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# The size distribution of monetary policy effects among South African manufacturing firms

Firm-level evidence from administrative tax data

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**Abstract:** Monetary policy is believed to have a disproportionate effect on firms, depending on their size. Financially constrained firms with limited access to capital markets are expected to be more sensitive to changes in interest rates; this is characteristic of small firms. This paper empirically tests this hypothesis for firms in the South African manufacturing sector, using the South African Revenue Service's comprehensive tax administrative data set. The interest coverage ratio is used to measure firms' debt service burden, thus capturing the effect of changes in interest rates on the debt burden of firms categorized by size. The results provide evidence to support the argument that the effect of monetary policy decisions on manufacturing firms depends on firm size: smaller firms experience greater effects of interest rate changes. These findings suggest that monetary authorities should consider the balance sheet health of firms, particularly small firms, when making monetary policy decisions.

**Keywords:** credit channel, firm heterogeneity, financial constraints, monetary policy, SARS administrative tax database, South Africa
**JEL classification:** E0, E4, E5

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# 1 Introduction

This paper examines the distributional impact of monetary policy on the debt service burden of manufacturing firms in South Africa. The study uses the South African Revenue Service's (SARS) tax administrative data set, which is a firm-level data set containing firms' balance sheet information. This comprehensive data set enables us to distinguish firms according to size, and to investigate the distributional impact of monetary policy on the balance sheet health of firms in South Africa. The research focuses on the effect of interest rate changes on the financial distress of firms grouped by size. It provides further evidence concerning the balance sheet channel of monetary policy transmission in South Africa, and to my knowledge it is the first research of its kind to use such a comprehensive data set in South Africa.

Monetary policy affects the real economy through various channels, including the interest rate, exchange rate, credit, and asset price channels. The credit channel—of which it is argued that imperfections or frictions in credit markets propagate and amplify the impact of the traditional interest rate channel by influencing firms' net worth and cash flow and the availability of credit—has received considerable attention following the seminal work by Bernanke and Gertler (1995). The credit channel may be decomposed into two: the balance sheet and bank lending channels.

In the presence of imperfections or frictions in credit markets, firms' access to credit depends on their net worth or other firm-specific characteristics. The net worth or balance sheet of a firm is a proxy for its financial health, and may be considered an indicator of the risk facing a lender (including the availability of sound collateral). The interaction of monetary policy and imperfections in credit markets influences the lending behaviour of banks, which has implications for the financing of firms. Monetary policy changes that lead to increased interest expenses on outstanding debts bearing a floating or adjustable rate affect firms' cash flow, liquidity position, and net worth. As a result, firms with a weaker balance sheet or net worth will face unfavourable changes in the cost or availability of credit. Firms that become financially constrained or face a higher cost of credit as a result of tighter monetary policy will cut their investment spending and hiring, which in the absence of offsetting counter-effects will result in a negative aggregate impact on economic growth.

This paper empirically investigates the operation of the balance sheet channel of the transmission mechanism in South Africa, focusing on manufacturing firms in South Africa over the period 2010–14. The paper estimates the distributional impact of monetary policy on firm balance sheets, and it tests the hypothesis that since firms are heterogeneous, monetary policy effects are not uniform. If changes in monetary policy in South Africa cause changes in firms' debt service burden and liquidity position, this may have implications for their access to credit and ability to finance investment. Small firms generally face greater credit access constraints compared with larger firms. They are also reliant on banks for financing, whereas larger firms can alternatively issue equity or debt to raise capital. It is therefore expected that the impact of monetary policy will be greater on small firms. The rich firm-level panel data set allows us to control for firm characteristics including firm size, and to provide evidence on the distribution of the impact of monetary policy among firms of different sizes.

Ippolito et al. (2017), using a comprehensive database of quarterly firm-level data on US firms, find that the interest coverage ratio responds strongly to monetary policy if firms use a greater share of bank debt as a percentage of asset size. They also find that these results only hold for firms that do not hedge their debt against interest rate risk. The present research similarly uses a

measure of interest coverage to capture the effect of monetary policy on the financial health of firms.

We make the assumption that most firms in South Africa make use of bank debt to finance their activities. Two observations justify that assumption. First, the South African corporate bond market remains relatively small and illiquid, and is dominated by a few large companies (Hassan 2013). Second, as of June 2018 only 375 firms were listed on the Johannesburg Stock Exchange (CEIC 2018), while our data set contains approximately 308,830 firms in the manufacturing sector. Therefore, it is likely that very few if any firms in our sample raise capital by issuing equity on capital markets. In light of the above-mentioned assumptions, the a priori expectation in this paper is that monetary policy will have a significant impact on small to medium firms, as they are assumed to make use of bank debt that is not hedged against interest rate fluctuations.

