, similar to BVAR(X) in our case, while in the case of LP-IV estimation, impulse responses are estimated by distinct IV regressions with no VAR parametric restrictions. Second, they show that a major appeal of LP-IV is that it is a direct regression approach and therefore does not assume that structural shocks can be recovered from current and lagged values of observed data (invertibility). However, they also show that SVAR-IV is more asymptotically more efficient than LP-IV, although SVAR-IV requires the assumption of invertibility.

4.4.1 Bayesian Vector Autoregression (BVAR)

In the BVAR(X) setting, we are interested in the impact of the exogenous variable(s) on the endogenous variables. That is, the impact of regulatory changes as captured by our narrative series, on a vector of endogenous variables.

Following Lütkepohl (2005), we consider a reduced form VAR(p,z) model with an exogenous variable z, and p, the number of lags where

$$Y_t = AY_{t-1} + Bz_t + U_t \tag{4.1}$$

with Y_t an $np \times 1$ vector of endogenous variables, where

$$Y_t = \begin{bmatrix} Y_t \\ Y_{t-1} \\ \vdots \\ Y_{t-p-1} \end{bmatrix}$$

A an $np \times np$ matrix of of coefficients, where

$$A = \begin{bmatrix} A_1 & A_2 & \cdots & B_{p-1} & A_p \\ I_n & 0 & \cdots & 0 & 0 \\ \vdots & \vdots & \ddots & & \vdots \\ 0 & 0 & \cdot & I_n & 0 \end{bmatrix}$$

, U_t an $n \times 1$ vector of white noise process, with Variance-Covariance matrix Σ, where

$$U_t = \begin{bmatrix} \varepsilon_t \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

z_t a $d \times 1$ vector of exogenous variables with B an $n \times d$ matrix of parameters where,

$$B = \begin{bmatrix} B_0 \\ 0 \\ \vdots \\ I_n \\ \vdots \\ 0 \end{bmatrix}$$

In the lag operator, equation (4.1) can be written as:

$$A(L)Y_t = B(L)z_t + U_t \tag{4.2}$$

where $A(L) = I_k - A_1 ... - A_p L^p$ and $B(L) = B_0 + B_1 + ... B_s L^s$. Since we are interested in the effects of the exogenous narrative indicators on endogenous variables, equation (4.2), can be multiplied with $A(L)^{-1}$ and be written as:

$$Y_t = D(L)z_t + A(L)^{-1}U_t \tag{4.3}$$

where $D(L) = A(L)^{-1}B(L)$ and assuming that $A(L)^{-1}$ is invertible. In essence and as with Lütkepohl (2005), the coefficient matrices D_i of the transfer function operator:

$$D(L) = \sum_{i=0}^{\infty} D_i L^i \tag{4.4}$$

contains the effects that changes in the exogenous narrative indicators have on the endogenous variables.

In order to compute impulse responses therefore, we solve forward from period t, equation (4.1), where

$$Y_{t+h} = A^h Y_{t-h} + \sum_{i=0}^{h-1} A^i B z_{t-i} + \sum_{i=0}^{h-1} A^i U_{t-i} \tag{4.5}$$

Now, defining the $n \times np$ matrix $J = [I_n 0....0]$ and using the fact that $J'JU_t = U_t$ and $JU_t = \varepsilon_t$, we can obtain h-step ahead forecast of Y_{t+h} as:

$$y_{t+h} = JA^h Y_t + \sum_{i=0}^{h-1} A^i B z_{t+h-i} + \sum_{i=0}^{h-1} JA^i J' u_{t+h-i} \tag{4.6}$$

Similarly, the $D_i s$ are the coefficient matrices of the exogenous variables, where;

$$D_i = JA^i B, i = 0, 1..., \tag{4.7}$$

Since we are using Bayesian techniques, it is important to explain its application in our setting. First, the use of VAR models suffers from over-parameterization, resulting in inefficient estimates and analysis (Gupta and Sichei, 2006). As such Bayesian methods impose restrictions on coefficients by assuming that they are likely to be near zero than coefficients on shorter lags (Lütkepohl, 2005). In essence, BVAR models involves supplementing the data with prior information on the distribution of coefficients and thereby improve out-of-sample forecast performance (Canova, 2011). In application, we rely on the Canova and Ferroni (2020) package to estimate a BVAR(X) (BVAR with exogenous variables) as we are interested in impulse responses to the exogenous variables. Formally, equation (4.1) can be written as:

$$Y_t = X_t\beta + \varepsilon_t \tag{4.8}$$

Equation (4.8) can be re-written as:

$$y = (I_n \bigotimes W_t)\beta + \epsilon \tag{4.9}$$

where, $y = vec(Y_t)$, $\epsilon = vec(\varepsilon_t)$, $X_t = (I_n \bigotimes W_t) = n \times nk, W_{t-1} = (Y_{t-1}..Y_{t-p}..., z_t)$ is $k \times 1$. $\beta = \vartheta(A_1, ...A_p, B)$ is an $n \times 1$. In application, we rely on Canova and Ferroni (2020) who support the estimation of BVAR(X) using Multivariate Normal-Inverse conjugate priors. Therefore, in the conjugate prior setting, the prior for the autoregressive parameters is centered at zero, with diagonal matrix of 10 and prior covariance matrix of residuals being the inverse Wishart with a unitary diagonal matrix as a scale and $n + 1$ degrees of freedom (Canova and Ferroni, 2020). Prior means for the exogenous coefficients are set to zero. More formally and as with Ciccarelli and Rebucci (2003) and Berka et al. (2018) the prior of the VAR coefficients β and VAR covariance matrix Σ are given as:

$$p(\beta|\Sigma) = N(\bar{\beta}, \Sigma \bigotimes \bar{\Omega}) \tag{4.10}$$

$$p(\Sigma) = IW(\bar{\Sigma}, \alpha) \tag{4.11}$$

where prior distribution of β is normal with prior mean $\bar{\beta}$ and variance-covariance $\Sigma \bigotimes \bar{\Omega}(\alpha - n - 1)^{-1}$, with α denoting the degrees of freedom of the inverse Wishart.

The matrix $\bar{\Omega}$ is a diagonal matrix where the diagonal elements are defined as:

$$\left(\frac{\pi_0\pi_1}{l^{\pi_3}\sigma_i}\right)^2 \tag{4.12}$$

where π_0 controls the overall tightness of the prior on the covariance matrix, π_1 controls the tightness of the prior on the coefficients on the first lag and as π_1 approaches 0, the prior is imposed relatively more tightly. Further, $l = ...1,,,p$ is the lag of variables, π_3 controls the degree to which coefficients on lags higher than 1 are likely to be zero and as π_3 increases, coefficients on higher lags are shrunk to zero more tightly. Lastly, σ_i measure the scale of fluctuations in variables or variances of the residuals. For the constant term, we have:

$$(\pi_0\pi_4)^2 \tag{4.13}$$

where π_0 is defined as before and π_4 is the prior variance on the constant and as π_4 approaches 0, the constant is reduced to 0. The marginal posterior distributions are drawn and simulated using the Gibbs sampler algorithm. As outlined by Koop and Korobilis (2010), the use of prior information aids in obtaining precise estimates of impulse responses.

