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International Lending Channel, Bank Heterogeneity and Capital Inflows (Mis)Allocation

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Abstract

This paper explores the role of banks' heterogeneity in international lending and its impacts on capital inflows allocation across firms by exploiting the inclusion of South Africa into the Citi Group's World Government Bond Index (WGBI). Using bank-level data, we provide evidence that banks holding sovereign bonds before the inclusion increase credit supply to non-financial firms after the shock. Moreover, less capitalized banks drive these effects. Using firm-level data in South Africa, we then show that credit is allocated to less financially constrained and less productive firms. Consistent with zombie-firms behavior, we find no evidence of a significant improvement in real outcomes after the increase of credit supply to those firms. Our paper adds to the literature by analyzing the interplay between banks' heterogeneity, capital inflows shocks and capital misallocation.

JEL classification: F21, F36, G21

Keywords: Capital inflows, Sovereign Debt, International Lending Channel, Misallocation

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1 Introduction

In recent years many middle-income countries have succeeded in developing markets for local-currency sovereign debt and attracting foreign investors. Since the Global Financial Crisis, the share of their local currency sovereign debt held by foreign investors increased from about 10% in 2009 to 25% in 2020 (Broner et al., 2021). Assessing how foreign investors' demand on domestic assets impacts firms' and aggregate outcomes remains one of the key questions in international finance. We study the response of banks to an unexpected increase in the demand for an important asset holding in their portfolio, namely sovereign debt, and the effect this has on their borrowers.

So far, the related literature has reached contrasting results on the effects of capital inflows. On the one hand, papers focusing on the surge of capital inflows in Southern Europe in the early 2000s point to a significant increase in resource misallocation, which eventually reduces aggregate productivity (Benigno et al., 2015; Gopinath et al., 2017). On the other hand, recent empirical evidence analyzing capital inflows in Eastern Europe and other emerging countries find opposite results (Larrain and Stumpner, 2017; Varela, 2018; Bau and Matray, 2023). We focus on a large emerging country, South Africa, and exploit a natural experiment to study how sovereign debt inflows affect financial intermediaries and shape credit allocation across firms. Specifically, we investigate three things: the presence (and duration of) a banking channel for sovereign debt inflows, the selection of firms affected by increased credit supply, and the aggregate productivity effects in the economy.

Assessing how sovereign debt inflows affect domestic firms is challenging from an empirical point of view since these flows are typically endogenous. To overcome this problem, we exploit the inclusion -in 2012- of South African government bonds in the Citigroup World Government Bond Index (hereafter WGBI). This index represents the largest benchmark for global sovereign fixed-income market investors. The unanticipated announcement of the inclusion of South Africa into this widely used market benchmark induced international investors to rebalance their portfolios, generating an increase in the global demand for these bonds. In turn, this event determined an upsurge in capital inflows to South Africa through the domestic sovereign debt market. Since the WGBI is exclusively composed of sovereign bonds, foreign investors' rebalancing only entails inflows to sovereign bond markets and does not directly affect the equity or corporate debt markets.

This natural experiment then provides an ideal setting to study the role of a banking credit channel for capital inflows. First, it triggers large inflows to just one specific type of bank asset, sovereign bonds. Second, as we discuss in more detail in Section 2, banks do not anticipate the announcement, and they only adjust their exposure to domestic government bonds after the date of the inclusion. Therefore, we exploit the information on bank's exposure to South African government bonds before the announcement and, along with bank and firm-level administrative information, identify the impact of the banking channel of international financial flows on capital allocation.

Using granular data from all commercial banks in South Africa, we find that banks holding government debt before the announcement increased their credit supply following the inclusion. Such increase is directed to the corporate non-financial sector. Importantly, we provide evidence that only banks with lower levels of capital ratio increase their supply of loans to non-financial firms. Moreover, through administrative data containing firms' tax information, we provide evidence that credit supply increases above and beyond changes in the firms' demand for credit. Furthermore, using firm-level data, we shed light on how banks allocate credit supply across firms. First, the expansion in credit significantly affects only firms with higher levels of collateral and lower productivity before the event. Second, although these firms face a significant increase in their access to credit, the effect on their productivity after such increase in credit is limited. As credit is allocated to less constrained and productive firms, the overall impact on the real economy is quite modest.

Our results are consistent with the so-called zombie lending by banks, namely the practice of extending loans to low-productivity firms to ensure that existing loans are repaid and to avoid reporting a loss in their balance sheets. The rise of unprofitable firms, persistently unable to cover debt servicing costs from current profits, has been documented in Japan (Peek and Rosengren, 1997; Caballero et al., 2008), the European Union (Blattner et al., 2019; Bonfim et al., 2022), India (Chari et al., 2021; Chopra et al., 2021), and in cross-country studies (Banerjee and Hofmann, 2018; Andrews, 2019). While the role of under-capitalized banks in the rise of zombie firms is well documented in the literature, to the best of our knowledge, there are no other articles analyzing how these banks propagate capital inflows and their role in shaping firms' capital misallocation.

Our paper also relates to other streams of literature. First, it relates to a vast literature studying the effects of capital inflows and integration on the real economy (Benigno et al., 2015; Gourinchas and Jeanne, 2006; Bonfiglioli, 2008; Chari et al., 2012; Pandolfi and Williams, 2020; Williams, 2018). More specifically, it adds to the literature analyzing the effects of financial integration on resource allocation and aggregate productivity, both in developing and advanced countries (Varela, 2018; Larrain and Stumpner, 2017; Gopinath et al., 2017; Bau and Matray, 2023).[1] The closest contribution to our paper is Williams (2018), who considers the Colombian inclusion into the J.P. Morgan's government bond index in order to estimate its effect on credit supply. With respect to this paper, our contribution is to provide evidence on how banks affect the allocation of sovereign debt inflows through the credit channel, and on a new mechanism explaining why capital inflows shocks do not always translate into an increase of productivity (Benigno et al., 2015; Gopinath et al., 2017).

More broadly, we add to an extensive literature in international finance investigating the effects of capital flows on firms, focusing on sovereign debt inflows, FDI, bank, and equity portfolio flows (Bottero et al., 2020; Broner et al., 2021; Kaat, 2021; Pandolfi and Williams, 2020; Schnabl, 2012). Most of these papers look at episodes of financial account liberalization across emerging countries at the macro level.[2] We add to this literature by using micro-level data on both banks and firms and showing how heterogeneity in lenders (banks) and borrowers (firms) is essential in evaluating the effects of sovereign debt inflows through the banking channel. With respect to papers using similar granular data (Baskaya et al., 2017; Cingano and Hassan, 2022; Cantù et al., 2022), our contribution is to leverage a natural experiment to provide evidence on the role of bank capitalization on credit misallocation during sovereign debt inflows episodes.

Finally, we relate to papers investigating the role of macroprudential policies in the context of capital inflow upsurges and how it transmits to the real economy (Baskaya et al., 2017; Galati and Moessner, 2013; Fendoğlu, 2017). Specifically, we wish to shed light on how appropriate

[1] These papers differ in the type of shock which is considered. Some focus on the transitional dynamics following a decline in the real interest rate in developed countries (Benigno et al., 2015; Gopinath et al., 2017), while others consider episodes of financial liberalization in emerging economies (Baskaya et al., 2016; Larrain and Stumpner, 2017; Williams, 2018; Varela, 2018; Bau and Matray, 2023; Cingano and Hassan, 2022; Baskaya et al., 2023).

[2] Broner et al. 2019, exploit episodes of large sovereign debt inflows after the announcements of the inclusion of six emerging countries into major sovereign debt indexes (Colombia, Czech Republic, Mexico, Nigeria, Romania, and South Africa). They find that financial firms, government-related firms, and firms that rely more on external financing experience higher returns than firms operating in tradable industries. Pandolfi and Williams 2020, complement these results by showing that financial and government-related firms exhibit a growth in income, employment, and dividends that is greater than that of tradable firms. They also show that more financially constrained firms appear to benefit from the inclusion events as well. Kaat 2021, focusing on the euro area, finds that cross-border debt flows raise the credit growth rates of low performing firms significantly more than those of high performing ones. Finally, Bottero et al. 2020, using Italian loan-level data, find that banks with a lower capital and less stable funding played an important role in the propagation of the Euro area financial shock through a credit contraction.

bank-level policies might mitigate the adverse effects of credit booms.