The findings in this paper indicate that monetary policy has a statistically significant and sizable impact on the balance sheets of small firms. An increase in interest rates leads to a relatively larger increase in the debt service burden, as measured by the interest coverage ratio, of small firms in the manufacturing sector. Small firms face limited access to capital due to their relatively lower net worth and higher idiosyncratic risks. They are therefore likely to face a higher premium for external finance. These results do not hold for medium and large firms, which is broadly in line with expectations. These results are robust to statistical biases associated with endogeneity, time, and fixed effects.

The results presented in this paper have policy implications, in that the South African Reserve Bank should consider the differential impact of its policy actions on the balance sheets of small firms. Small firms, which are characterized by liquidity constraints and reliance on bank credit, bear a relatively large and significant burden of interest rate increases. There is evidence to show that monetary policy has a disproportionate impact on the financial health of small firms. The rest of the paper is organized as follows: section 2 presents a literature review; section 3 describes our data and an exploratory data analysis; in section 4 we summarize our method and present our regression results; and section 5 concludes with a discussion of potential policy implications.

## 2 Literature review

One channel through which monetary policy can affect the real economy is by influencing the market price of credit: changes in short-term interest rates affect the cost of borrowing for household consumption and firms' investment spending. A second transmission channel, the credit channel of the monetary policy transmission mechanism advanced by Bernanke and Gertler (1995), Hubbard (1995), and Mishkin (1995), may act alone or as an amplification of that effect.

The credit channel emphasizes the role of asymmetric information in credit markets in amplifying the impact of interest changes on real economic variables (Bernanke and Gertler 1989; Bernanke et al. 1999). Information asymmetry problems in capital markets are reflected in the costs borne by financial institutions or borrowers. These costs include those associated with evaluation, monitoring, and verification. These agency costs arise if the borrower is believed to have better information than the lender about their ability and commitment to meet their debt payment obligations, and better information on the prospect of their investment projects being financed by borrowing. This principal-agent problem and the associated costs give rise to what Bernanke and Gertler (1995) describe as the external finance premium. This is defined as the difference in the cost of raising funds externally (through borrowing or issuing equity) and internally (using retained earnings).

In the presence of credit market imperfections associated with asymmetric information, the perceived cost of external finance will be higher than that of internal finance. The credit channel may operate through two channels: the bank lending channel and the balance sheet channel. This study focuses on the balance sheet channel, in which the external finance premium that firms face is inversely related to their balance sheet or net worth (Bougheas et al. 2004; Gertler and Gilchrist 1994). A monetary policy tightening increases firms' interest expenses, reducing their cash flow and net asset value. This in turn reduces the value of collateral and limits access to external finance. It is through this propagation mechanism that monetary policy tightening magnifies the impact of interest rates on firms' investment spending, employment, and production. In accordance with the credit channel model, this paper's estimates of the effect of monetary policy focus on firms' interest coverage: a decline in interest coverage may affect investment by reducing cash flow, which reduces available internal finance and increases the risk of bankruptcy.

Firms with a lower net worth face higher external financing costs and less favourable credit terms. The impact and strength of monetary policy is likely to be heterogeneous across firms, given that firms' access to external finance is largely dependent on individual firms' specific attributes, including their balance sheet position.

## 3 Data description

The firm-level panel data set used in this study is from tax administrative data sourced from SARS. The data set is the outcome of 'Southern Africa—Towards Inclusive Economic Development (SA-TIED)', a joint research project between the South African National Treasury, SARS, and UNU-WIDER. It merges company income tax data with employee tax certificates (IRP5) issued to firm employees, as well as value-added tax data for firms and customs data for trading firms. This merged data (the CIT-IRP5 panel) creates a rich firm-level data set containing firms' characteristics, balance sheets, income statements, and tax-related information. For more information on the unique data set, see Pieterse et al. (2016).

The CIT-IRP5 panel data is an unbalanced panel with annual[1] data from 2010 to 2014. The number of firms included in the study is restricted to firms with non-zero and non-missing observations for the sales or turnover variable. Table 1 briefly shows the descriptive statistics of variables used in the study. The full description and calculation of the variables is given in Table A1 in the Appendix. The size of a firm is defined according the Department of Trade and Industry's National Small Business Amendment Bill (2003) and is based on turnover alone. Furthermore, Statistics South Africa (StatSA) adjusts these definitions annually, using factor adjustments to reflect changes that occur over time, both within the firms themselves and in the economy, which may have an impact on firms' turnover.

[1] In the literature, research largely focuses on the short-run impact of monetary policy on macroeconomic aggregates, as it is conventionally believed that the impact of monetary policy fades beyond the business cycle. As a result, high-frequency data is used to test empirical effects of monetary policy. However, due to data limitations this paper uses annual data, and the findings in this paper can be thought of as the long-run effects of monetary policy on firms. Romer and Romer (1998) investigated the short-run and long-run impacts of monetary policy on the well-being of poor households. They found evidence of a systematic relationship between prudent monetary policy, which maintains low inflation and stable output, and the well-being of the poor in the long run, using annual data.