4.4.2 Local Projections-IV (LP-IV)

The narrative regulatory indicators also allow us to estimate the effects of regulatory changes using direct estimation methods. As such, we rest and extend on the local projection technique of Jordà (2005), through the use of Instrumental Variables, that is Local Projections-IV (LP-IV), following Owyang et al. (2013), Stock and Watson (2018) Fieldhouse et al. (2018), Barnichon and Brownlees (2019) among others. Relative to the VAR, the advantage of LP is that impulse responses are not functions of structural parameters of the VAR and thereby less sensitive to model misspecification (Caldara and Herbst, 2019). The intuition behind the use of LP-IV rests on predictions of RBC models, such as that of Dia and Menna (2016) and our DSGE model in chapter 3, where the impact of productivity shocks in banking are analysed. We argue that negative bank productivity shocks implicitly mimic regulatory changes. More formally, we have:

$$l_t^s = d_t^d = \left[a_t \left(h_t^b \right)^{1-\kappa} \left(k_t^b \right)^{\kappa} \right], \tag{4.14}$$

where l_t^s is loan supply and d_t^d is loan demand, a_t is banks' total factor productivity (TFP) and h_t^b and k_t^b are hours and physical capital in banks, respectively. The objective is to use our narrative indicators to instrument for a_t. However, since we do not observe a_t in the data, we use our narrative indicators to instrument the implicit price of credit or loan supply, which is the interest rate margin $r^l - r^d$, with r^l the loan rate and r^d the deposit rate. Following predictions of real business cycle (RBC) models, the intuition is that an increase in bank regulation reduces bank productivity and has implications for the loan interest rate and bank interest margin. More specifically, predictions from RBC models indicate that negative bank productivity shocks which we argue mimic tightened regulation, results in higher loan interest rate and higher bank spread. Similarly, a positive productivity shock, which mimics advances in technology in the banking industry results in lower cost of credit and thereby reduced bank margins. Therefore, we use our narrative indicators as instruments for the interest rate margin, thus implicitly instrumenting for (negative) bank productivity, which we do not observe in the data.

To explore the effects of regulatory changes, the estimation technique is essentially based on two-stage least squares (2SLS) where in the first stage, we test the relevance of the instrument. More formally, we have:

$$r_{t+h} = \Delta_h + \alpha z_t + \delta X_{t-p} + u_{(h)t+h} \tag{4.15}$$

where r_t represents the bank interest rate margin or spread, z_t is the instrument and $u_{(h)t+h}$ is the predicted error term. The regression equation also includes a constant as a regressor, Δ_h as well as lagged values of the spread and other control variables, X_{t-p}.

Following the estimation of equation (4.15), we obtain predicted values. In the second stage, we formally introduce the effect of interest spread shocks, or implicitly, the effect of negative bank productivity shocks, instrumented by our narrative indicators. More formally, we have

$$y_{i,t+h} = \theta_h + \hat{\beta}_h \hat{r_t} + \hat{\delta} X_{t-p} + \hat{u_{(h)}}_{t+h} \tag{4.16}$$

In equation (4.16), y_t are the response variables to the dynamic multiplier $\hat{\beta}_h$ associated with shocks to the interest margin instrumented by the narrative indicators. The predicted values obtained in equation (4.15) are represented by $\hat{r}_t$ and as with the regression in equation (4.15), we include a constant θ_h and and lagged values of the spread and response variables X_{t-p} as additional regressors. As such, Ordinary Least Squares (OLS) estimation of equation (4.16) is made possible by the external narrative indicators serving as instruments for $\hat{r}_t$.

Formally, assuming that ϵ_{1t} is the structural interest margin shock, the narrative series capturing regulatory events z_t therefore serve as instruments for ϵ_{1t}. cite-stock2018identification highlight the conditions that must be satisfied for the instrument to be valid and enable the estimation of estimate dynamic causal effects. The conditions are such that there must be correlation between z_t and ϵ_{1t}, that is $corr(\epsilon_{1t}, z_t) \neq 0$ and z_t must not contemporaneously be correlated with other structural shocks, that is $corr(\epsilon_{it}, z_t) = 0$ where ϵ_{it} are structural shocks other than interest margin shock. In addition, the structural interest margin shock must be uncorrelated with all shocks at all leads and lags, or put otherwise, z_t must be unpredictable given past shocks, that is $corr(\epsilon_{t+j}, z_t) = 0$. The condition $corr(\epsilon_{1t}, z_t) \neq 0$ amounts to the relevance of the instrument, as with equation (4.15) while the condition $corr(\epsilon_{it}, z_t) = 0$ amounts to the exogeneity of the narrative indicators. Lastly, since ϵ_{1t} is unobserved, its scale is unknown and as such, we assume the unit-effect normalization. That is, the scale of ϵ_{1t} is fixed such that a 1 percentage point productivity shock, implicitly instrumented by regulatory narrative indicators (drafting and announcement of regulation ($Draft$) and implementation of regulation ($Implementation$)), increase the spread by 1 percentage point. In the two-stage least squares estimation technique, the unit-effect normalization is imposed automatically (Stock and Watson, 2018).

The inclusion of additional regressors in equation (4.16) is motivated by the fact that the instrument z_t might satisfy the exogeneity condition and secondly, the inclusion of additional regressors could reduce sampling variance of the IV estimator by reducing the variance of the error term (Stock and Watson, 2018).

4.4.3 Local Projections

In this section, we evaluate the impulse responses to regulatory changes using local projections technique, following Jordà (2005). In essence, we estimate the following regression:

$$y_{i,t+h} = \beta_h^j \epsilon_t + X_{t-p} + u_{t+h}^j \tag{4.17}$$

where $y_{i,t+h}$ are the response variables to the shock ϵ_t which is set to the narrative regulatory indicators. X_{t-p} are control variables. In essence, we are estimating the direct effects of regulatory shocks, as captured by our narrative indicators. The assumptions underlying the estimation of equation (4.17) using OLS as put forth by Stock and Watson (2018), is that ϵ_t is exogenous (unrelated with other shocks) and is observable. Therefore to compare with LP-IV, we estimate equation (4.17) with the assumption that ϵ_t is exogenous and is set to the narrative regulatory indicators.

4.5 Results

4.5.1 Impulse Responses: BVAR(X)

Our BVAR(X) includes five endogenous variables and two exogenous variables. The endogenous variables include the prime overdraft rate, interest rate margin (spread), which is the difference between the prime overdraft rate and the deposit rate, corporate credit or credit to private to non-financial corporations, household credit and an index of industrial production as a measure of output. The exogenous variables include the dummy $Draft$, which takes a value of 1 during dates or events of announcements and drafting of regulation and 0 otherwise and the $Implementation$ dummy which takes a value of 1 during implementation dates and 0 otherwise. We use monthly data to conduct our estimations, with all the data except the spread and the prime overdraft rate, in real terms and detrended using the Hodrick-Prescott (HP) filter with the smoothing parameter set to 14 400, conventional for monthly data. Our estimation sample ranges from January 2001 to December 2019. We include 4 lags on the BVAR(X) as suggested by the Akaike Information Criterion. All the data is taken from the South African Reserve Banks' monthly release of data database.

Consequently, impulse responses to exogenous regulatory changes, that is changes in the narrative indicators ($Draft$ and $Implementation$), from 0 to 1 are reported. As outlined by Angelopoulou et al. (2007), it is also important to note that despite substantial information regarding the magnitude of the effects being potentially lost due to the categorization of the regulatory changes as a dummy, the timing and direction of the effects from the regulatory changes should be reliable.

The impulse responses are estimated with 68 percent bands (light grey) and 95 percent bands (dark grey). Figure 4.3 shows impulse responses to the announcement of regulation. Corporate and household credit rise, with banks also able to achieve better margins on credit extension as the interest margin rises. The positive effects on credit extension are also immediate and last for about 10 months. This consequently has spill-over effects on output as industrial production also rises.