The rest of this paper is organized as follows. Section 2 provides more details on South African Inclusion into the WGBI. Section 3 describes the data, while section 4 presents the empirical strategy. Section 5 presents the results, and section 6 contains some robustness checks. The final section 7 concludes.

2 Institutional Background and Data

2.1 South African Sovereign Bonds Index Inclusion

For international investors, an index such as the WGBI represents a hypothetical portfolio of investment choices with exposure to a specific segment of the domestic financial market. The index provides a benchmark for international investors, who can replicate the composition in their own portfolios. [3] In this paper, we exploit the rebalancing of one of these indexes in 2012, namely the inclusion of South Africa into the WGBI, to analyze the banking channel of sovereign debt inflows. The WGBI is the largest government bond index in the world, which has more than US$2 trillion in assets under management benchmarked against it.

The episode we consider represents an ideal laboratory for our research question, as it triggered a massive capital inflow by foreign investors to one specific asset. The inclusion was unexpected, undetermined by the country's economic fundamentals, and importantly unanticipated by banks. Therefore, we are able to exploit the banking exposure to sovereign bonds before the inclusion to estimate the banking channel of capital allocation.

On the 16th of April 2012, Citigroup announced that 11 Southern African sovereign bonds were eligible for inclusion into the WGBI.[4] These newly eligible bonds had a market value of US$88bn and would carry a projected market weight of 0.44% in the index. In line with the idea of an increased foreign demand for these assets, Sienaert (2012) estimated a sovereign inflow of US$5-9 billion in the days following the announcement, or up to about 10% of total market capitalization.

The inclusion of South Africa was part of a more general strategy of Citigroup to diversify the

[3]Pandolfi and Williams (2019); Williams (2018) provide evidence of an increase in sovereign bond prices due to changes in the J.P. Morgan GBI-EM Global Diversified index composition.

[4]As highlighted by Broner et al. (2021), the first news on the inclusion was reported by Reuter and is dated 17th April 2012, at 07:05 AM (Eastern Standard Time). We then consider this date as the time of the inclusion in our empirical analysis.

WGBI coverage and was not driven by changes in the South African economic fundamentals.[5] In addition, at the time of the inclusion, at least six other emerging countries met all the criteria needed to be eligible for inclusion in the WGBI.[6] Moreover, we should emphasize that South Africa had met all the entry requirements since 2009, while it was selected only three years later. More specifically, the entry criteria required: (i) minimum market capitalization (USD50bn), (ii) credit rating of at least A-/A3 by Standard and Poors and Moody's, respectively), and (iii) no barriers to entry. In South Africa, sovereign debt market capitalization was above the minimum since the beginning of the '90s, Moody's country rating was above the threshold since 2009, and there was no restriction to capital inflows since the Financial Rand System was abolished in 1995 (Molemoeng, 2014). Nevertheless, as shown in previous literature, international investors tend to replicate indices composition, therefore they adjust their portfolios just after index rebalancing events.(Cremers et al., 2016; Raddatz et al., 2017; Pandolfi and Williams, 2019) Moreover, we do not find any evidence of anticipatory behavior by banks in South Africa in the years preceding the inclusion (see Figure 1). The next section describes the data.

2.2 Data

This paper uses three primary data sources. The first is the BA900 regulatory form, a mandatory form that the South African Reserve Bank (SARB) requires all commercial banks and mutual banks to complete monthly. This database is available publicly via the Reserve Bank website and houses the 48 banks which have been registered from January 1993 to present, containing information on bank liabilities and assets. Using the BA900 data, we are able to collect information on the bank's total loans, their loans to the private and non-financial corporate sector, as well as the bank's market share, their ratio of government debt exposure, and their size and capital ratio. Most importantly, we are also able to track the banking loan supply and exposure to sovereign debt before and after the country's inclusion into the WGBI.

The second source of data is the SNL Financial database. This database contains a snapshot

[5]The inclusion of the South African bonds was preceded by the inclusion of Polish (2005), Malaysian (2007), and Mexican (2010) bonds and followed by the inclusion of Nigerian bonds in the JP Morgan government bond index (August 2012). See more details on the coverage expansion in https://www.businesswire.com/news/home/20120417006717/en/Citi-Considers-South-Africa-for-World-Government-Bond-Index.

[6]Based on information from the IMF Global Debt Database, the IMF Capital Control Database (Fernández et al., 2016), and Fuchs and Gehring (2017). According to these sources, countries meeting the requirements were Chile, Czech Republic, China, Hong Kong, Israel, and Qatar, but only China was included in the WGBI in 2021.

of the bank branches from the eight largest banks in South Africa.[7] These eight banks represent more than 95% of the country's banking assets throughout the sample period. Although we are only able to observe a snapshot of the bank branches and not their full dynamics, the SNL shared with us the dynamics of branches' closures and openings. The time span varies by institution, with ABSA covering the longest span starting in 2015, and Capitec covering the shortest, starting in 2019. We use the information on the branch locations with a larger common time span (i.e., starting in August 2019).

Finally, we use administrative tax data at the firm level obtained from the South African Revenue Services (SARS) for the 2009–2018 period. The primary data source is the South African Corporate Income Tax (CIT) data. CIT data are collected by SARS annually and concern the tax year ending in February each year. Firms must submit a corporate income tax return in which they self-report information concerning their income, expenditures, equity and liabilities, capital items, and tax credits. Almost all reporting items are compulsory, and compliance is high, given that SARS may audit firms in a given year. We complement firms' employment information using employee income tax certificates (IRP5 forms) to construct a measure of employment for each firm. IRP5 data are aggregated for each Pay-As-You-Earn (PAYE) reference number. A table linking the PAYE reference numbers to the tax reference number of the firm in the CIT dataset is used to match employees to firms. Companies identified by a unique tax reference number may have multiple PAYE numbers. We match all employees with a matching PAYE reference number to their corresponding tax reference number.[8]

Using the NT-SARS firm-level panel, we are then able to exploit the information on firms' assets and liabilities as well as their geographical location. We can also obtain information on their access to bank loans. Furthermore, using data on firm costs and sales, we can estimate their value-added, and exploiting the information on firm inputs (e.g., labour costs and intermediate material) and capital from Kreuser and Brink (2021), we can estimate a two-digit sector production function. Finally, following the method proposed by Ackerberg et al. (2015), we estimate firms' productivity and firms' marginal revenue products of capital (hereafter MRPK).[9]

Table 4 provides summary statistics on some of the firms' outcomes, such as their value added, sales, input and labor costs, in 2011, that is in the year before the inclusion. We test for possible differences in firms located in districts where banks had a low exposure to government

[7]Specifically, it includes Nedbank, Standard Bank of South Africa, First Rand (FNB), Capitec, Albaranka, ABSA, Investec, and African Bank.

[8]For more information on the firm-level data used here, see Pieterse et al. (2018).

[9]See Appendix B, for more details.

bonds with respect to firms located in districts in which banks were highly exposed.[10] As shown in Table 4, firms located in districts with a low exposure to the shock are statistically similar to those located in highly exposed districts. This evidence reduces one's concerns on sorting between firms' characteristics and their exposure to the shock. The next section describes our empirical strategy.

3 Empirical Strategy

This section is divided into three main parts. First, we discuss how we exploit bank-level data to estimate the banking channel of sovereign debt inflows. Second, it discusses how we estimate the allocation of credit supply using firm-level data, and how we disentangle credit supply and demand. Lastly, we describe how we exploit firms heterogeneity to shed some light on how credit supply is allocated and their efffects on other firms' outcomes.