Table 1: Descriptive statistics, full sample

| | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| Coverage ratio | 0.141 | 0.111 | 0.103 | 0.103 | 0.092 |
| JIBAR | 6.493 | 5.579 | 5.365 | 5.137 | 5.864 |
| Profitability | 0.203 | 0.211 | 0.222 | 0.240 | 0.228 |
| Book leverage | 12.665 | 12.573 | 14.649 | 16.126 | 13.762 |
| Short-term debt | 677,798.7 | 722,579.3 | 801,384.6 | 849,494.2 | 947,007.9 |
| Total fixed assets | 1,281,089.769 | 1,148,624.632 | 1,191,406.138 | 1,317,326.737 | 1,434,224.121 |
| N | 62049 | 63071 | 62523 | 61696 | 59491 |

Note: JIBAR = Johannesburg interbank average rate. Only average values are reported in Table 1. Table A2 in the Appendix is a full table that includes standard deviations.

Source: author's compilation based on CIT-IRP5 panel data.

Table 1 provides average values of the variables used in the study, limited to the manufacturing sector from 2010 to 2014. The sample consists of a total of over 308,830 firms over the period. The average coverage ratio[2] in the sample declined over the same period from 14.1 per cent to 9.2 per cent, as interest rates measured by the Johannesburg interbank average rate (JIBAR) also broadly dropped until 2013. The book leverage ratio, which measures the extent to which firms use debt to finance operations relative to equity, also increased over the period.

In order to estimate the distributional impact of monetary policy on firms, firms in the sample are grouped according to size definitions. Firms are classified into three broad groups: small, medium, and large firms. The firm size definitions are based on the National Small Business Amendment Bill. The definitions are factor-adjusted annually by StatSA based on turnover alone. This paper uses the manufacturing firm size definitions indicated in StatSA's (2016) annual financial statistics, and it merges small and very small firm sizes to create a single 'small' group.[3]

The total sum of manufacturing firms in the sample drops from 308,830 to 215,357 once firms are classified into their respective groups. This is a result of the exclusion of firms with missing values for sales in the grouping of firms by size.

Table 2 shows the variables used in the study, defined by firm size. A brief look at the statistics indicates that firms of all sizes have on average an interest coverage ratio of 11.33 per cent. Smaller firms further rely on debt to finance their operations, with an average book leverage ratio of 15.08 per cent, which is higher than the leverage ratios of both medium and large firms.

[2] The interest coverage ratio is calculated as (interest paid / (interest paid + operating cash flow)), so that an increase in the ratio indicates an increase debt service burden of firms. In the data set, interest paid is reported, instead of interest expenses.

[3] Firm size is defined based on the firm's annual turnover. Small: turnover <= 25 million ZAR; medium: turnover >= 65 million ZAR; large: turnover >= 255 million ZAR (StatSA 2016).

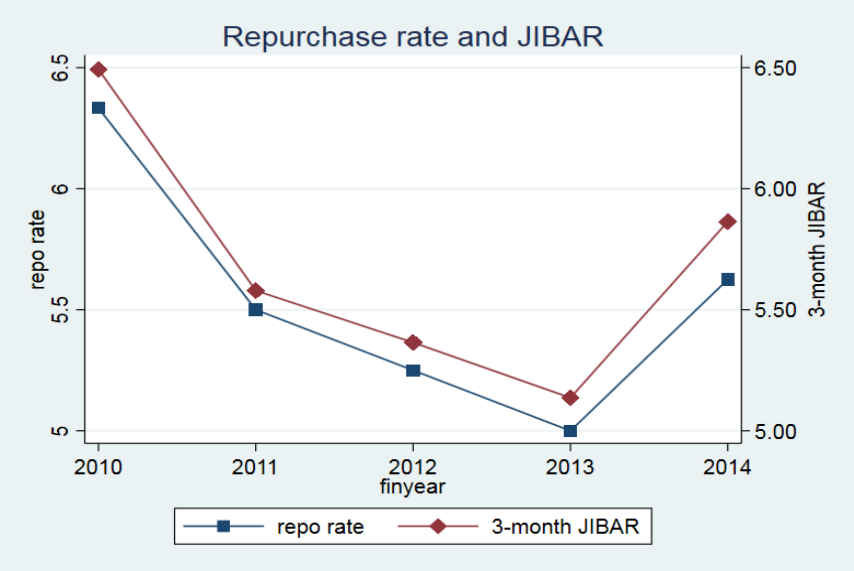
Table 2: Descriptive statistics by firm size

| | Small | Medium | Large |
|---|---|---|---|
| Coverage ratio | 0.113 | 0.113 | 0.113 |
| Firm age | 13.4 | 17.3 | 20.6 |
| Profitability | 0.230 | 0.176 | 0.173 |
| Book leverage | 14.900 | 10.886 | 7.748 |
| Short-term debt | 300,041.2 | 1,575,270.0 | 4,596,134.8 |
| Total fixed assets | 696,094.6 | 2,838,024.3 | 6,237,606.5 |
| Current ratio | 6.073 | 3.597 | 2.927 |
| N | 216640 | 23785 | 18299 |

Note: Column headings indicate firm size and profitability calculated as a percentage of total assets. The full list of variables and their calculations is provided in Table A1 in the Appendix.

