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WP/24/14

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Authorised for publication by Konstantin Makrelov

14 October 2024

South African Reserve Bank

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Basel III regulations and financing decisions of non-financial firms: the South African evidence

Tesfaye T Lemma,* Michael Machokoto† and Tendai Gwatidzo‡

Abstract

This study examines the impact of the Basel III regulatory framework on financing decisions within South Africa's real sector. Using a sample of 2 045 firm-year observations spanning the years 2011–2015 and employing the difference-in-differences approach, we find a significant decrease in debt financing and debt maturity for firms deemed "constrained" relative to "unconstrained" firms in the post-Basel III implementation period. Further analyses suggest that the Basel III regulatory framework has a persistent effect on financing decisions in the real sector. Our findings indicate that the Basel III regulatory framework reduces leverage and debt maturity, especially for constrained firms.

JEL classification

G28, G32, F23

Keywords

Basel III regulations; real effects; constrained firms; corporate financing decisions; debt maturity structure

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1. Introduction

Bank capital regulation continues to receive significant attention in academic, policymaking and regulatory circles, particularly following the 2007–2008 global financial crisis (Avezum, Huizinga and Raes 2022; Hyun and Rhee 2011). Capital-based regulations are widely regarded as the most effective means of mitigating moral hazards in the banking system, and their implementation is aimed at ensuring the stability and soundness of financial institutions (Behn, Haselmann and Wachtel 2016; Deli and Hasan 2017). Despite the requirements of Basel II for banks to hold risk-sensitive capital, the available evidence indicates the inadequacy and countercyclicality of capital requirements under this framework and the impact this has had on bank lending practices and access to finance for firms (Avezum, Huizinga and Raes 2022; Behn, Haselmann and Wachtel 2016; De Jonghe, Dewachter and Ongena 2020; Fraisse, Lé and Thesmar 2020; Gopalakrishnan, Jacob and Mohapatra 2021; Mishkin and Eakins 2015).

In response to the limitations of the Basel II capital requirements, Basel III standards have implemented not only strengthened capital requirements but also time-varying, procyclical bank capital requirements expected to generate countercyclical capital buffers (Basel Committee on Banking Supervision 2009; De Jonghe, Dewachter and Ongena 2020). These measures are intended to dampen procyclical trends in credit supply. However, no previous study has explored the impact of the procyclical capital requirements under Basel III on financing decisions in the real sector. This is significant, as the purpose of the Basel III regulatory framework was to reduce excessive procyclicality in credit supply, which is believed to have positive firm-level real effects (Drumond 2009; Jiménez et al. 2017). This study addresses this research gap by examining the impact of Basel III capital requirements on the financing decisions of non-financial firms in the South African context.

The existing literature presents conflicting views on the association between the more stringent capital requirements established under the Basel III framework and the financing strategy of real sector non-financial firms. Deli and Hasan (2017) and Hyun and Rhee (2011) suggest that the higher and more stringent capital requirements under Basel III may lead banks to reduce their risk-weighted assets, which could

reduce loans to meet the capital requirements. Conversely, Avezum, Huizinga and Raes (2022) maintain that higher and more stringent capital requirements (such as those imposed under Basel III) may prompt banks to resort to equity financing, which is more costly than debt financing (see also De Jonghe, Dewachter and Ongena 2020). As a result, banks may pass the additional costs of equity financing to borrowers in the form of higher interest rates, which could discourage the demand for borrowing. However, the more stringent and higher requirements under Basel III may enhance banks' loss-absorbing capacity and dampen the procyclicality of credit supply, leading to increased bank lending (Deli and Hasan 2017; Hellwig and Admati 2014; Jiménez et al. 2017). Furthermore, although banks may pass the rise in funding costs due to Basel III requirements down to borrowers, the latter may still demand bank loans due to the increased value of the tax shield offered by debt financing as interest expenses increase (Avezum, Huizinga and Raes 2022; De Jonghe, Dewachter and Ongena 2020). Thus, the impact of the implementation of the Basel III accord on the financing decisions of non-financial firms remains an open empirical question.