3.1 Bank Level Government Bond Exposure, Sovereign Inflows and Credit Supply

Our empirical strategy is similar to the one used by Baskaya et al. (2023), who analyzes the effects of the sovereign risk spikes caused by an earthquake in Turkey on banks credit supply. As banks rely on different sources to grant credit, we exploit the differences in their exposure to sovereign bonds before the South African inclusion into the WGBI, to estimate the effect of this shock on credit supply. In our baseline specification, we use a continuous variable to define banking exposure:

$$Gov\_Debt\_Exp_{b,2011} = \frac{Gov\_bond\_holdings_{b,2011}}{Total\_assetsb, 2011} \tag{1}$$

in equation (1), banking exposure is given by the ratio between the average marketable stock of sovereign debt of each bank b divided by its total assets in 2011.

We then use a difference in differences estimator to analyze the effect of the increase in sovereign debt inflows on banks' total lending, private lending, and non-financial corporate lending. We exploit the banking exposure to sovereign bonds using the following specification:

$$y_{b,t} = \quad \delta_1 Gov\_Debt\_Exp_{b,2011} \times Post\_WGBI + \beta_t X_b + \alpha_{b,m} + \epsilon_{i,t} \tag{2}$$

[10] Our definition of exposure is given in Equation 4. Low (high) exposure means that a firm is located in a district in which banks have an exposure below (above) the district average.

where $y_{b,t}$ represents the credit supply of bank b at the monthly date t. We control for bank-month ($\alpha_{b,m}$) and baseline bank characteristics by date ($\beta_t X_b$) unobserved heterogeneity, in order to disentangle the changes due to the inclusion from other contemporaneous bank-specific confounders.

A dynamic specification of the difference in differences estimator then allows us to identify the timing of the effect and to check whether banks more exposed to sovereign bonds behave differently with respect to the control group, even before the date of the inclusion. The equation then becomes the following:

$$y_{b,t} = \quad \sum_{i=2009}^{2018} \delta_{1,t} I(t=i) \times Gov\_Debt\_Exp_{b,2011} + \alpha_{b,m} + \alpha_t + \epsilon_{i,t} \qquad (3)$$

where the measure of banking exposure is taken from equation (1). We cluster the standard errors at the bank-month level.

3.2 Disentangling Credit Supply from Firm Credit Demand

Previous literature documented the link between firm characteristics and capital inflows allocation (Gopinath et al., 2017; Larrain and Stumpner, 2017; Bau and Matray, 2023). The same characteristics might also affect the demand for bank credit, potentially biasing our results, when using bank-level data. For example, Broner et al. (2021) show that government-related firms and firms relying more on external financing experience relatively higher returns after a country's inclusion into a major sovereign debt index. They also show that tradable industries experience lower returns than firms in non-tradable industries.[11] The approach that we describe in this section allow us to deal with the presence of these possible firm-level confounders.

In order to disentangle credit demand from credit supply, we follow the approach proposed by Degryse et al. (2019), who clusters firms into industry-location-size-time bins. Since firms in same cluster are very similar, they are also very likely to have a similar demand for credit. Hence, by controlling for cluster fixed effects, we are able to disentangle firms' credit demand from banks' supply of loans. Moreover, in this way, we are also able to control for any other time-varying common shocks at the industry-location-size-time level.[12] Furthermore, with respect to Degryse et al. (2019), we also include the firms' MRPK into our definition of a cluster, to control for the fact that firms facing different financial constraints may also have a different

[11] However, we should emphasize here that the exchange rate in South Africa did not steadily appreciate after the inclusion (Broner et al., 2021).

[12] See Jakovljević et al. (2020) for more details.

demand for bank credit over time.[13] Our underlying assumption is that by controlling for the MRPK-sector-location-size-time unobserved heterogeneity, we capture the credit demand of similar firms in the cluster.

To estimate the effect of sovereign debt inflows on firms' access to finance, we measure the firms' exposure to bank credit by exploiting information on the branch locations of the eight largest South African Banks, along with their exposure. As we do not have information on which branches (or even banks) firms borrow directly, we proxy this relationship by using proximity between bank branches and the firm location (Dass and Massa, 2011).[14] For each one of the 51 districts in South Africa, we then calculate the regional banking exposure as follows:

$$Gov\_Debt\_Exp_d = \sum_{b=1}^{n} Gov\_Debt\_Exp_{b,2011} \times \frac{Branches_{bd}}{TotalBranches_d} \tag{4}$$

where d denotes the in which district the headquarter of the firms is located, therefore, $\frac{Branches_{db}}{TotalBranches_d}$ is the share of branches of bank b on district d, and $Gov\_Debt\_Exp_{b,2011}$ is the ratio, for each bank, between its average marketable stock of sovereign debt and total assets in 2011.[15]

Finally, we use the following specification to analyze the effect of the inclusion on the credit supply faced by the firms. Specifically, we employ the following specification:

$$y_{i,t} = \delta_1 Gov\_Debt\_Exp_d \times Post + \alpha_i + \alpha_{d(t,r,s,Size,MRPK)} + \epsilon_{i,t} \tag{5}$$

where i is the firm, t denotes the year, r is the province where the firm Head Quarter (HQ) is located, s is the firm sector, and $Size$ represents bins of firms' size. The coefficient $\alpha_{d(t,r,s,Size,MRPK)}$ is our control for firms' loan demand and represents the MRPK-sector-location-size-time cluster fixed effects.

3.3 Heterogeneous Allocation

The main goal of our paper is to understand how bank heterogeneity shapes sovereign inflows allocation through the credit channel. In this section, we describe our empirical strategy to estimate these credit patterns. We do that by estimating the heterogeneous allocation of credit supply across firms. First, we focus on firms facing different degrees of financial constraints

[13]We computed the size and the MRPK in 2011, namely before the shock.

[14]These eight banks represent more than 95% of the country's banking assets since 2011. Section 2.2 contains more details on the branches' information.

[15]This approach is very similar the one used by other papers in the literature (Huber, 2018; Baskaya et al., 2023).

before the inclusion, by taking their MRPK as a measure of financial constraint. We then analyze the heterogeneity in the firms' access to credit across firms belonging to the same sector. Hence, we augment our baseline specification as follows:

$$\begin{aligned} y_{i,t} = \quad & +\alpha_i + \alpha_{d(t,r,s,Size,MRPK)} + \delta_L Gov\_Debt\_Exp_d \times Low\_MRPK_i \times Post \\ & +\delta_H Gov\_Debt\_Exp_d \times High\_MRPK_i \times Post + \epsilon_{i,t} \end{aligned} \tag{6}$$

where $High\_MRPK_i$ denotes whether the firm faced low financial constraints in 2011, as measured by a productivity greater than the sectoral mean, in 2011, while Low_MRPK_i denotes whether the firm had a productivity below the sectoral mean, in the same year. The two coefficients of interest in this specification are δ_L and δ_H, which represent the heterogeneous effect of the banking channel of sovereign debt inflows, after the shock, for firms with low financial constraints (namely low MRPK) and firms with high financial constraints, respectively.

Second, we test whether credit allocation depends on the firm's level of risk. To do so, we distinguish between firms with low and high levels of collateral, by employing the following specification:

$$\begin{aligned} y_{i,t} = \quad & \delta_{LL} Gov\_Debt\_Exp_d \times Low\_MRPK_i \times Low\_Risk_i \times Post \\ & +\delta_{LH} Gov\_Debt\_Exp_d \times Low\_MRPK_i \times High\_Risk_i \times Post \\ & +\delta_{HL} Gov\_Debt\_Exp_d \times High\_MRPK_i \times Low\_Risk_i \times Post \\ & +\delta_{HH} Gov\_Debt\_Exp_d \times High\_MRPK_i \times High\_Risk_i \times Post \\ & +\alpha_i + \alpha_{d(t,r,s,Size,MRPK)} + \epsilon_{i,t} \end{aligned} \tag{7}$$

where δ_{LL} represents the effect on low financially constrained and low risk firms, δ_{LH} represents the effect on low financially constrained and high risk firms, δ_{HL} denotes the effect on high financially constrained and low risk firms and δ_{HH} is the effect on high financially constrained and high risk firms, respectively.