Source: author's compilation based on CIT-IRP5 panel data.

Figure 1: Repurchase (repo) and JIBAR rates



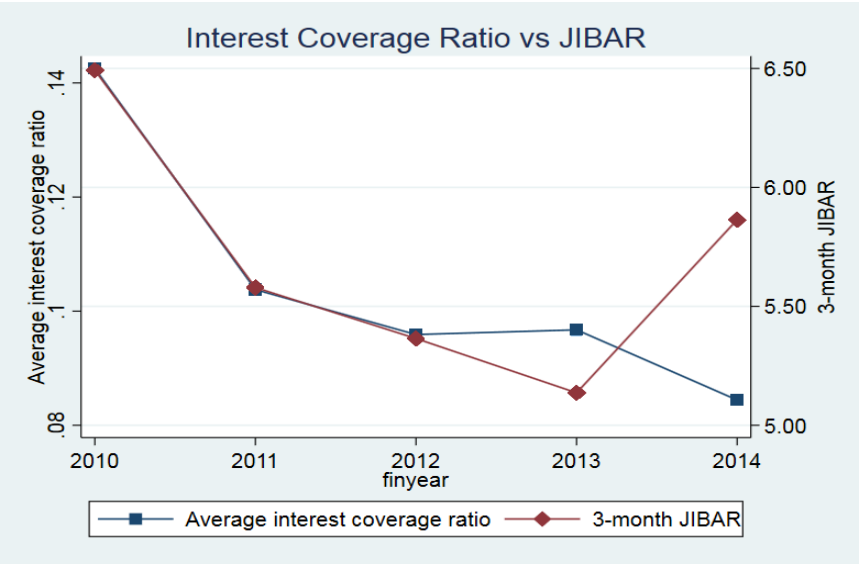

Source: author's calculations based on CIT-IRP5 panel data.

Figure 1 plots the three-month JIBAR and the repurchase (repo) rate, the official policy interest rate used by the South African Reserve Bank when making monetary policy decisions. The repo rate is the reference interest rate which underlies all other interest rates in the economy. Monetary policy was broadly accommodative between 2010 and 2013, rising thereafter.

Figure 2 shows the relationship between the average interest coverage ratio and the JIBAR over the sample period. There is a positive relationship between the variables until the year 2012, after which the relationship diverges.

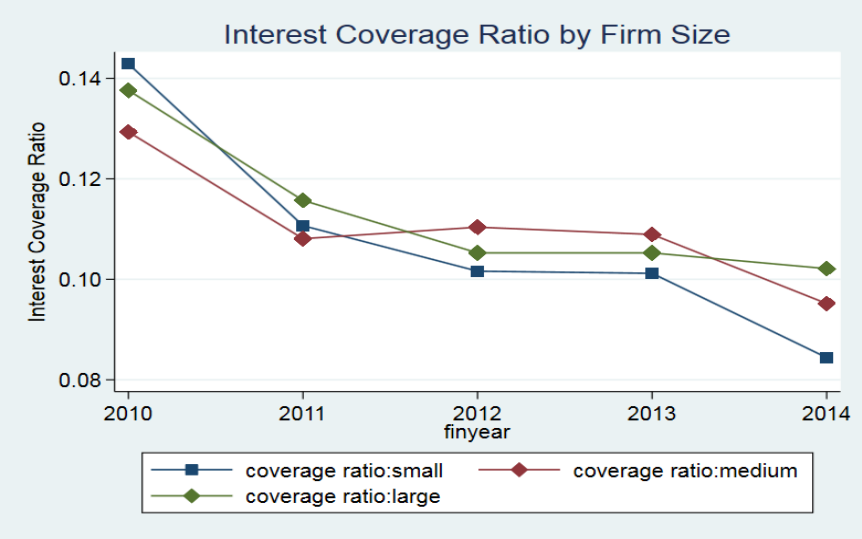
Increasing interest rates as measured by the JIBAR are expected to increase the interest expenses of firms with floating-rate loans, causing a higher debt service burden and reducing internal funds. Tight monetary policy that leads to a weakening of the balance sheet of financially constrained firms will affect those firms' ability to finance investment and expansion.

Figure 2: Interest coverage ratio and JIBAR




Source: author's calculations based on CIT-IRP5 panel data.