Two important factors inform our decision to focus on South Africa. First, existing studies suggest that the credit supply effect of bank capital regulation is conditioned by prevailing bank capitalisation before the implementation of regulatory regimes (Chiuri, Ferri and Majnoni 2002; Fang et al. 2022). In this regard, the South African banking sector was deemed adequately capitalised even before the implementation of Basel III regulations in 2013 (Maredza 2016), indicating that the procyclical capital requirements espoused under Basel III may have less pronounced financial and real sector effects in the South African environment. Second, the available evidence shows that low economic growth environments reinforce the inverse association between capital regulations and credit supply (Fang et al. 2022). The South African economy has experienced low growth rates in the decade since the implementation of the Basel III framework (Tapscott 2017), suggesting that the lacklustre performance of the South African economy might accentuate the real sector effect of bank capital regulation. While the fact that South African banks were well capitalised even before the introduction of Basel III regulations may have enhanced the financial system's ability to absorb losses in periods of stress, South Africa's declining economic growth may have muted the positive impact of Basel III regulations.

We analyse data drawn from 432 non-financial firms (2 045 firm-year observations) listed on the Johannesburg Stock Exchange covering the period from 2011 to 2015. Using a difference-in-differences (DiD) methodology, we evaluate the differential impact of Basel III regulations on the financing decisions of financially “constrained” (treated) and “unconstrained” (untreated) firms. Our initial findings indicate that the overall impact of Basel III regulations on financing decisions was insignificant. However, our DiD analysis reveals significant cross-sectional variations in the impact of Basel III regulations. Specifically, we observe a significant reduction in debt financing among constrained firms relative to their unconstrained peers following the implementation of Basel III. This finding is consistent with those in De Jonghe, Dewachter and Ongena (2020) and Gopalakrishnan, Jacob and Mohapatra (2021), which suggest that reduced credit supply associated with bank capital regulations affects riskier firms. Our results are consistent when alternative variable definitions, categorisations of firms and event window periods are employed, and they pass several falsification tests.

In our subsequent analyses, we delved into the impact of Basel III regulations on the debt maturity structure of non-financial firms. Our results suggest that the implementation of Basel III regulations had no statistically significant effect on the debt maturity structure of these firms. However, our DiD analysis revealed a noteworthy cross-sectional heterogeneity post-Basel III. Specifically, constrained firms tend to reduce their debt maturity by approximately 2.42% to 7.98%, on average, during the post-Basel III implementation period relative to their unconstrained counterparts. Notably, our results remain consistent across different categorisations of firms into constrained and unconstrained subgroups and alternative event window periods, as well as falsification tests, indicating the robustness of our findings. Based on these findings, we conclude that the implementation of Basel III regulations significantly affected the debt maturity structure of constrained non-financial firms.

Our finding that firms facing financial constraints reduce their use of debt financing relative to financially unconstrained firms indicates that banks may have avoided constrained firms to minimise risky assets in their endeavour to comply with the Basel

III framework's capital requirements. Conversely, firms may have avoided borrowing due to higher costs being passed down by banks using relatively costlier equity financing to meet stringent Basel III capital requirements. The reduction in the use of debt financing by constrained firms may have led to decreased corporate default risk and, by extension, systemic risk. However, it may also have limited constrained firms' access to credit and, as a result, their ability to pursue capital investment opportunities.

The observed decrease in the debt maturity structure of constrained firms relative to their unconstrained counterparts in the post-Basel III period suggests that banks may have slowed the provision of long-term financing, particularly to financially constrained firms. The decrease in the use of long-term debt financing by financially constrained firms may have helped banks maintain the level of liquidity required to fulfil their obligations during times of stress. However, it may also have exposed constrained firms to increased risks of loan refinancing and interest rate volatility.