Finally, we take measures of firms' real outcomes, such as total factor productivity (TFP), value-added, sales, costs, and physical capital, as the dependent variables. We then use the same specification of Equation 7 to analyze the effects of the change in the access to bank credit on real outcomes. The next section presents the results.

4 Results

In this section, we start by using bank-level data to provide evidence on the effect of the South African inclusion on credit supply, by exploiting differences in banking exposure to sovereign bonds before the event. We then use firm-level information to provide further evidence on the expansion of bank credit supply, controlling for unobserved heterogeneity in the firms' demand for credit. Finally, exploiting firms' heterogeneity before the shock, we study how the expansion of credit supply is allocated across firms and its effects on real outcomes.

4.1 Bank Heterogeneity and Credit Supply

As shown in previous papers (Cremers et al., 2016; Raddatz et al., 2017; Williams, 2018; Pandolfi and Williams, 2019), since international investors tend to replicate the index portfolio, their demand for government bonds increases at the time of the rebalancing. Therefore, we begin by considering the dynamics of bond holdings by banks around the time of the inclusion. This is important to rule out anticipatory behavior by the banks, which could bias our estimated effect of index inclusion on credit supply.

Figure 1 ahows that banks did not adjust their government bond holdings prior to the event. As the demand for these bonds by international investors increases after the inclusion, banks face an unexpected funding windfall, given the price increase of their bond holdings (Khwaja and Mian, 2008; Schnabl, 2012). Moreover, our dynamic specification shows that during the years following the shock, banks do decrease their holdings of sovereign bonds, which in turn contributed to an increase in their credit supply. This evidence is consistent with a crowding out of private credit before the entrance of foreign investors and with a financial repression channel (Williams, 2018; Kose et al., 2022).[16]

As shown in Table 1, banks differentially exposed to sovereign bonds behave differently in terms of credit provision after the shock. Specifically, as can be seen, only banks with greater exposure before the inclusion extended credit supply after. We then decompose the effect, distinguishing between the effect on total credit, credit to the private sector, and credit to only non-financial private firms. Although total credit and credit to the private sector both increase, the effect is, in fact, driven by the increase of credit provided to non-financial private firms. To disentangle the impact on the non-financial corporate sector from the other sectors, in Table 2, we show that total credit and credit to the private sector, when excluding the non-financial corporate sector, do not increase after the inclusion.

Considering the specification in which we control for bank unobserved heterogeneity in terms of size, foreign ownership, and capitalization (in Column (12) of Table 1), a one percentage

[16] As foreign institutional investors entered the domestic sovereign debt market, the domestic financial institutions might be able to sell the excess of debt that they could not offload before and use the proceeds to extend credit.

point higher exposure to government bonds before the inclusion generates a 0.135 percentage point higher credit supply in the years following the inclusion. In our preferred specification of column 12, we weigh the regression by the bank market share before the inclusion to estimate the economy-wide credit supply effect. We estimate that aggregate credit to non-financial firms in South Africa increased by 12,6% after the inclusion.

Our results are in line with previous findings in the literature on changes in sovereign bond demand by foreign investors to the credit supply (Williams, 2018; Bottero et al., 2020; Baskaya et al., 2023). In particular, Williams (2018) finds that banks highly exposed to government bonds (or market makers) tend to increase credit supply by 4.1%, as compared to less exposed banks, after the inclusion of Colombia into the J.P. Morgan's GBI-EM index. Although his results are not directly comparable to ours, we show in a robustness test that highly exposed banks tend to increase credit supply by 14.2 percent, compared to less exposed banks (see Table 8). It is important to emphasize that our results represent the long-run effect on credit supply (i.e., even four years after the inclusion), while Williams (2018) focuses on the short-run effect, that is up to one year after the inclusion.

We then proceed to investigate whether banks' heterogeneity plays a role in explaining the increase in credit supply. To do so, we distinguish between banks with low and high levels of capital ratio.[17] The results presented in Table 3 show that less capitalized banks are responsible for the increase in credit supply experienced by the firms. Among banks that are more exposed to sovereign bonds before the inclusion, only banks with lower levels of capitalization significantly increased their credit supply. In particular, their credit supply increase by about 30%, as compared to the trend before the event. Moreover, taking into account the banks' market share before the inclusion, we find that the increase in aggregate credit supply is entirely driven by the supply of credit provided by undercapitalized banks. This result should depend on the the fact that under capitalized banks are likely those for which the constraints in lending was binding before the inclusion. The stronger effects associated to less capitalized banks is in line, for example, with previous research analyzing the effects of sovereign risk on credit supply transmitted through banks' portfolio in the EU area during the Greek bailout in 2010 (Bottero et al., 2020).

Our results provide new evidence on the role of bank capitalization in propagating unanticipated increases in capital inflows to the sovereign debt market to credit supply (Williams,

[17] We define banks with a low level of capital ratio as those in which the ratio between the bank capital and total assets is below 8%. We chose this value because, according to Basel III, the minimum capital adequacy ratio is 8%. Then, this threshold is quite conservative.

2018; Genaioli et al., 2014; Baskaya et al., 2023). In the next section, we analyze if banks' heterogeneity interacts with firms' heterogeneity and affects the allocation of credit supply during the sovereign inflow episode.

4.2 Firm Heterogeneity and Credit Supply Allocation

As we previously mentioned in section 3.2, our results could be biased by the presence of some confounding effects arising after the inclusion of South Africa into the index. To disentangle the effect of credit supply from other possible effects on credit demand driven by the inclusion, we calculate the banking exposure to sovereign bonds in 2011, at the local level, and, following Degryse et al. (2019), we control for province-sector-size-MRPK-time unobserved heterogeneity. Furthermore, controlling for these cluster fixed effects, should also allow us to absorb other possible sector specific confounders, such as those documented by Broner et al. (2021) on tradable, government-related, or more financially dependent sectors.

Table 5 shows that firms located in districts where banks held larger proportion of government bonds before the inclusion, experience a significant increase in credit supply after the shock. These results are in line with those presented in Section 4.1, using data at the bank level. In our firm-level specification in this table we are also able to control for unobserved credit demand heterogeneity. We then confirm that our results in the previous section are not driven by an increase in credit demand. Most importantly, Table 5 shows that firms benefit from a significant increase in their access to credit, and that this increase is even larger when controlling for credit demand related unobserved heterogeneity. In quantitative terms, in our preferred specification in column 5 (in which we control for province-sector-size-MRPK cluster fixed effects), a one percentage point increase in the banking exposure to sovereign bonds generates a 0.22 percentage points increase in banks' credit supply after the inclusion. Considering the average regional exposure to the shock and using the results from this specification, we estimate an increase of around 12% in credit supply, in line with the results presented in the last section using bank-level data.

Finally, in Table 6, we provide evidence on the role of firms' heterogeneity for the allocation of credit supply. In particular, column (1) shows that only firms with lower MRPK benefit from an increase in credit supply, while firms with higher productivity do not. Furthermore, as shown in column (2), bank credit is allocated to firms with lower productivity but higher collateral, hence to less financially constrained firms. Moreover, our results document that the banking channel of sovereign debt inflows does not benefit firms that are either more financially constrained or more productive, since their access to credit does not change. On the other hand, firms with lower productivity and higher collateral experience a significant increase in bank loan supply.

4.3 Capital Inflows Misallocation and Real Outcomes

In this section, we finally analyze if the increase in bank credit, benefiting less productive and less financially constrained firms, in turn translates into an improvement of real outcomes. More specifically, we consider total factor productivity, value-added, sales, and input acquisition, (i.e., labor costs and physical capital). As shown in Table 7, we find no evidence of an improvement in real outcomes of the less productive and financially constrained firms after the large increased access to credit. Hence, we find no evidence of a significant effect on productivity or resource reallocation.