Figure 3: Interest coverage ratio by firm size




Source: author's calculations based on CIT-IRP5 panel data.

Figure 3 plots the average interest coverage ratio by firm size. The interest coverage ratio is our measure of firms' financial distress; it captures the impact of changes in monetary policy on firms' interest expenses, liquidity position, and overall balance sheet. Financially constrained firms—i.e. where the desired level of investment exceeds available internal funds (retained earnings or profits), and where there is a weak balance sheet (proxy for net worth)—face a higher cost premium of external finance. This is due to the asymmetric information that exists in credit markets between lenders and borrowers.

As a result, small firms which face idiosyncratic risks and are liquidity-constrained are expected to be significantly affected by monetary policy changes relative to larger firms. The coverage ratios for firms of all sizes have been broadly declining since 2010 in line with the reduction in interest rates, as seen in Figure 1. This would suggest the financial distress (induced by interest changes) of firms has moderated somewhat over the period.

In 2010 small firms had a higher interest coverage ratio, but it has since become lower than the coverage ratios of medium and large firms. This may suggest that the cut in interest rates more broadly (shown in Figures 1 and 2) may have more greatly benefited small firms relative to larger firms.

## 4 Methodology and empirical results

The main objective of this paper is to investigate the differential impact of monetary policy on the balance sheet strength of heterogeneous firms categorized by size. The JIBAR is our proxy for monetary policy, and the interest coverage ratio is firms' debt service burden as measured by the interest coverage ratio.

Monetary policy can have an impact on the liquidity position of firms exposed to interest rate risk. An increase in interest expenses reduces a firm's available cash flow and overall net worth. The net worth of a firm is a proxy for the collateral that a firm provides against borrowing. In the presence of asymmetric information in credit markets, firms with a lower net worth or creditworthiness face a higher external cost of finance. The interaction of monetary policy and asymmetric information in credit markets has implications for firms' lending behaviour and access to finance.

The empirical framework adopted to test this relationship to some extent borrows[4] from Ippolito et al. (2017).[5] The model estimated is:

$$\mathrm{CoverageRatio}_{it} = \beta_0 + \beta_1 \mathrm{Policy}_{i,t-1} + \beta_2 \mathrm{Controls}_{i,t} + u_i + \varepsilon_t \quad [1]$$

where $i = 1...N$, $t = 2010 \ldots 2014$, and $\varepsilon_t$ is the error term.

The interest coverage ratio ($\mathrm{CoverageRatio}$)[6] is the dependent variable in our estimated equations and is calculated as interest paid over the sum of interest paid and operating cash flow, as in Ippolito et al. (2017). $\mathrm{CoverageRatio}$ is a conventionally used proxy for the balance sheet health of firms in the literature. In this case, an increase in the ratio indicates an increased debt service burden. The increase in interest rates raises the interest expenses on outstanding debt for a given cash flow level, pushing up the interest coverage ratio.

[4] The regression equation borrows from Ippolito et al. (2015). However, we have removed the cash flow volatility variable and the correlation variable between the JIBAR and cash flow from the estimated equation, due to concerns that these variables may be highly correlated with the dependent variable.

[5] Ippolito et al. (2015) use a database of quarterly firm-level data on US firms over the period 2004–08, and they extend their analysis to cover the quantitative easing period of 2008–11 to test the balance sheet channel of monetary policy. The paper is able to control for the extent of bank debt usage by firms, and to distinguish between floating versus fixed rate debt as well as the hedging behaviour of firms. The paper finds that monetary policy might hurt firms that have unhedged bank debt, as they are exposed to interest rate fluctuations. These findings suggest that unhedged bank debt is important for the transmission of monetary shocks.

[6] To calculate the interest coverage ratio, interest paid instead of interest expenses payable is used. This is because in the data set, interest paid is reported instead of interest expenses. The difference between the two is that interest paid is interest expenses that have already been paid in a given financial year, and interest expenses are the interest payable. This should have no substantial implications for our results, as both measures contain the effect of changes in interest rates.

To approximate the monetary policy stance, the three-month JIBAR[7] is used as the policy variable in this study. This is the rate at which domestic South African banks borrow and lend to each other in the interbank market, and is the most widely used interest rate benchmark in the domestic money market. The South African Reserve Bank's repo rate is the main monetary policy tool, and it underlies all variable market interest rates. Firms are expected to borrow in credit markets at a rate closer to the JIBAR than to the repo rate, and changes in the repo rate move variable market interest rates, including the JIBAR, in the same direction.

The control variables included in the estimated equation are return on assets, book leverage ratio, short-term debt, and total fixed assets. The full description of the control variables is given in Table A1 in the Appendix.