Figure 4.3: Impulse responses to regulatory announcements and passing of bills into regulation

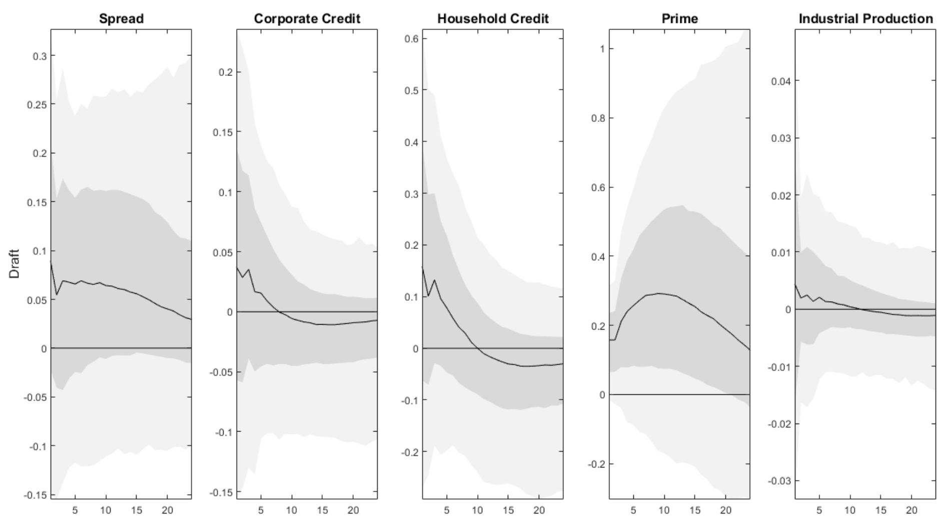
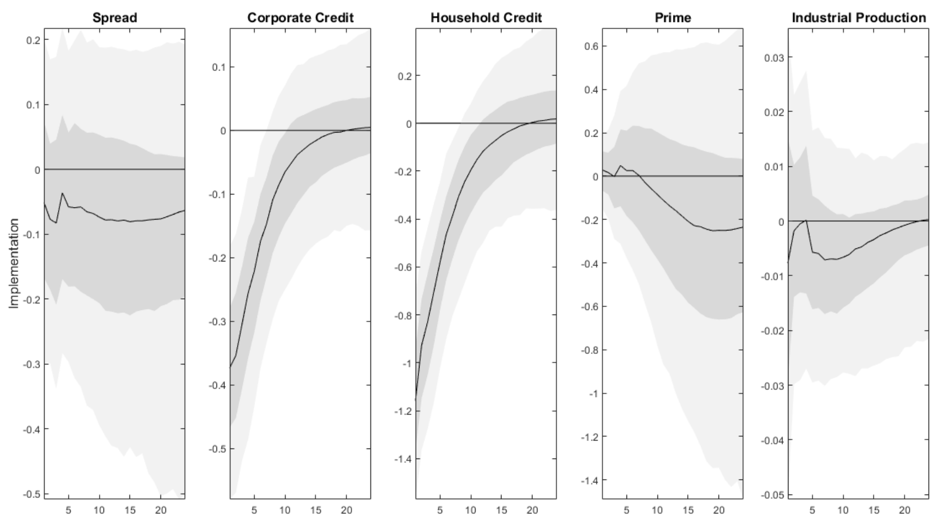


Figure 4.4 shows impulse response following implementation of regulation. As expected, both corporate and household credit decline, with the responses immediate and persistent. Despite differences in methodology, our results are in line with some of the work analysing the effects of bank regulation. For instance, Budnik and Rünstler (2020) show that the tightening of capital requirements induce a persistent decline

in corporate credit, with the effects more concentrated on corporate credit relative to household credit. Berka et al. (2018) also show that regulatory constraints can induce banks to limit loans they offer as they are required to hold more liquid capital, implying that less capital is available for credit extension. Figure 4.4 also shows reduced revenue from credit extension as the spread also falls following regulatory implementation. As noted by Budnik and Rünstler (2020), the immediate negative effect on industrial production can also be attributed to tightening conditions for short-term finance, corresponding to lower liquidity needs of banks.

Figure 4.4: Impulse responses to Implementation of regulation



If the magnitude of the effects are to be taken as is, results from Figure 4.3 and 4.4 show that the effects of regulatory changes are concentrated on household credit relative to corporate credit, contrary to the findings of Budnik and Rünstler (2020). The results indicate that greater risk weights are potentially attached to household loans relative to corporate loans, following regulatory changes. For instance, Imbierowicz et al. (2018) finds that banks in Denmark retrenched more of their lending portfolio with higher risk weights, in response to higher capital requirements.

4.5.2 Local Projections-IV: First Stage Regressions

This section presents results from the estimation of equation (4.16), where impulse responses to shocks to the interest margin, instrumented by the narrative indicators are reported. All the variables are detrended using the Hodrick-Prescott (HP) filter with the smoothing parameter set to 14 400, conventional for monthly data. This is particularly important for our linear regressions. First however, we report the first stage regressions from equation (4.15). Tables 4.3 and 4.4 below show the first-stage IV regressions, where the spread or interest rate margin is regressed on the instruments ($Draft$ and $Implementation$). Columns (1) of Table 4.3 and 4.4 show that the respective instrument is not significant in explaining the interest rate margin, with also a small first stage F-statistics. This raises weak instrument concerns highlighted by Stock and Watson (2018). Column (2) from the Table 4.3 however, shows that when controls are included in the first stage estimation, the $Draft$ instrument with a higher F-statistic, validates its relevance as an instrument for the interest rate margin. Robust standard errors (residuals of the regression) which are not shown in Tables 4.3 and 4.4 are smaller for the estimation with controls relative to the estimation without controls.

Table 4.3: First Stage IV Regressions: Draft on Interest rate Margin (Spread)

	(1)	(2)
	Interest Margin	Interest Margin
$Draft$	0.01	0.0295
	(0.52)	(1.70)
N	228	224
Controls	No	Yes
First-stage F-stat	0.79	6.42
R-squared	0.0017	0.47

This table reports fist stage IV regressions. All the variables are detrended using the Hodrick-Prescott (HP) filter. The dependent variable is the Interest rate margin (spread). $Draft$ is the narrative indicator; announcement and drafting of regulation. Controls are four lags of the Spread, Corporate Credit, Household Credit and Industrial Production. t statistics are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The results are also similar when using $Implementation$ as an instrument for the interest rate margin. The model with controls improves the relevance and validity of the instrument in explaining the interest rate margin. Importantly, a further take-away from Tables 4.3 and 4.4 are the signs of the instruments in explaining the spread, which are positive. The intuition is that narrative regulatory instruments serve as implicit negative bank productivity shocks. Following the regulatory changes as captured by our narrative indicators, banks are prompted to invest in compliance and regulatory staff and, thereby raising bank costs. In turn, banks are prompted to raise loan rates, subsequently raising bank margins, in order to absorb and externalise rising costs due to increased regulation.

Table 4.4: Implementation on Interest rate Margin (Spread)

	(1) Interest Margin	(2) Interest Margin
$Implementation$	0.0452	0.183**
	(0.40)	(2.68)
N	228	224
Controls	No	Yes
First-stage F-stat	0.16	24.91
R-squared	0.0006	0.66

This table reports fist stage IV regressions. All the variables are detrended using the Hodrick-Prescott (HP) filter. The dependent variable is the Interest rate margin (spread). *Implementation* is the narrative indicator; implementation of regulation. Controls are four lags of the Spread, Corporate Credit, Household Credit and Industrial Production. t statistics are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4.5 below shows the results for the LP-IV from equation (4.16). An important take-away from Table 4.5 is the assumption of the unit-effect normalization that underpins local projections. That is, a 1 percentage point productivity shock, implicitly instrumented by regulatory narrative indicators, increase the spread by 1 percentage point. This is shown in table 4.5 by the estimated contemporaneous effects, that is at $lag(h) = 0$, for $Draft$ as an instrument and $Implementation$ as an instrument. Further, we include lagged values of $Implementation$ as an additional control, in addition to lagged values of the spread, industrial production, household and corporate credit. The inclusion of lagged values of $Implementation$ ensures the validity of regulatory implementation as an instrument for the interest rate margin.

Table 4.5: Estimated causal effects of narrative regulatory shocks on Interest Margin: Jorda Local Projections, Instrumental Variables (LP-IV)

	(1)	(2)	(3)
		Draft	*Implementation*
	Lag(h)		
Spread	0	1 (0.00)	1 (0.00)
	6	1.68 (0.78)	1.42 (0.50)
	12	0.74 (0.78)	0.59 (0.36)
	20	0.45 (0.56)	0.75 (0.53)
Controls		4 lags of Controls	4 lags of Controls and Z

This table shows evidence of unit-effect normalization that underpins local projections. The dependent variable is the Interest rate margin, *Spread*. *Draft* is the narrative indicator, announcement and drafting of regulation. *Implementation* is the narrative indicator, Implementation of regulation. Controls are four lags of the Spread, Corporate Credit, Household Credit and Industrial Production. Z is four lags of Implementation. Robust standard errors in parentheses All the variables are detrended using the Hodrick-Prescott (HP) filter.