These results contribute to a related literature focusing on the impacts of capital inflows on resource allocation, more specifically on the effects of sovereign debt inflows credit channel on capital misallocation. We provide new evidence that the allocation of such inflows might be distorted by financial institutions with lower levels of capitalization Larrain and Stumpner (2017); Gopinath et al. (2017); Varela (2018); Bau and Matray (2023). These findings also corroborate the contrasting effects on real outcomes found in Pandolfi and Williams (2020). While they focus on the average effects of six emerging countries (including South Africa), we focus only on one of those. Moreover, relative to their paper, we provide evidence of the banking channel mechanism that might generate these contrasting results. Furthermore, our results are in line with the literature dealing with zombie firms and are consistent with the evergreening behavior of less capitalized banks (Peek and Rosengren, 1997; Caballero et al., 2008; Banerjee and Hofmann, 2018; Andrews, 2019). Our work provides new evidence on the role of less capitalized banks in triggering capital inflow misallocation, as sovereign debt inflows are passed on by less capitalized banks to less productive firms with lower levels of financial constraint.

The following section discusses possible threats to our empirical strategy and contains some robustness analysis.

5 Robustness Checks

We performed a number of robustness checks on our baseline empirical analysis, we discuss four of them in more detail in this section

5.1 Dynamic Effects and Parallel Trends

Using a dynamic specification of our difference-in-differences estimator (see Equation 3), we provide evidence in favor of a parallel trends assumption. First, as shown in Figure 1, banks more exposed to government bonds do not display any anticipatory behavior in their sovereign debt holdings, in the years preceding the South Africa inclusion into the WGBI. Moreover, in the same figure, we also provide evidence that banks more exposed to government bonds in 2011, decreased their holdings in the years after the inclusion, in line with dynamics on credit presented in in Figure 3. In other words, while we find no evidence of a differential behavior in the lead up to the inclusion in the index, we do find that more exposed banks significantly expand their credit supply after.

Furthermore, Figure 4 provides evidence in line with the findings of Figure 3 using firm-level data instead of bank-level information. Such a figure also shows evidence in line with an heterogeneous allocation of credit, which benefits less productive firms. Our dynamic results document a persistent effect on credit supply, which is consistent with a financial repression channel and the dynamics of banks' government bond holdings documented in Figure 1 (Williams, 2018; Kose et al., 2022). Taken together, these results provide evidence on the validity our identification strategy and shed some light on the dynamics effects of the inclusion on banks' behavior in terms of sovereign bond holdings and credit provision.

5.2 Alternative Measure of Bank Exposure

We consider an alternative measure of banking exposure to sovereign bonds, and adopt this alternative definition in the specification described in Equation 2. Banks which are more exposed to government bonds are now defined as those laying in the third tercile of the distribution of government bonds with respect to total assets. Using this alternative definition, which is closer to Williams (2018), we obtain results very similar to those described in Section 4.1.

More specifically, Tables 8 and 9 present the results we obtain when using this alternative measure of exposure. As can be seen they are very similar to the baseline results of Tables 1 and 3. In column 4 of Table 8, more exposed banks experience an increase in credit supply of

14.2% after the shock, when compared to less exposed ones. Table 9 shows that the effects on less capitalized banks drive the results, as in our baseline specifications.

5.3 More on Bank Heterogeneity

In Williams (2018), the author uses the fact that some banks are primary dealers of government bonds (i.e., market markers) as the measure of exposure to government bonds during the Colombian inclusion to analyze the effects of such events on credit supply. In this section, we control for unobserved heterogeneity for primary dealers and analyze the heterogeneous effects for market and non-market makers depending on their level of capitalization as in Table 3.

Our results in Column (1) in Table 10 replicate previous results in Table 3 with controls for unobserved heterogeneity by primary dealers. This specification has more strict controls than our baseline specification. However, it can potentially bias our results downwards if the effects from the index inclusion are stronger to market-maker banks, even among banks with the same level of government exposure. Although this possibility exists, our results are very similar to our baseline specification and indicate that the increase in credit supply is concentrated on low-capitalized banks.

In Column (2), we allow for the possibility of heterogeneous effects depending on the capitalization and the fact that the banks are market makers. This is in line with the previous results and indicate a significant increase in credit supply concentrated on low-capitalized banks. This is higher for non-primary dealers, although they are not statistically different from each other. Among high-capitalized banks, we show that there is no statistically significant change in credit supply for high-capitalized primary dealers. For non-market makers, high-capitalized banks, there is some evidence that banks decrease credit supply after the inclusion. However, these effects are not very economically significant since high-capitalized non-market maker banks represented only 11,43% of loan market share at the time of the inclusion.

Our results in this section provide evidence that the results from our baseline specification are not driven only by government bonds' primary dealers. Our results also confirm that low-capitalized banks, including non-market maker banks, drive the credit supply increase.

5.4 More on Firm Heterogeneity

We analyze if firm heterogeneity may play a role in our setting, by mediating the effects of the shock on credit supply. Although our empirical strategy can deal with demand heterogeneity, it could still be the case the credit supply is allocated to sectors directly benefiting from the inclusion. Hence, we augment the specification of Equation 7 by adding two interaction terms between our measure of banking exposure and an indicator variable for government-related or tradable sector, respectively, to control for possible differential effects for those sectors during inclusion events (Broner et al., 2021). In this way, we check if sectoral heterogeneity may explain the heterogeneous effects found in the baseline specification.

The results shown in Table 11 confirm that the heterogeneity in the firms' productivity and amount of collateral both play an essential role in explaining credit supply allocation, in line with our baseline specification. The point estimates are also very similar. Most importantly, we find no evidence of a significant differential effect for firms operating in the tradable industries or for government-related firms. In conclusion, we confirm that the heterogeneity among firms belonging to the same sector is an important factor to explain credit allocation, while the heterogeneity across sectors is irrelevant.

6 Conclusion

We exploit a natural experiment affecting the foreign investors' demand for the local currency sovereign debt market, in South Africa, to estimate the effect of sovereign debt inflows on firms' access to bank credit. We show that the shock, which originated in the government debt market, spillovers to the credit market through banks, which have an important role in the allocation of credit supply. Specifically, we find that less capitalized banks, which are simultaneously more exposed to sovereign bonds before the inclusion into the WGBI index, increase their credit supply. In turn, this increase in credit supply is allocated to firms with higher collateral and lower productivity. As credit is allocated to those firms, it does not significantly affect firms' productivity or other real outcomes.

Although there is a general consensus that prudential regulation improves financial stability by reducing non-performing loans and minimizing risk in the banking system (Dell'Ariccia et al. (2012); Demirgüç-Kunt and Huizinga (2010); Laeven and Levine (2009)), our paper adds to such discussion by providing evidence on how banking capitalization may undermine the ability of a country to reap the benefits of capital inflow shocks. While this paper examines the effects of sovereign debt inflows focusing on the banking channel, future research might then want to investigate the direct effect of the increase in resources of the South African government on government-related firms.