Table 3: Pooled ordinary least squares regression results

| | (1) | (2) | (3) |
|---|---|---|---|
| Variables | Small | Medium | Large |
| JIBAR (-1) | 0.1816** | -0.0305 | 0.0953 |
| | (0.0267) | (0.8312) | (0.5982) |
| Return on assets | -1.3289*** | -4.2113*** | -4.9261*** |
| | (0.0000) | (0.0000) | (0.0000) |
| Book leverage | 0.2706*** | 0.2908*** | 0.2881*** |
| | (0.0000) | (0.0000) | (0.0000) |
| Short-term debt | 0.2242*** | 0.1609*** | 0.1954*** |
| | (0.0000) | (0.0000) | (0.0000) |
| Total fixed assets | 0.0884*** | 0.1035*** | 0.1053*** |
| | (0.0000) | (0.0000) | (0.0000) |
| Observations | 10,884 | 2,886 | 2,000 |
| R-squared | 0.2248 | 0.3694 | 0.4025 |

Note: p-value in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard robust estimators are used. All variables are trimmed to exclude outliers.

Source: author's calculations based on CIT-IRP5 panel data.

This paper tests for the distributional impact of monetary policy across firm sizes over the period 2010–14.

Table 3 provides preliminary results using a pooled ordinary least squares (OLS) regression. The variables included in the regression are logarithmic. The dependent variable is the interest coverage ratio, and the explanatory variable of interest is the JIBAR. The interest coverage ratio is calculated such that an increase in the coverage ratio indicates an increase in the debt service burden of firms. This implies that a positive relationship is expected between the dependent variable and the explanatory variable of interest, i.e. the JIBAR. An increase in interest rates should increase firms' interest expenses for current cash flow levels, raising the interest coverage ratio.

Preliminary results in Table 3 suggest that monetary policy does have a statistically significant impact on the debt service costs of small firms. The coefficient for JIBAR in column 1 is quite sizable and significant at a 10 per cent level of significance. A one percentage point increase in interest rate is associated with a mean increase of 18.2 per cent in the interest coverage ratio. The

[7] The use of the JIBAR as the policy variable may introduce an element of endogeneity into the right-hand side of the regression equation, since the JIBAR is market-determined and may therefore be influenced by firms' demand for bank credit, which influences banks' interbank demand and supply.

JIBAR coefficients are negative for medium firms and positive for large firms, but both estimated coefficients are statistically insignificant. The preliminary results focusing on small firms are in line with expectations and findings in the literature; they conform with the notion that small firms have relatively lower collateral and therefore face higher risk premiums when borrowing from banks. However, pooled OLS regression coefficients suffer from heterogeneity bias, which is addressed by estimating a fixed effects model, as in Table 4.

Table 4: Fixed effects regression results

| Variables | (1)<br>Small | (2)<br>Medium | (3)<br>Large |
|---|---|---|---|
| JIBAR(-1) | 0.3570*** | 0.1745 | 0.1254 |
| | (0.0000) | (0.2583) | (0.4199) |
| Return on assets | 0.0667 | -0.3056 | -0.2352 |
| | (0.5218) | (0.2835) | (0.5212) |
| Book leverage | 0.0600*** | 0.0290 | 0.0738 |
| | (0.0015) | (0.4756) | (0.2104) |
| Short-term debt | 0.0355** | 0.0713*** | 0.0491 |
| | (0.0269) | (0.0036) | (0.1208) |
| Total fixed assets | 0.0239** | 0.0879*** | 0.0112 |
| | (0.0245) | (0.0045) | (0.6209) |
| Observations | 10,884 | 2,886 | 2,000 |
| R-squared | 0.0151 | 0.0318 | 0.0134 |
| Number of FID | 7,025 | 1,828 | 1,164 |
| Firm FE | Yes | Yes | Yes |

Note: Robust p-values in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard robust estimators. All variables are trimmed to exclude outliers. FID: firm identifier. FE: fixed effects.

Source: author's calculations based on CIT-IRP5 panel data.

Table 4 presents the results after controls for firm fixed effects using robust standard estimators. These are unobservable factors across firms that could explain changes in the interest coverage ratio and are constant over time. In column 1, the JIBAR coefficient is still positive and large, and statistically significant at a one per cent level of significance. A one percentage point increase in interest rates will see the debt service burden of small firms rise by 35.7 per cent. The interest rate coefficients for medium and large firms are both statistically insignificant. Small firms are more sensitive to changes in interest rates. Small firms which are financially constrained and have relatively weaker balance sheets and idiosyncratic risks face a higher external finance premium. For medium and large firms there is no statistically significant relationship between monetary policy and the interest coverage ratio. Medium and large firms with larger balance sheets have relatively larger collateral to provide against borrowing, and as a result face relatively lower external financing premiums.