4.5.3 Impulse Responses: Local Projections-IV

This section presents the impulse responses from the estimation of equation (4.16). We are interested in the response of variables to the interest margin shock, instrumented by our narrative indicators. Figure 4.5 shows the effects of regulatory announcements and drafting of regulation (*Draft* dummy) with 90 percent bands.

Since we are implicitly instrumenting for (negative) bank productivity, results from Figure 4.5 show that changes in regulation, which mimic productivity shocks, results in a decline in both corporate and household credit. The positive and immediate response of the spread support and our story. The intuition is that negative productivity shocks mimic tightened regulation, which we implicitly instrument for using the interest rate margin. The regulation is captured by the narrative series and as such, the increase in the loan interest and interest rate margin imply that banks pass on the cost of regulatory changes. This results in lower corporate and household credit volumes. Contrary to the BVAR(X) results, the negative response of corporate and household credit are delayed.

Figure 4.5: Impulse responses to regulatory announcements and passing of bills into regulation

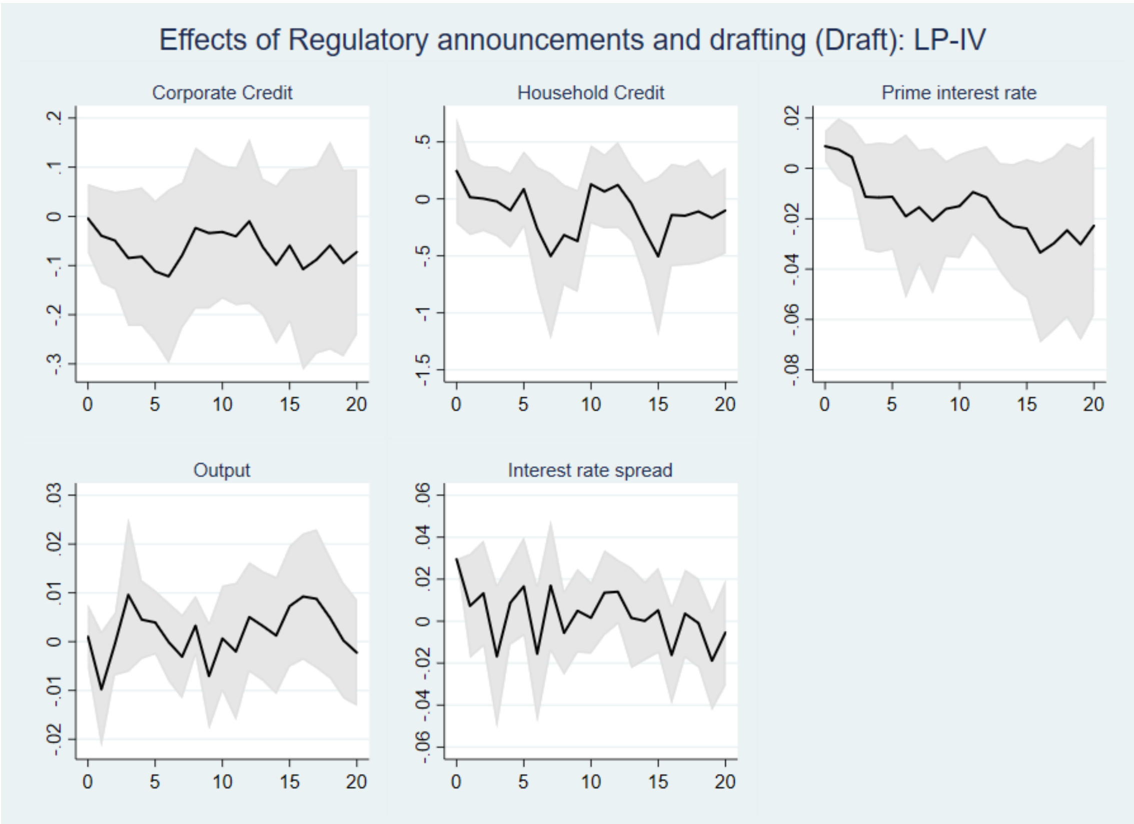
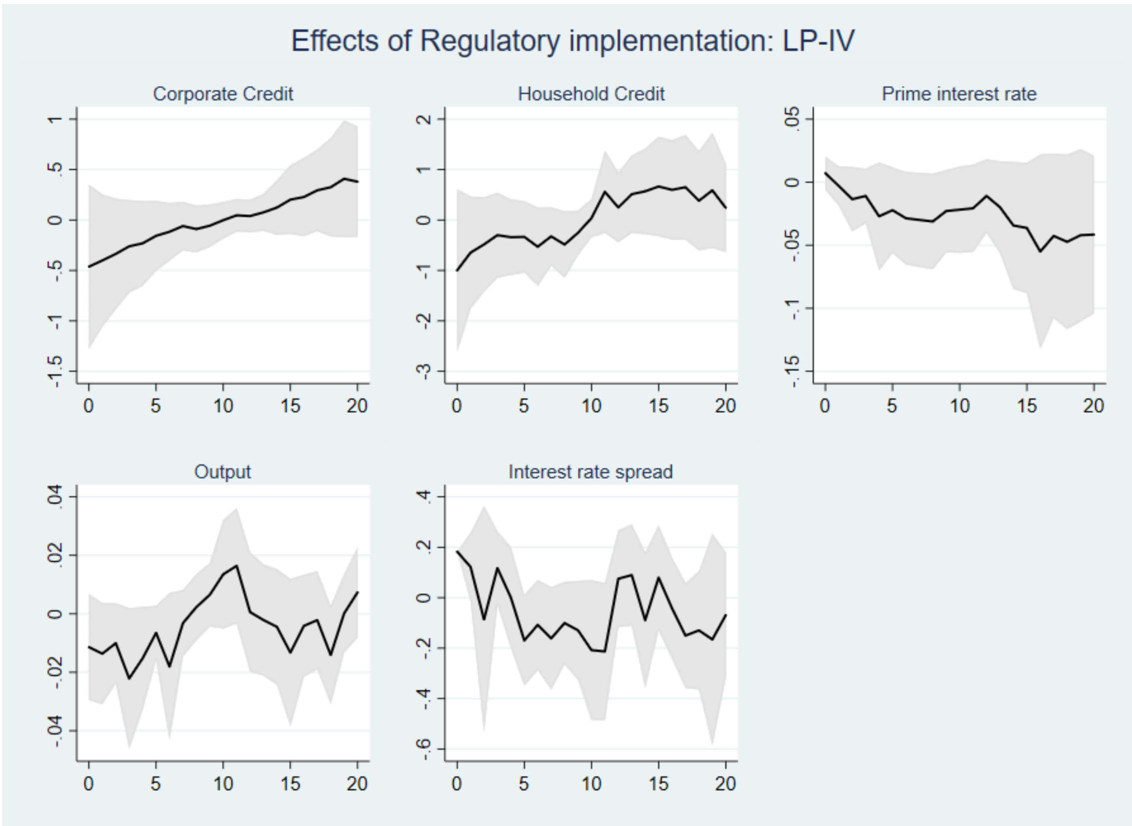


Figure 4.6 shows the effects of regulatory implementation (*Implementation* dummy). As with figure 4.5, corporate and household credit fall, following implementation. Contrary to Figure 4.5 however, Figure 4.6 shows that the response of corporate and household credit are immediate. Output also falls, following reduced credit in the economy. Importantly, Figure 4.6 shows that the effects of regulatory implementation are concentrated on household credit relative to corporate credit, as with Figures 4.3 and 4.4 from BVAR(X). In addition, the impact on the spread is more pronounced

following implementation relative to the impact following announcements shocks.