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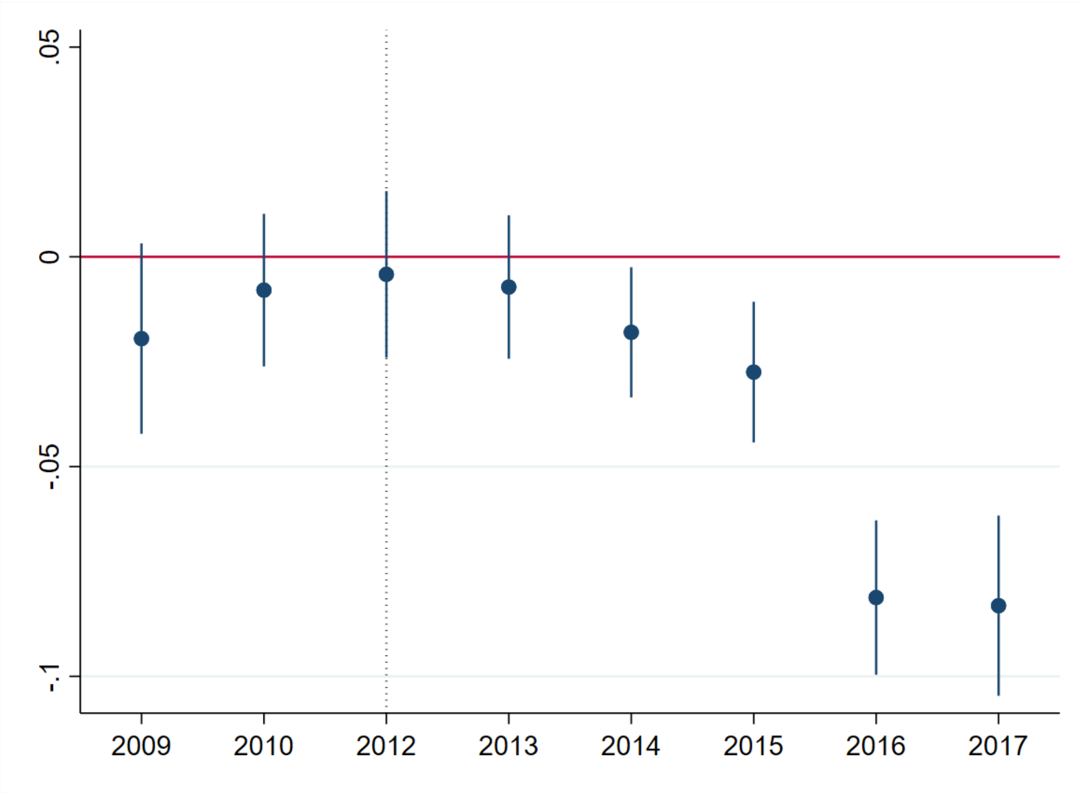
Figures and Tables

Figure 1: Bank Aggregate Dynamic Effects - Government Bond Holdings



Notes: i) Reported 95% confidence intervals are based on robust Standard errors. ii) Specification based on a Poisson pseudo-likelihood regression due to a high number of observations with zero government bond holdings. iii) Controls include bank and date FEs. Specification:

$$y_{b,t} = \sum_{i=2009}^{2018} \delta_{1,t} I(t = i) \times Exposure_b + \alpha_b + \alpha_t + \epsilon_{i,t}$$

Figure 2: South African Government Bond Holdings

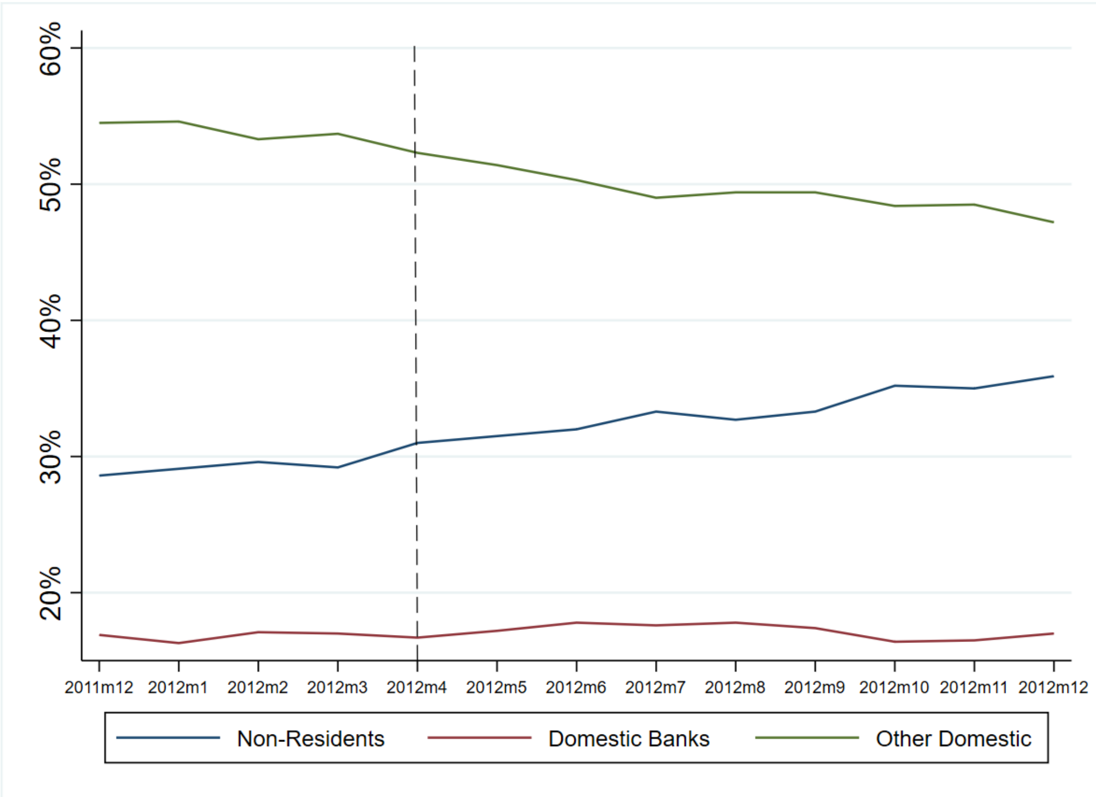
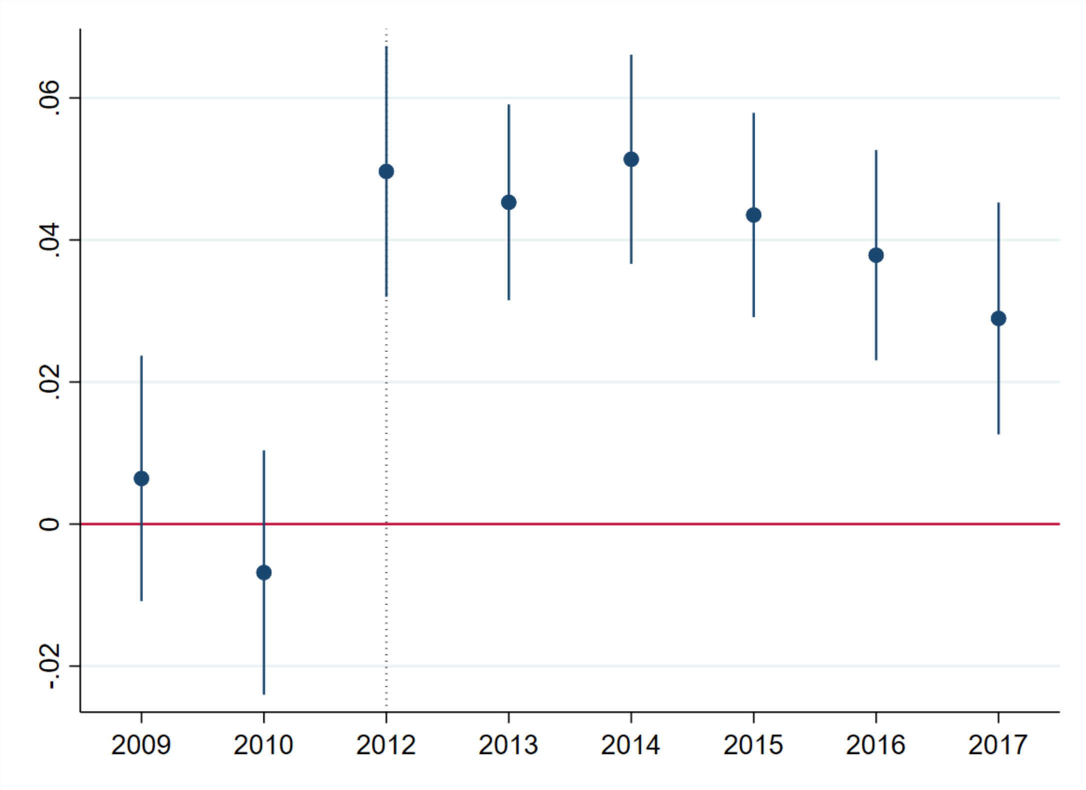
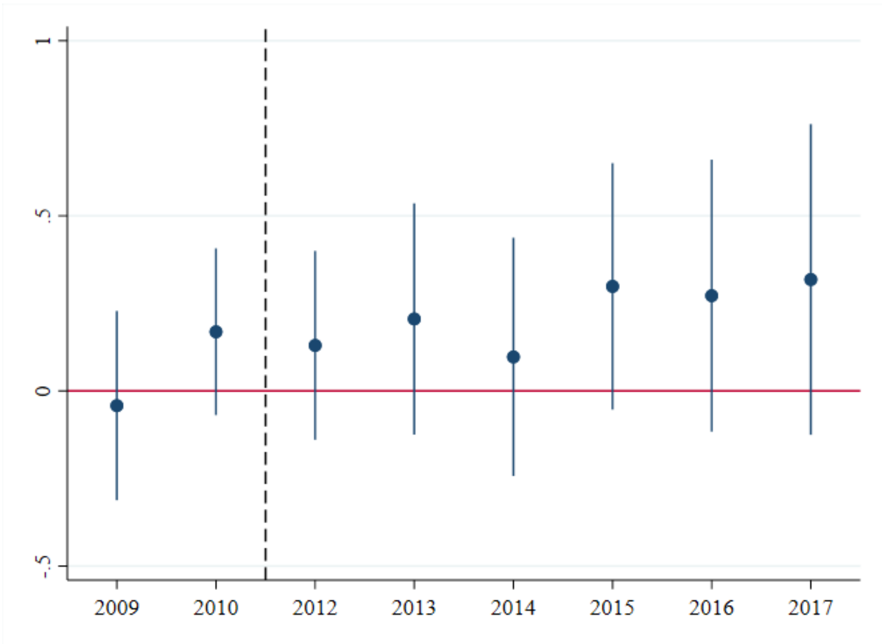