In terms of the coefficients of the explanatory variables in Table 4, the picture is mixed. Return on assets, which is a measure of profitability, has negative signs for medium and large firms only. Profitable firms, and those with higher credit worthiness or a higher market value of assets, are considered less risky and face a relatively lower external finance premium. Therefore, the expected sign of the return on assets coefficient is negative. Nevertheless, the coefficients are not statistically significant across firm sizes. The book leverage variable measures the extent to which firms use debt versus equity to finance their spending. The variable is expected to have a positive relationship with the dependent variable, as firms that use more debt finance will be burdened by higher interest expenses if interest rates rise. Therefore, firms with a higher book leverage will be more sensitive

to monetary policy changes. In Table 4, the book leverage coefficient is positive across columns 1–3, in line with expectations. Moreover, the coefficient is highly statistically significant for small firms. Short-term debt is subject to variable interest rates along with adjustments to monetary policy. It is expected that firms with large short-term debts will also be sensitive to interest rate changes; similarly to book leverage, a positive sign is expected. The coefficients of short-term debt are positive in the regression results for all firm sizes in Table 4, and are statistically significant for small and medium firms. Small firms are largely dependent on non-intermediated or bank financing to overcome informational disadvantage. Large firms have access to other sources of funding, and therefore are not reliant on intermediated funding, because the market generally has information about this category of firms. Finally, asset size is a common control variable in the literature, largely included as a proxy for market access.

Firms with a larger asset value have better access to capital markets, as this measures their net worth. Therefore, a negative relationship is expected with the interest coverage ratio, which is our dependent variable. In the regression results in Table 4, the coefficients of total fixed assets—which we use to measure financing constraints, as in Gertler and Gilchrist (1994)—are surprisingly positive across the estimated results. The signs of the controls are mostly in line with expectations, except total fixed assets.

The return on assets is our measure of profitability, and is calculated as net profit over total assets. It is also an important variable to include because it is a key consideration for lenders assessing a firm's credit risk profile, which has implications for the risk premiums faced by firms.

Table 5: Time and firm fixed effects regression results

| | (1) | (2) | (3) |
|---|---|---|---|
| Variables | Small | Medium | Large |
| JIBAR(-1) | 0.0029 | -6.1587** | 6.7040 |
| | (0.9896) | (0.0138) | (0.2212) |
| Return on assets | 0.0731 | -0.3118 | -0.2003 |
| | (0.4827) | (0.2759) | (0.5851) |
| Book leverage | 0.0607*** | 0.0253 | 0.0691 |
| | (0.0013) | (0.5313) | (0.2459) |
| Short-term debt | 0.0352** | 0.0712*** | 0.0493 |
| | (0.0275) | (0.0033) | (0.1233) |
| Total fixed assets | 0.0248** | 0.0890*** | 0.0098 |
| | (0.0194) | (0.0046) | (0.6740) |
| Observations | 10,884 | 2,886 | 2,000 |
| R-squared | 0.0174 | 0.0370 | 0.0188 |
| Number of FID | 7,025 | 1,828 | 1,164 |
| Firm fixed effects | YES | YES | YES |
| Time dummies | YES | YES | YES |

Note: Robust p-values in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard robust estimators. All variables are trimmed to exclude outliers. FID: firm identifier. FE: fixed effects.

Source: author's calculations based on CIT-IRP5 panel data.

Table 5 presents the regression estimates after controls for both fixed and time effects. The coefficient for the JIBAR for small firms is quite small and also statistically insignificant, suggesting no causal relationship between interest rates and the debt service burden of small firms. The time horizon of our panel is relatively short, running from 2010 to 2014; therefore there is little time variation, and as a result time effects may not be present. Nevertheless, we present the regression estimates results controlling for time effects to check the consistency of the findings.

Table 6: General methods of moments regression results

| Variables | (1) Small | (2) Medium | (3) Large |
|---|---|---|---|
| JIBAR(-1) | 0.0547 | 0.2005 | 0.4839 |
| | (0.8560) | (0.8126) | (0.3118) |
| Return on assets | -6.0215 | -7.1851 | -5.2790 |
| | (0.3090) | (0.6734) | (0.1808) |
| Book leverage | 0.3053 | 0.8809 | 0.0937 |
| | (0.5939) | (0.2407) | (0.7207) |
| Short-term debt | -0.0600 | -0.2889 | 0.0544 |
| | (0.9232) | (0.5562) | (0.8528) |
| Total fixed assets | 0.5217 | -0.5692 | -0.5403 |
| | (0.4005) | (0.2637) | (0.4044) |
| Observations | 10,887 | 2,886 | 2,000 |
| Arellano Bond test AR1 | 0.112 | 0.563 | 0.029 |
| Arellano Bond test AR2 | 0.483 | 0.359 | 0.447 |
| Hansen test | 0.751 | 0.734 | 0.770 |
| Number of FID | 7028 | 1828 | 1164 |

Note: robust p-values in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard robust errors. All variables are trimmed to exclude outliers. FID: firm identifier. FE: fixed effects.