Figure 4.6: Impulse responses to implementation of regulation



The results suggest that the rising spread as well as declining credit volumes indicate dominant negative credit supply effects, which are initiated by negative bank productivity shocks.

4.5.4 Impulse Responses: Reduced Form Local Projections

The previous section highlighted results from the estimation of LP-IV. In this section, we estimate direct LP based on equation (4.17), where ϵ_t is the shock of interest and is set to the narrative regulatory indicators. The equation is estimated with 4 lags of control variables, which are also detrended. Ramey (2016) highlights that an added advantage of LP-IV over LP is that LP-IV is able to yield information on the relevance and importance of the instruments and the standard errors of the multiplier is just the standard error of the coefficients. However, LP and LP-IV results in identical results up to a scaling (Ramey and Zubairy, 2018). Figure 4.7 and 4.8 show the impulse response functions of the variables to the narrative regulatory indicators. As with impulse responses from LP-IV, both corporate and household credit fall while the spread rises following the shocks.

Figure 4.7: Impulse responses to regulatory announcements and passing of bills into regulation

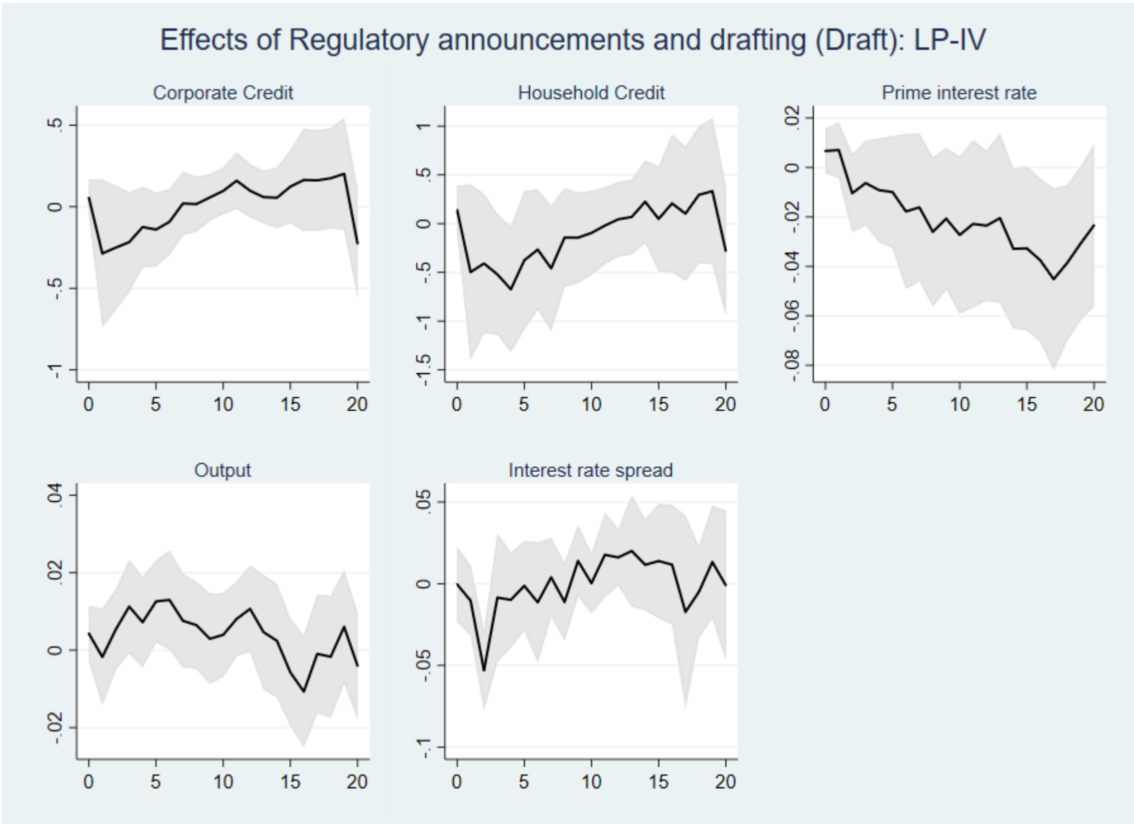
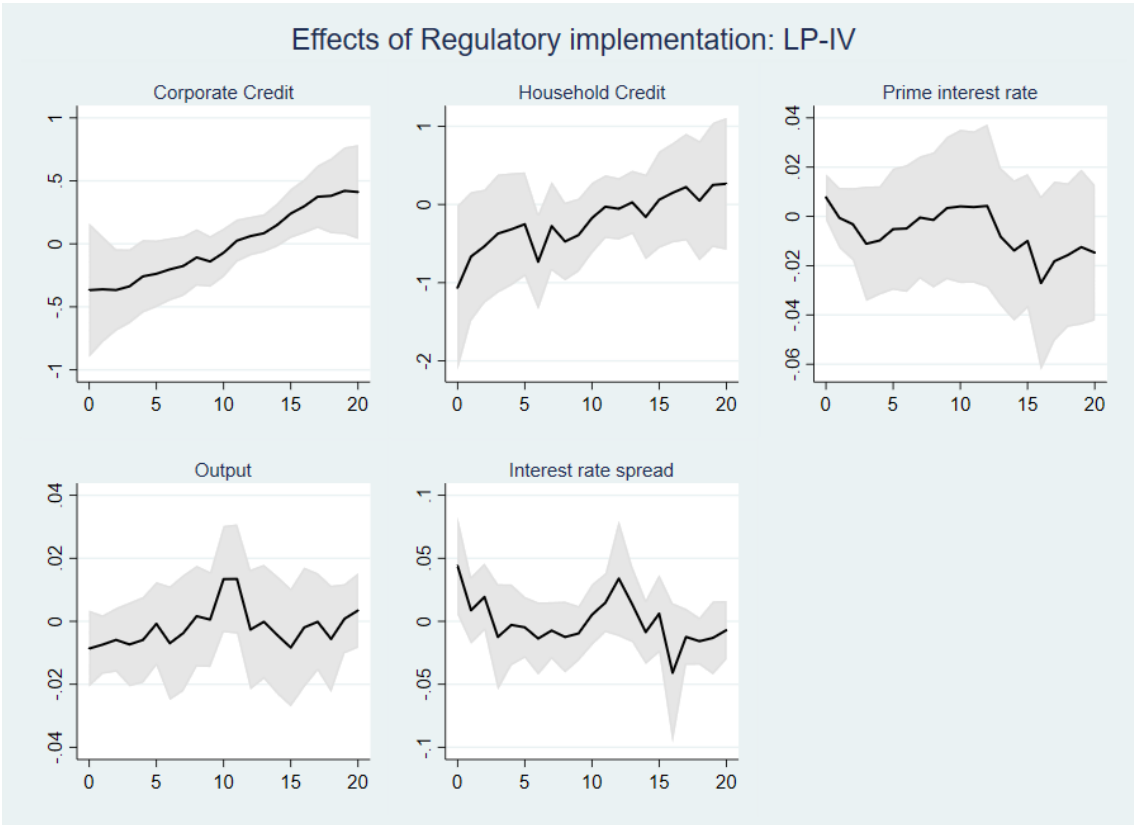


Figure 4.8: Impulse responses to implementation of regulation



The superiority of LP-IV relative to LP is evident when we compare Figures 4.5 and 4.6 to Figures 4.7 and 4.8.