Figure 3: Bank Aggregate Dynamic Effects - Credit Supply



Notes: i) Reported 95% confidence intervals are based on robust Standard errors. ii) Controls include bank and date FEs. Specification: $y_{b,t} = \sum_{i=2009}^{2018} \delta_{1,t} I(t=i) \times Exposure_b + \alpha_b + \alpha_t + \epsilon_{i,t}$

Figure 4: Firms Dynamic Effects



(a) Firms Loans - High MRPK

(b) Firms Loans - Low MRPK

Notes: i) Standard errors clustered at the firm level in parenthesis. ii) Controls include firm and Province X Sector X Size X MRPK X Time cluster FEs. iii) MRPK and Size bins are the deciles of the firm MRPk and total Assets in 2011. Specification: $y_{b,t} = \sum_{i=2009}^{2018} \delta_{1,t} I(t=i) \times Exposure_b + \alpha_b + \alpha_t + \epsilon_{i,t}$

Table 1: WGBI Inclusion and Bank Credit

	Total Loans				Loans - Private Sector				Loans - Private Non-Financial			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Exposure × Post	0.044***	-0.005	0.015***	0.021***	0.053***	0.000	0.022***	0.027***	0.135***	0.039***	0.036***	0.027***
	(0.010)	(0.003)	(0.004)	(0.004)	(0.011)	(0.003)	(0.004)	(0.004)	(0.028)	(0.003)	(0.004)	(0.005)
Observations	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049	3049
R Squared	0.889	0.952	0.958	0.966	0.885	0.950	0.955	0.965	0.876	0.989	0.989	0.991
Bank FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Date FE	✓	✓			✓	✓			✓	✓		
Size X Date			✓	✓			✓	✓			✓	✓
Foreign Bank X Date			✓	✓			✓	✓			✓	✓
Capital Ratio X Date				✓				✓				✓
Weigthing		✓	✓	✓		✓	✓	✓		✓	✓	✓

Notes i) Robust standard errors in parenthesis. ii) Banks' size are represented by quartiles of total assets and capital ratios by quartiles of the original variable iii) Regression weighted by the total loans market share in 2011. iv) * p<0.10, * p<0.05, ** p<0.01.

Table 2: WGBI Inclusion and Bank Credit Excluding Non-Financial Private Credit

	Total Loans Exc. Non-Financial			Private Sector Exc. Non-Financial		
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure × Post	-0.010	-0.005	-0.023**	-0.007	-0.007	-0.030***
	(0.007)	(0.008)	(0.009)	(0.008)	(0.008)	(0.010)
Observations	3049	3049	3049	3049	3049	3049
R Squared	0.867	0.903	0.914	0.856	0.894	0.904
Bank FE	✓	✓	✓	✓	✓	✓
Date FE	✓			✓		
Size X Date		✓	✓		✓	✓
Foreign Bank X Date		✓	✓		✓	✓
Capital Ratio X Date			✓			✓

Notes i) Robust standard errors in parenthesis. ii) Banks' size are represented by quartiles of total assets and capital ratios by quartiles of the original variable iii) Regression weighted by the total loans market share in 2011. iv) * p<0.10, * p<0.05, ** p<0.01.

Table 3: WGBI Inclusion, Bank Capital Ratio Heterogeneity and Credit

	Loans - Private Non-Financial	
	(1)	(2)
Exposure × Post × Low Capital Ratio	0.296***	0.038***
	(0.050)	(0.003)
Exposure × Post × High Capital Ratio	0.062*	-0.002
	(0.037)	(0.014)
Observations	3049	3049
R Squared	0.902	0.991
Bank FE	✓	✓
Size X Date	✓	✓
Foreign Bank X Date	✓	✓
Capital Ratio X Date	✓	✓
Weighting		✓

Notes i) Robust standard errors in parenthesis. ii) Banks' size are represented by quartiles of total assets and capital ratios by quartiles of the original variable iii) Regression weighted by the total loans market share in 2011. iv) * p<0.10, * p<0.05, ** p<0.01.

Table 4: Firms' Summary Statistics

	All	Low Exposure	High Exposure	p-value
Bank Loans	19,642,352.26	31,670,032.20	5,244,749.73	0.32
Value Added	8,334,265.29	7,790,347.41	8,985,356.24	0.40
Sales	32,204,606.35	34,197,071.14	29,819,548.20	0.45
Input Cost	23,870,341.08	26,406,723.73	20,834,192.01	0.29
Labor Cost	3,104,110.11	3,015,256.26	3,210,471.64	0.52
N	38,881	21,184	17,697	

Note: All values represented in 2011 South African Rands.

Table 5: WGBI Inclusion and Firms' Bank Loans

	Loans				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	0.089**	0.132**	0.145***	0.158***	0.224***
	(0.043)	(0.054)	(0.056)	(0.059)	(0.070)
Firm FE	✓	✓	✓	✓	✓
Time FE	✓				
Province X Time FE		✓			
Province X Sector X Time FE			✓		
Province X Sector X Size X Time FE				✓	
Province X Sector X Size X MRPK X Time FE					✓
Observations	302386	302386	302118	271709	238215
R^2	0.564	0.564	0.570	0.596	0.662

Notes i) Standard errors clustered at the firm level in parenthesis. ii) MRPK and Size bins are the deciles of the firm MRPk and total Assets in 2011. iii) * p<0.10, * p<0.05, ** p<0.01.

Table 6: WGBI Inclusion and Firms' Bank Loans Heterogeneity

	Loans	
	(1)	(2)
Exposure × Post × Low MRPK	0.270***	
	(0.084)	
Exposure × Post × High MRPK	0.163	
	(0.118)	
Exposure × Post × Low MRPK × Low Collateral		0.262
		(0.185)
Exposure × Post × Low MRPK × High Collateral		0.272***
		(0.092)
Exposure × Post × High MRPK × Low Collateral		0.178
		(0.137)
Exposure × Post × High MRPK × High Collateral		0.109
		(0.203)
Firm FE	✓	✓
Province X Sector X Size X MRPK X Time FE	✓	✓
Observations	238221	238221
R^2	0.613	0.662

Notes i) Standard errors clustered at the firm level in parenthesis. ii) MRPK and Size bins are the deciles of the firm MRPk and total Assets in 2011. iii) Low MRPK represents firms below the median in MRPK at the sectoral level and low collateral firms are firms below the median in terms of fixed assets at the sectoral level iv) * p<0.10, * p<0.05, ** p<0.01.