This study makes two significant contributions to the literature on the impact of regulatory changes on the banking sector. Firstly, prior research has examined the influence of risk-sensitive capital requirements, such as those outlined in Basel II, on financing decisions in non-financial firms (Gopalakrishnan, Jacob and Mohapatra 2021). However, this study extends this literature by investigating whether and how the more stringent capital requirements under Basel III inform financial strategy formulation in the real sector. It thus adds to the broader discourse on the effects of regulatory changes on the banking sector and their impact on the real economy. Secondly, while the established literature recognises that corporate financing decisions are influenced by numerous non-regulatory factors, such as firm-, industry- and country-level characteristics (Barclay and Smith Jr 1999; Flannery 1986; Frank and Goyal 2009; Jensen 1986; Marsh 1982; Myers and Majluf 1984; Rajan and Zingales 1995; Titman and Wessels 1988), this is the first study to examine the role of time-varying, procyclical and more stringent capital requirements under Basel III regulations in informing the financing decisions of non-financial firms. As such, it provides novel insights into the corporate finance literature by introducing a new determinant of a firm's financing policy.

The remainder of this paper is organised as follows. Section 2 discusses the background literature and develops our hypotheses. Section 3 outlines the empirical framework of the study. Section 4 presents the findings and discussion, and section 5 concludes.

2. Background literature and hypotheses

Bank capital regulation continues to garner significant attention across academic, policy and regulatory circles, particularly following the 2008 financial crisis (Avezum, Huizinga and Raes 2022; Hyun and Rhee 2011). Capital-based regulations are widely regarded as the most effective means to mitigate moral hazards in the banking system. The implementation of such regulations aims to ensure the stability and soundness of financial institutions (Behn, Haselmann and Wachtel 2016; Deli and Hasan 2017). Prior research has established a link between bank capital regulation and the stability of the financial sector (Agenor, Alper and Da Silva 2018; Hakenes and Schnabel 2011), credit supply (Aiyar, Calomiris and Wieladek 2014; Chiuri, Ferri and Mainoni 2002; De Jonghe, Dewachter and Ongena 2020), risk-taking behaviour in the banking sector (Furlong and Keeley 1989; Zheng et al. 2017) and bank competition and consolidation (Uhde and Heimeshoff 2009). Although bank capital regulation has implications for non-financial firms' decisions, studies examining the relationship between bank capital regulation and non-financial firms' financial strategies are scarce. A few studies have used the Basel II framework to explore the interaction between banking sector regulation and non-financial firms' decisions (e.g. Gopalakrishnan, Jacob and Mohapatra 2021). This study aims to fill the gap in the literature by investigating the impact of Basel III bank capital requirements on corporate financing decisions in the South African context.

The Basel II framework, which requires banks to maintain a minimum capital ratio based on asset quality rather than asset type, increases the sensitivity of required capital to credit risk. As a result, capital requirements under Basel II were countercyclical and negatively affected banks' lending capacity, particularly for those unable to promptly raise sufficient new capital (Behn, Haselmann and Wachtel 2016; Repullo and Suarez 2013). This is consistent with the evidence, which shows that the implementation of Basel II regulations led to changes in the financing decisions of firms

in the real sector. For example, Gopalakrishnan, Jacob and Mohapatra (2021) found that the corporate sector responded to these regulations by increasing reliance on accounts payables, reducing dividend payouts and lowering capital investments. Similarly, Fraisse, Lé and Thesmar (2020) found that increases in capital requirements under Basel II are associated with decreases in bank lending. These findings suggest that the countercyclical capital requirements of the Basel II framework would dampen the availability of bank credit to the corporate sector.

To address the adverse effects of Basel II countercyclical capital requirements on bank lending, global regulators introduced the Basel III accord, which reinforced the quality and quantity of capital requirements under Basel II and mandated countercyclical buffers to be built in good times for use during rainy seasons (De Marco, Kneer and Wieladek 2021; Repullo and Suarez 2013). Research has shown that capital requirements under the Basel III framework are more procyclical than the risk-weighted regulatory capital ratio (Brei and Gambacorta 2016). In South Africa, Liu and Molise (2018) document evidence that the procyclical capital requirements under Basel III effectively mitigate the countercyclicality of capital requirements under Basel II. The authors submit that Basel III improves the quality and quantity of bank capital, which enhances banks' capacity to absorb losses during periods of stress. However, the impact of the increased, time-varying and procyclical capital requirements under Basel III on the financing decisions of non-financial firms remains an empirical question.