In closing the discussion of our results, we also explore with the narrative indicators included in the VAR, following Ramey (2011), Li et al. (2021) and Plagborg-Møller and Wolf (2021). In effect, we estimate the BVAR model where the narrative policy indicators are embedded in the BVAR. Identification is achieved through Choleski decomposition, where the indicators are ordered first in the BVAR. The assumption is that none of the variables in the BVAR affect the narrative indicators contemporaneously. We then evaluate shocks to the narrative indicators. The results are shown in Appendix 4.7.3, by Figures 4.9 and 4.10. Impulse responses are estimated with 68 percent bands (light grey) and 90 percent bands (dark grey). Figure 4.9 shows the effect of shocks to the $Draft$ dummy and since the indicators are implicit instruments for negative bank productivity shocks, this prompts banks to raise the loan interest rate. Consequently, the spread rises on impact as shown by Figure 4.9. Both corporate and household credit fall, with the effects relatively persistent. The spill-over effects on industrial production take a while to come into effect, only falling after 9 months. The results are relatively similar when we consider $Implementation$ shocks in Figure 4.10. Both corporate and household fall on impact, with the effects more pronounced on household credit relative to corporate credit. Effects on industrial production are negative, immediate and persistent following implementation shocks.

4.6 Conclusion

This chapter explores and investigates the effects of regulatory changes in the SA banking industry. To do so, we use the narrative approach in the spirit of Romer and Romer (2004), to build a narrative series of regulatory changes. Building on the predictions of RBC models such as that of Dia and Menna (2016), Dia et al. (2018) and ours in chapter 3, we use the narrative indicators of regulatory changes as; (1) exogenous regulatory changes and (2); implicit instruments to negative bank productivity shocks. The narrative indicators are decomposed as announcements and drafting of regulation $Draft$ and the implementation of regulation, $Implementation$.

Consequently, we record 14 actions and events that contain significant information regarding the announcement and passing of regulation, $Draft$ and 12 actions and events that result in the implementation of the regulations, $Implementation$.
In practice, we apply Bayesian Vector Autoregression (BVAR) augmented with exogenous variables (BVAR(X)), Local Projections (LP) and Local Projections-Instrumental Variables (LP-IV). In the BVAR(X) and LP settings, we use the narrative indicators as exogenous variables or exogenous regulatory policy changes and estimate the dynamic effects of such regulatory changes. In the LP-IV setting, we use the narrative indicators as instrumental variables (IVs) to the interest rate margin and thereby implicitly instrumenting for negative bank productivity shocks. As such, the novelty that the chapter introduces is; (1) building a narrative series of regulatory changes in the SA banking industry and (2); using the narrative series in the LP-IV setting, following the predictions of RBC models, to estimate the effects of the regulatory changes.

Results in the BVAR(X) setting indicate evidence of potential anticipation effects, where banks can expand credit for instance, during periods of regulation drafting, in order to take advantage of less stringent requirements on credit before tighter requirements are introduced and implemented. In addition, our results consistently show that corporate and household credit fall following regulatory changes, further shedding light on the impact of macroprudential policies. The positive relationship between our narrative indicators and the interest rate margin in the LP-IV setting importantly validate our motivation for resting on RBC models.

As outlined earlier, the use of implementation dates potentially pose limitations to identifying macroprudential implementation shocks. This however presents an opportunity for further research. For instance we aim to construct a narrative series of macroprudential regulations, with and without implementation lags as with Fang et al. (2022) and Fernández-Gallardo Romero and Lloyd (2023) and macroprudential policies with quick and delayed implementation as with Mokas and Giuliodori (2023).

4.7 Appendices

4.7.1 Timelines and Actions

This section presents actions and events that identify our narrative indicators. As outlined earlier, the narrative instruments serve as implicit bank productivity shocks. Therefore, we consider: (1) actions and events that are specific in their intentions and (2), actions and events that might imply a change in bank behaviour with respect to credit extension, productivity and reallocation of physical resources such as physical capital and labour. Where possible, we also track the actions and events from the date they are announced, issued or published until the date they are introduced or implemented. Consequently, we record 14 actions and events that contain significant information regarding the announcement and passing of regulation between 2001 and 2019. Similarly, 12 actions and events that result in implementation of the regulations are recorded.

2001/01/31: Basel Committee on Banking Supervision (BCBS) published Advanced Internal Ratings Based Approach for Credit Risk of the New Basel Capital Accord. Banks would, in addition to incorporating probability of default, which the bank was exposed to the borrower at the time of default, need to incorporate the maturity of such exposures when assessing risk characteristics of the borrower (BCBS, 2001). *Importantly, this implies a change in bank lending behaviour as banks need to place further and possibly stricter assessment in their decisions to extend credit.*

2003/04/22: The South African Reserve Bank (SARB) issued Banks Act circular 8/2003 announcing to make changes to the quality of capital banks held. *This implied that banks would need to raise amount of capital they hold, potentially limiting credit extension as less capital is available for lending.*

2003/07/01: The Financial Intelligence Centre Act (38 of 2001) is introduced to co-ordinate policies and efforts aimed at countering money-laundering activities. *Although not directly related to Basel Accords, the implication of such regulation for banks amongst others, is investment in staff and equipment required to perform and execute such policies and efforts.*

2004/02/20: SARB issues Circular 1/2004 announcing that banks would have to increase their capital holdings ahead of Basel II implementation on 1 January 2008. The Capital levels required would be at the Registrar of Banks' discretion. *As with the above actions, announcements to banks to increase capital holdings would potentially imply that banks have less capital for credit extension. Alternatively, banks* *would potentially increase the cost of lending, for a given level of credit extension in order to keep up with capital requirements* (Deloitte, 2014).

2004/06/30: BCBS announces and issues final Basel II Capital Adequacy Framework, which is later endorsed and adopted by SARB. It regulates how banks should calculate minimum capital requirements for credit, market and operational risks. For instance, Total Capital ratio would be at least 8 percent and Tier 2 Capital limited to 100 percent of Tier I Capital (BCBS, 2006).

2004/12/13: SARB issues Circular 19/2004 announcing changes in calculation of quality of capital to be introduced in January 2006. For instance, 60 percent of minimum capital adequacy ratio is to consist of primary share capital.

2005/03/01: Capital adequacy levels are increase to 13.67 percent, following the announcement made in Circular 8/2003.

2006/01/01: Circular 19/2004 announcing changes in the calculation of quality of capital, where 60 percent of minimum capital adequacy ratio is to consist of primary share capital, is introduced.

2006/05/24: BCBS announces that it will maintains a 1,06 scale factor for credit risk-weighted assets.

2007/12/31: Basel II is approved for publication and promulgated into law by Parliament.

2008/01/01: Basel II is implemented.

2009/07/31: BCBS announces enhancements to the Basel framework for computation of capital for increased risk in trading book.

2010/01/31: SARB transposes into law, BCBS's enhancements to the Basel framework for computation of capital announced in 2009/07/31

2011/06/30: BCBS issues Basel III.

2011/07/31: SARB requests that all equity investment risk exposures be risk weighted under the simple risk weighted method introduced.

2012/01/01: Basel 2.5 that was announced in 2009/07/31 by BCBS and later announced by SARB in 2010/01/31 is introduced.

2012/05/31: SARB issues guidance Note G5/2012 announcing that it will provide liquidity facility to assist banks in meeting the liquidity Coverage Ratio (LCR).

2012/06/30: SARB transposes Basel III into law and publishes Counter-cyclical

Capital Buffer (CCyB) rules. The CCyb rules are set to be implemented 1 January 2016.

2013/01/31: Basel III is implemented following its announcement by the BCBS in 2011/06/30 and later passed into law by the SARB in 2012/06/30.

2014/01/31: Basel III regulatory deductions against Core Tier 1 quality Capital is introduced. SARB further introduces additional capital requirements for counterpart credit risk.

2014/10/31: BCBS announces and issues final rules for the Net Stable Funding Ratio(NSFR).

2015/01/31 Basel III Liquidity Coverage Ratio (LCR) is introduced.

2015/02/28: Monitoring Tools for Intraday Liquidity Management is adopted into domestic regulation. The implementation date for the tools is set for 1 July 2016.

2016/01/01: The Counter-cyclical Buffer rules that passed into law in 2012/06/30, are introduced.

2016/07/01: A 4 percent Leverage ratio requirement is introduced.

2019/10/01: Capital requirements for bank exposures to central counterparties and for equity investments in funds are introduced. The standardized approach for measuring counterparty credit risk exposures is also introduced.