Table 7: WGBI Inclusion and Firms Real Outcomes

	TFP	Value Added	Sales	Input Costs	Labor Costs	Capital
Exposure × Post ×Low MRPK × Low Collateral	0.030	-0.014	-0.067	-0.024	-0.058	-0.046
	(0.031)	(0.045)	(0.046)	(0.083)	(0.051)	(0.084)
Exposure × Post ×Low MRPK × High Collateral	0.032*	0.024	-0.004	-0.014	-0.010	-0.029
	(0.017)	(0.026)	(0.025)	(0.064)	(0.028)	(0.034)
Exposure × Post ×High MRPK × Low Collateral	0.002	-0.014	-0.008	-0.087*	-0.019	0.031
	(0.019)	(0.029)	(0.030)	(0.049)	(0.031)	(0.081)
Exposure × Post ×High MRPK × High Collateral	0.017	0.005	0.034	0.040	-0.012	-0.001
	(0.028)	(0.040)	(0.041)	(0.085)	(0.042)	(0.073)
Firm FE	✓	✓	✓	✓	✓	✓
Province X Sector X Size X MRPK X Time FE	✓	✓	✓	✓	✓	✓
Observations	238221	238221	238221	238221	238221	238221

Notes i) Standard errors clustered at the firm level in parenthesis. ii) MRPK and Size bins are the deciles of the firm MRPk and total Assets in 2011. iii) * p<0.10, * p<0.05, ** p<0.01.

A Robustness Checks

Table 8: WGBI Inclusion and Bank Credit Excluding Non-Financial Private Credit

	Loans - Private Non-Financial			
	(1)	(2)	(3)	(4)
High Exposure × Post	0.703***	0.212***	0.192***	0.142***
	(0.232)	(0.016)	(0.020)	(0.021)
Observations	3049	3049	3049	3049
R Squared	0.875	0.989	0.989	0.991
Bank FE	✓	✓	✓	✓
Date FE	✓	✓		
Size Bins X Date			✓	✓
Foreign Bank X Date			✓	✓
Capital Ratio X Date				✓
Weigthing		✓	✓	✓

Notes i) Robust standard errors in parenthesis. ii) Banks' size are represented by quartiles of total assets and capital ratios by quartiles of the original variable iii) Regression weighted by the total loans market share in 2011. iv) * p<0.10, * p<0.05, ** p<0.01.

Table 9: WGBI Inclusion, Bank Capital Ratio Heterogeneity and Credit

	Loans - Private Non-Financial	
	(1)	(2)
High Exposure × Post × Low Capital Ratio	2.206***	0.160***
	(0.524)	(0.016)
High Exposure × Post × High Capital Ratio	0.072	-0.203
	(0.589)	(0.275)
Observations	3049	3049
R Squared	0.903	0.991
Bank FE	✓	✓
Size Bins X Date	✓	✓
Foreign Bank X Date	✓	✓
Capital Ratio X Date	✓	✓
Weighting		✓

Notes i) Robust standard errors in parenthesis. ii) Banks' size are represented by quartiles of total assets and capital ratios by quartiles of the original variable iii) Regression weighted by the total loans market share in 2011. iv) * p<0.10, * p<0.05, ** p<0.01.

Table 10: WGBI Inclusion and Bank Credit - Market Makers' Controls

	Loans - Private Non-Financial	
	(1)	(2)
Post × Exposure × Low Capital Ratio	0.311***	
	(0.053)	
Post × Exposure × High Capital Ratio	-0.045	
	(0.034)	
Post × Exposure × Low Capital Ratio × Non-Prim. Dealers		0.982***
		(0.136)
Post × Exposure × Low Capital Ratio × Prim. Dealers		0.195***
		(0.045)
Post × Exposure × High Capital Ratio × Non-Prim. Dealers		-0.755***
		(0.074)
Post × Exposure × High Capital Ratio × Prim. Dealers		-0.024
		(0.029)
Observations	3049	3049
R Squared	0.921	0.931
Bank FE	✓	✓
Bank Characteristics X Date FE	✓	✓
Prim. Dealers X Date FE	✓	✓

Notes i) Robust standard errors in parenthesis. ii) Banks' size are represented by quartiles of total assets and capital ratios by quartiles of the original variable iii) * p<0.10, * p<0.05, ** p<0.01.

Table 11: WGBI Inclusion and Credit Supply Allocation - More on Firms' Heterogenity

	Loans		
Post × Exposure× Low MRPK × Low Collateral	0.302	0.344*	0.373*
	(0.185)	(0.194)	(0.194)
Post × Exposure× Low MRPK × High Collateral	0.313***	0.258***	0.289***
	(0.094)	(0.096)	(0.097)
Post × Exposure× High MRPK × Low Collateral	0.229*	0.235	0.273*
	(0.139)	(0.146)	(0.147)
Post × Exposure× High MRPK × High Collateral	0.159	0.083	0.122
	(0.205)	(0.207)	(0.207)
Post × Exposure× Tradable Sector	-0.374*		-0.307
	(0.218)		(0.222)
Post × Exposure× Gov. Related		-0.207	-0.189
		(0.150)	(0.151)
Firm FE	✓	✓	✓
Province X Sector X Size X MRPK X Time FE	✓	✓	✓
Sample	238215	224254	224254
N	0.662	0.668	0.668

Notes i) Standard errors clustered at the firm level in parenthesis. ii) MRPK and Size bins are the deciles of the firm MRPk and total Assets in 2011. iii) Low MRPK represents firms below the median in MRPK at the sectoral level and low collateral firms are firms below the median in terms of fixed assets at the sectoral level iv) * p<0.10, * p<0.05, ** p<0.01.

B Measuring MRPK

Using a similar approach as in Hsieh and Klenow (2009), I assume firms may face some idiosyncratic frictions that generate some capital wedges, $(1+\tau_{is}^{K})$, due possible policies that affect the firm marginal product. The profit of firm i in the sector s is given by:

$$\begin{gathered} max_{Y_i,L_i,K_i} \tfrac{\sigma-1}{\sigma}(Y_i)^{\frac{\sigma-1}{\sigma}} - wL_i - (1+\tau_{Ksi})RK_i \\ st: Y_i = A_i K_i^{\alpha_{K,s}} L_i^{\alpha_{L,s}} \end{gathered} \tag{8}$$

To calculate empirical measure of MRPK used in this paper and described in Section 2.2, I need to calculate the intensity of the factors specific to each sector. I use the Ackerberg et al. (2015) method to estimate my production functions assuming a Cobb-Douglas production function:

$$Y_{ist} = A_{ist} K_{ist}^{\alpha_{Ks}} L_{ist}^{\alpha_{Ls}} \tag{9}$$

assuming the intensity of factors of production is constant by sector. The estimation of sectoral elasticities to the sectoral 2 digits information were obtained from the estimate proposed in Ackerberg et al. (2015) through the firm's added value taking into account the critiques of Gandhi et al. (2020). The control function approach assumes that observed value added includes additive measurement error $\epsilon_{i,t}$. Therefore, given log productivity ω_{it}, measured log value added y_{it}:

$$y_{ist} = \beta_0 + \alpha_{Ks} k_{ist} + \alpha_{Ls} l_{ist} + \omega_{iSt} + \varepsilon_{ist} \tag{10}$$

this method relies on several assumptions.[18] Using the firms maximization problem, the first order condition imply:

$$MRPK_i = R(1+\tau_{Ki}) = \alpha_{K,s} \times \frac{\sigma-1}{\sigma} \times \frac{P_i Y_i}{K_i}. \tag{11}$$

we assume that σ is equal to 3 and R is equal to 10% which is similar to Hsieh and Klenow (2009) and other papers in the literature. Using information on firms' value-added, firms´ capital and the sectoral production function parameters, we estimate firms' marginal return of capital.

[18]For more details, see Ackerberg et al. (2015).