Source: author's calculations based on CIT-IRP5 panel data.

In order to address possible biases associated with endogeneity, general methods of moments (GMM) estimates are presented in Table 6. Arellano and Bond (1991) show that GMM estimates are not only efficient and consistent, but are also robust to heteroscedasticity and autocorrelation, particularly in samples with a short time horizon and large firm dimension. We use the second lag of the JIBAR as our instrument. We find that the JIBAR is positive across all firm sizes; however, all three coefficients are statistically insignificant. Indeed, none of the coefficients in Table 6 are statistically significant, although some exhibit the expected signs. The return on assets coefficients are negative across columns 1–3. More profitable firms are considered less risky from a credit risk perspective. Total fixed assets, our measure of capital market access, are also negative in line with expectations, but only for medium and large firms. The p-values of the AR2 test are 0.483, 0.359, and 0.447 for small, medium, and large businesses respectively, suggesting that the null hypothesis of no second-order serial correlation in the residuals is not rejected. Furthermore, the Hansen test across columns 1, 2, and 3 also indicates that we do not reject the null hypothesis of exogenous instruments. Overall, our model is a good fit.

## 5 Conclusion

This paper has studied the distributional impact of monetary policy on firms in South Africa, focusing on the balance sheet channel of the transmission mechanism. The empirical findings show that monetary policy has a statistically significant impact on the balance sheet strength of small firms in the domestic manufacturing sector. The interest coverage ratio is a measure of financial tightness, and it captures the transmission of monetary policy shocks to the balance sheet strength of firms exposed to interest rate risks. An increase in the interest coverage ratio indicates that firms may face difficulty making interest rate payments with current cash flow levels following

a monetary policy tightening. This is particularly relevant and significant for financially constrained firms with limited access to external finance. As a result, monetary policy that weakens the balance sheet position of this particular class of firms may force them to cut investment spending and hiring to avoid default. In aggregate, this will have implications for domestic investment, employment, and growth in the economy. The evidence in this paper shows that there is a systematic relationship between monetary policy and the debt service burden of small firms. Therefore, domestic monetary authorities should consider the impact of their policy decisions on small firms in South Africa when making decisions on interest rate changes. A full analysis of the impact of monetary policy across heterogeneous firms will assess the responses to coverage ratio changes associated with monetary policy changes in firms' production, inventory demand, and employment, categorized by firm size.

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## Appendix

Table A1: Variables and their calculations

| Variable | Definition | Description |
|---|---|---|
| Coverage ratio | Interest paid / (interest paid + operating cash flow) | The calculation of the interest coverage ratio follows Ippolito et al. (2017). This is a conventional indicator used in the literature to measure the debt service burden firms face when interest expenses increase for a given level of cash flow. An increase in the coverage ratio indicates an increased debt service burden. |
| JIBAR | Three-month Johannesburg interbank average rate | This is a widely quoted money market benchmark interest rate, and it is used as a proxy for changes in monetary policy. |
| Return on assets | Net profit/total assets | Firms that are more profitability are less risky, and are expected to face less stringent credit terms. Furthermore, firms with low profitability are more responsive to monetary policy (Ehrmann and Fratzscher 2004). |
| Book leverage | Total debt / total equity | Book leverage is included to control for the degree of bank usage by firms. Ippolito et al. (2017) use market leverage. However, due to data limitations, we approximate market leverage with book leverage instead. |
| Short-term debt | Interest-bearing debt with a maturity of less than a year | |
| Total fixed assets | Log (total fixed assets) | Total asset size is included to control for firms' capital market access (Gertler and Gilchrist 1994), which is also a common control variable in the literature. The size of a firm is a proxy for capital market access. Financially constrained firms with a weaker balance sheet or net worth face higher costs of external finance. |

Source: author's compilation.

Table A2: Descriptive statistics, full sample including standard deviations

| | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|
| | Mean | Std | Mean | Std | Mean | Std |
| Coverage ratio | 0.113 | 0.137 | 0.113 | 0.133 | 0.113 | 0.128 |
| Firm age | 13.424 | 9.770 | 17.285 | 12.843 | 20.577 | 16.668 |
| Profitability | 0.233 | 0.464 | 0.175 | 0.239 | 0.172 | 0.263 |
| Book leverage | 14.900 | 106.098 | 10.886 | 71.879 | 7.748 | 53.920 |
| Short-term debt | 308,170.1 | 769,254.4 | 1,587,930.08 | 2,147,810.44 | 4,628,193.18 | 4,885,855.07 |
| Total fixed assets | 696,094.6 | 1,937,951.6 | 2,838,024.3 | 4,737,104.2 | 6,237,606.5 | 7,913,645.6 |
| N | 178846 | | 20164 | | 16188 | |

Note: Std = standard deviation.

Source: author's calculations based on CIT-IRP5 panel data.