Table 4.6: Tabular view of Timelines and Actions

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Date	Announcements and passing of regulation	Dummy	Implementation	Dummy
2001/01/31	BCBS published Advanced Internal Ratings Based Approach for Credit Risk of the New Basel Capital Accord	1		
2003/04/22	SARB issued Banks Act circular 8/2003 that advised on proposed ammendments to the legislation relating the issue of certain capital instruments	1		
2003/07/1			Financial Intelligence Centre Act introduced to co-ordinate policy and efforts to counter money-laundering activities	1
2004/02/20	SARB issues Circular 1/2004 announcing bank to hold more capital ahead of Basel II implementation	1		
2004/06/30	BCBS announces final Basel II Capital Adequacy Framework	1		
2004/12/13	SARB issues Circular 19/2004 announcing changes to calculation of quality of capital to be implemented January 2006	1		
2005/03/01			Capital Adequacy Levels increase to 13.67 percent from 11.96 percent in 2003	1
2006/01/01			Circular 19/2004 requiring 60 percent of minimum capital adequacy ratio to to consist of primary share capital is introduced	1
2006/05/24	The BCBS in a press release maintains 1,06 scaling factor for credit risk-weighted assets	1		
2007/12/31	Basel II is approved for publication and promulgated into law by Parliament	1		
2008/01/01			Basel II is implemented	1
2009/07/31	BCBS announces enhancements to the Basel framework for computation of capital for increased risk in trading book	1		
2010/01/31	SARB transposes into law, BCBS's enhancements to the Basel framework for computation of capital announced in 2009/07/31	1		
2011/07/01			SARB requests that all equity investment risk exposures be risk weighted under the simple risk weighted method introduced	1
2011/06/30	BCBS issues Basel III	1		
2012/01/01			Basel 2.5 is introduced	1
2012/05/31	SARB issues Guidance announcing the provision of a committed liquidity facility that will assist banks in meeting the LCR	1		
2012/06/30	SARB transposes Basel III into law and publishes Counter-cyclical Capital Buffer (CCyB) rules	1		

Table 4.7: Tabular view of Timelines and Actions continued

.

Date	Announcements and passing of regulation	Dummy	Implementation	Dummy
2013/01/31			Basel III is introduced	1
2014/01/31			Basel III regulatory deductions against Core Tier 1 quality Capital is introduced	1
			SARB further introduces additional capital requirements for counter-part credit risk	
2014/10/31	BCBS announces and issues final rules for Net Stable Funding Ratio	1		
2015/01/31			Basel III Liquidity Coverage Ratio (LCR) is introduced	1
2015/02/28	Monitoring Tools for Intraday Liquidity Management is adopted into domestic regulation	1		
2016/01/01			Counter-cyclical Buffer rules are introduced	1
2016/07/01			A 4 percent Leverage ratio requirement is introduced	1
2019/10/01			Capital requirements for bank exposures to central counterparties and for equity investments in funds introduced	1
			Standardized approach for measuring counterparty credit risk exposures introduced	

4.7.2 Additionally Exogeneity tests

Table 4.8: Probit estimation results: Four lags of Variables on Draft

	(1) Draft	(2) Draft	(3) Draft	(4) Draft	(5) Draft	(6) Draft
$FirmCredit_{t-4}$	0.68					0.51
	(1.11)					(0.97)
$HouseCredit_{t-4}$		0.05				-0.01
		(0.26)				(0.38)
$Output_{t-4}$			14.30*			14.83**
			(5.89)			(4.75)
$Primerate_{t-4}$				-0.01		0.02
				(0.06)		(0.09)
$Spread_{t-4}$					0.08	0.02
					(0.19)	(0.29)

Notes: This table reports probit estimation results. The dependent variable is the narrative indicator, announcement and drafting of regulation (Draft). The control variables are detrended using the Hodrick–Prescott filter, with a constant entering the regressions as well. $FirmCredit$ is Corporate Credit, $HouseCredit$ is Household Credit, $Output$ is Industrial Production, $Primerate$ is Prime overdraft rate and $Spread$ is the Interest rate spread. t statistics are in parentheses. Significance at: * $p < 0.1$, sym** $p < 0.05$, *** $p < 0.01$.

Table 4.9: Probit estimation results: Four lags of Variables on Implementation (Impl)

	(1)	(2)	(3)	(4)	(5)	(6)
	Impl	Impl	Impl	Impl	Impl	Impl
$FirmCredit_{t-4}$	0.45					0.85
	(1.05)					(0.53)
$HouseCredit_{t-4}$		-0.15				-0.48
		(0.13)				(0.26)
$Output_{t-4}$			-2.12			-3.79
			(5.55)			(5.79)
$Primerate_{t-4}$				-0.07		-0.13
				(0.08)		(0.08)
$Spread_{t-4}$					0.07	0.37
					(0.19)	(0.24)

Notes: This table reports probit estimation results. The dependent variable is the narrative indicator, implementation of regulation (Impl). The control variables are detrended using the Hodrick–Prescott filter, with a constant entering the regressions as well. $FirmCredit$ is Corporate Credit, $HouseCredit$ is Household Credit, $Output$ is Industrial Production, $Primerate$ is Prime overdraft rate and $Spread$ is the Interest rate spread. t statistics are in parentheses. Significance at: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.7.3 Additional Impulse Responses

4.7.4 Impulse Responses: BVAR, Choleski Identification: Instruments ordered first

Figure 4.9: Impulse responses to Regulatory Draft

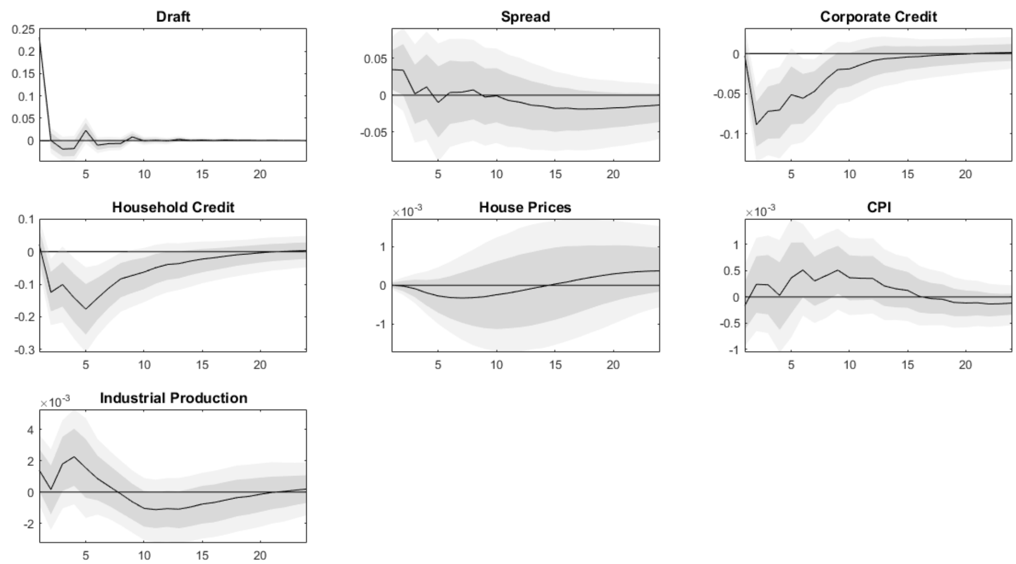
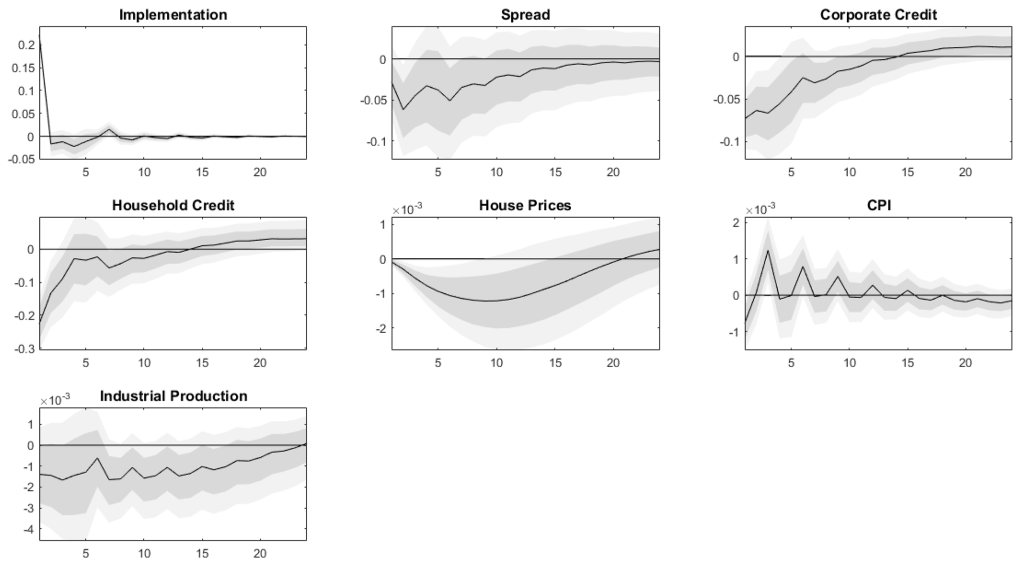