The existing literature presents conflicting predictions regarding the interaction between the more stringent and higher capital requirements under Basel III and the financing decisions of non-financial firms. For example, both Deli and Hasan (2017) and Hyun and Rhee (2011) contend that a higher and more stringent capital requirement is likely to lead banks to reduce their risk-weighted assets, which could reduce loans to meet the capital requirement. Similarly, Avezum, Huizinga and Raes (2022) maintain that more stringent capital requirements (such as those under Basel III) could induce banks to use equity financing, which is more costly than debt financing (see also De Jonghe, Dewachter and Ongena 2020). As a result, banks may pass the incremental cost of raising equity capital on to borrowers in the form of higher interest rates, which may discourage firms from borrowing (Avezum, Huizinga and Raes 2022).

In line with this, a study based on German small and medium-sized enterprises showed a significant increase in the cost of debt after the introduction of Basel II regulations (Schindele and Szczesny 2016).

It is widely acknowledged that the more stringent and procyclical capital requirements under Basel III have the potential to enhance banks' loss-absorbing capacity and dampen the procyclicality of the credit supply, thereby improving bank lending (Deli and Hasan 2017; Hellwig and Admati 2014; Jiménez et al. 2017). Empirical evidence suggests that these requirements effectively stabilise banks' ability to provide credit, thereby reducing excessive credit fluctuations (Gersbach and Rochet 2017; Liu and Molise 2018; Yu and Ryu 2021). However, banks may also pass the increased funding costs under the Basel III regime down to borrowers. Despite this, borrowers may still prefer bank loans due to the tax shield offered by debt financing, which increases with interest expense (Avezum, Huizinga and Raes 2022; De Jonghe, Dewachter and Ongena 2020). Based on these conflicting predictions, our hypothesis (in the null form) is stated as follows:

Hypothesis: The implementation of Basel III is not associated with financing decisions in non-financial firms.

3. Methodology and data

3.1 Data source

The data regarding firm-level characteristics were sourced from the Thompson Reuters' DataStream database, which provides comprehensive information on all publicly listed firms in South Africa. This study explores financing decisions in the corporate sector in reaction to the 2013 implementation of Basel III regulations in South Africa. Following the methodology of Gopalakrishnan, Jacob and Mohapatra (2021), we considered a five-year event window, 2011–2015, in the primary analysis, which provided us with an initial sample of 13 601 firm-year observations. However, we eliminated 3 411 firm-year observations from the financial sector, as our study focuses on non-financial firms. We also excluded 2 144 firm-year observations from the utility industry due to the specific regulations that might impact their financing decisions (Lemma and Negash 2011). After removing 850 firm-year observations with abnormal

sales and asset growth, we filtered the sample by dropping firms with missing values for the variables included in the study. The final dataset used for the primary analyses comprises 2 045 firm-year observations.

3.2 Model specifications

Our study examines whether and how the Basel III regulations impacted the financing decisions of non-financial firms. Thus, we estimate the following model:

$$LEVER_{i,t} = \alpha_0 + \alpha_1 POST_t + \boldsymbol{\beta X_{it-1}} + \eta_i + \epsilon_{it} \quad (1)$$

where $LEVER_{i,t}$ is the dependent variable that captures the financing decisions of firm *i* in year *t*, proxied by total, long-term and short-term debt ratios. α_0 is a constant and α_1 is the coefficient of interest to be estimated and captures the changes in leverage between the pre- and post-Basel III periods. $\boldsymbol{\beta}$ is the vector of coefficients for control variables to be estimated. $POST_t$ is a dummy variable that equals 1 for the post-Basel III period (post-2013) and 0 otherwise. $\boldsymbol{X_{i,t-1}}$ is a vector of control variables identified in prior studies to have a relationship with corporate financing decisions (Barclay and Smith 1999; Flannery 1986; Frank and Goyal 2009; Jensen 1986; Lemma 2012; Marsh 1982; Myers 1984; Myers and Majluf 1984; Rajan and Zingales 1995; Titman and Wessels 1988). η_i is the firm fixed effects that control for unobserved factors that might influence the results.[1] $\epsilon_{i,t}$ is the error term. All variables used are defined in detail in Annexure A.