Figure 4.10: Impulse responses to Regulatory Implementation



Chapter 5

Conclusion and Summary

The objective of the thesis is to analyse and understand the interaction between the banking sector and the economy in South Africa (SA). This rests on analysing the efficiency of the SA banking sector and the effects of changes in banking sector efficiency on the macroeconomy. In doing so, we: (1) calculate a measure of banking sector productivity in a bid to evaluate its historical evolution thereof; (2) develop a model linking the productivity of the banking sector and the macroeconomy and investigate the effects of bank productivity shocks and their spill-over effects on the economy; and (3) empirically estimate the macroeconomic effects of regulatory changes in the SA banking industry.

The first research question is documented in chapter 2. In addition to computing a measure of banking sector productivity, the chapter builds the foundation for the thesis due to its descriptive analysis of the SA banking industry. The computation of the productivity measure allows us to study the evolution and contribution of the banking industry, consistent with similar work in the literature, as with Haldane et al. (2010), Philippon and Reshef (2013) and Bazot (2017). It also allows us to evaluate whether the development, increased contribution and influence of the banking industry has translated into lower cost of intermediation or improved productivity. The productivity measure is defined as the ratio of income share of the banking industry to quantity of intermediated assets or bank output and is interpreted as the unit cost of creating and maintaining an intermediated asset. By definition and computation, the productivity measure sheds light on whether income share of the industry defined by Philippon (2015) as broad fees, spreads and other income paid by the non-financial sector to the banking industry, has been matched by greater bank output.

Our analysis shows that income share of the banking industry in SA from 1993 to 2017, exhibits an upward trend. It increases from just under 2 percent in 1993 to over 4 percent in 2008, as a percentage of GDP. This is similar to the experiences of UK, Japan, Canada and the US. Our results indicate that there is no apparent trend in the unit cost of intermediation, which signals constant bank productivity. The unit cost of intermediation rises post 1999 until 2002, which is driven by rising income share relative to bank output. This is also indicative of the notion that how much society is paying for banking services is not matched by what society is obtaining from banks. The 1999 to 2002 period also coincides with various mergers in the banking industry and the demise of various banks during the period. Post 2008, the cost ratio declines and eventually flattens to almost similar levels in 1993. This signals and entails rent-extraction behaviour by banks as the development and improvements in the SA banking industry such as technological improvements, appear to not have been passed to the end users of banking service (i.e., households and firms) in the form of lower cost of intermediation.

In chapter 3, we link the productivity of the banking sector and macroeconomic outcomes by analysing the effects of bank productivity shocks. The adoption of labour and physical capital in the banking industry are key in influencing banking sector productivity. To do so, we develop a Dynamic Stochastic General Equilibrium (DSGE) model along the lines of Dia and Menna (2016) and Dia et al. (2018), calibrated for the SA economy. In the model, banks are treated as firms, employing labour and physical capital to provide intermediary services or output such as credit and deposits. We also extend the modelling strategy by introducing basic labour market heterogeneity, where we assume that banks use only skilled labour to produce output. Therefore, we also aim to document the heterogeneity of the South African labour market with specific regards to banks and the rest of the private sector firms. Our results show that positive productivity shocks hitting the banking industry, which are akin to shocks on the productivity of loan and deposit origination and monitoring, results in less labour and physical capital adoption. This resembles the consequences of banks' recent adoption and implementation of technological advances and digitisation, which has resulted in reduced bank branch networks. Conversely, negative bank productivity shocks result in increased labour and physical capital adoption. This we argue, mimic the consequences of tightened regulatory changes in the banking industry, where banks subsequently invest in regulation and compliance staff and systems needed to implement and meet new regulatory requirements. Furthermore, our results show that the loan interest rate and the interest margin rise following negative shocks. This implies and signals that banks externalise and pass on the higher cost of expanding labour and physical capital following tightened regulation, to end-users of banking services.

The closing chapter of the thesis analyses and empirically estimates how banking sector regulation in SA affects the relationship between the banking sector and the macroeconomy. The chapter also analyses the contribution of banking sector regulation in determining the efficiency of the sector. We build the analysis on predictions from the model in chapter 3. In particular, the model indicates that negative bank productivity shocks, which we argue mimic tightened regulation, results in relatively greater adoption of labour and capital to implement the regulatory changes. This results in higher loan rates and interest spread as banks shift regulatory costs.
To capture regulatory changes in the SA banking industry, we introduce a narrative series of regulatory changes in the banking sector from 2001 to 2019. We use the series to estimate and analyse the macroeconomic effects of regulatory changes. The exogenous narrative series is constructed from documents containing regulatory records in the banking sector and is decomposed into drafting and announcement of regulation and eventual implementation of the regulation.
In application, we use the narrative regulatory series as exogenous variables in the Bayesian Vector Autoregression (BVAR) framework and Local-Projections (LP) framework. Both models allow us to estimate the effects of exogenous regula-

tory changes on macroeconomic variables. We further use The series in a Local-Projections Instrumental Variables (LP-IV) framework. where the series of regulatory changes serve as instrumental variables (IVs) to the bank interest rate margin and thereby implicitly instrument for negative bank productivity shocks. To our knowledge, we are the first to study the relationship between bank regulation and bank productivity in SA, using narrative methods of identification.

Results from our analysis indicate evidence of anticipation effects where banks increase lending in anticipation of stringent regulatory requirements in future, as both corporate and household credit rise. Our results also show persistent and negative effects on both corporate and household lending following regulatory implementation. The effects of regulatory changes are relatively more pronounced on household credit relative to corporate credit. Importantly in the LP-IV setting, our results show the positive and immediate response of the interest margin (spread) to narrative regulatory shocks. This supports and validate our story. The intuition is that negative productivity shocks mimic tightened regulation, which we implicitly instrument for using the interest rate margin. The regulation is captured by the narrative series and as such, the increase in the loan interest and interest rate margin imply that banks pass on the cost of regulatory changes.

In summary, the thesis highlights the continued influence and role of banks as primary financial intermediaries. The theoretical model we develop further shows that banks' adoption of labour and physical capital (real resources) has implications for the rest of the economy, following productivity shocks. The model also sheds light on some of the peculiarities we observe in the SA banking industry with regard to labour and physical capital. Further research can possibly incorporate a richer labour market framework with search and matching frictions. Such a framework can also provide superior analysis of the peculiarities observed in the banking industry.

By also linking the theoretical and empirical models, we highlight that productivity shocks in the banking sector mimic effects of changes in bank regulation. The chapter also contributes to the growing work that investigates the effects of macroprudential regulation in SA and emerging markets.

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