Prior research suggests that the effects of bank regulation-related exogenous shocks on firms' access to finance may be partially explained by firm-specific characteristics of borrowers (De Jonghe, Dewachter and Ongena 2020). Similarly, studies have found that banks are less likely to provide credit to poorly performing firms (Bertrand, Schoar and Thesmar 2007) and that interest rate deregulation can affect corporate financing decisions differently for constrained and unconstrained firms (Berger et al. 2020). Building on these observations, we investigate whether there is a disparity in the

[1] Time fixed effects are not included, as the focus in this baseline regression is on the differences in leverage before and after the implementation of Basel III (pre-Basel III vs post-Basel III periods).

influence of Basel III regulations between constrained and unconstrained firms. We express the model for this analysis as follows:

$$LEVER_{it} = \alpha_0 + \alpha_1 POST_t * TREATED_i + \boldsymbol{\beta X_{it-1}} + \eta_i + \eta_t + \varepsilon_{it} \quad (2)$$

where $TREATED_i$ is a dummy variable that equals 1 if a firm is deemed financially "constrained" and 0 otherwise. α_1 is the coefficient of interest to be estimated, and in this case captures the leverage from the pre-Basel III to the post-Basel III period for the treated group (constrained firms) relative to the untreated group (unconstrained firms). η_i and η_t are firm and time fixed effects, respectively. $POST_t$ and $TREATED_i$ are not included on their own in the model, as they are subsumed by the firm and time fixed effects, respectively. Annexure A presents definitions of the variables.

The empirical literature offers several strategies for identifying financially constrained firms. In this study, we use five approaches to identify constrained firms. The first two approaches involve a firm's size, measured by the natural logarithm of either the firm's market capitalisation (Log(Mkt. Cap.)) or sales (Log(Sales)). The third approach uses the dividend ratio, defined as the ratio of a firm's dividend payments to its total assets, as proposed by Fazzari, Hubbard and Petersen (1987) and Kadapakkam, Kumar and Riddick (1998). The fourth approach employs the Whited and Wu Index (WW Index) to identify financially constrained firms (Whited and Wu 2006). Finally, the fifth approach relies on firm age (Log(Age)), computed as the natural logarithm of the years since a firm's establishment, to identify financially constrained firms (Hoberg and Maksimovic 2015). Annexure A presents definitions of the variables.

We classify a firm as financially constrained (treated) if it falls within the lower tercile of the distribution for firm size, dividend ratio or firm age, all based on pre-Basel III values. In addition, a firm is classified as financially constrained (treated) if it is in the upper tercile of the distribution of the WW Index, also using pre-Basel III values. The decision to use pre-Basel III data ensures that our classifications accurately reflect the financial environment before the significant regulatory changes introduced by Basel III, which could have altered firm behaviour and financial strategies. This approach allows us to establish a baseline of financial constraints that is not confounded by post-Basel

III adjustments. Additionally, we exclude firms in the middle terciles to concentrate on the more distinctly constrained and unconstrained firms, thereby reducing ambiguity and ensuring a sharper distinction between the treated and control groups. This methodological choice aligns with the literature (Almeida and Campello 2001, 2007; Machokoto 2021) and enhances the clarity and precision of our analysis, allowing for more robust comparisons and insights.

4. Results and discussion

4.1 Preliminary results

Table 1 provides a summary of the descriptive statistics for the full sample (Panel A), the pre-Basel III subsample (Panel B) and the post-Basel III sample (Panel C). The table also includes results of t-tests for differences in mean values of key variables between the pre-and post-Basel III periods (Panel D). The descriptive statistics show that approximately 18.6% of assets in the real sector were financed by interest-bearing debt, with 61.9% being long term and 38.1% being short term. These debt ratios are higher than those reported for emerging markets by Machokoto et al. (2021) but slightly lower than the global average documented in similar studies (Huang, Lu and Faff 2021; Öztekin 2022).

Table 1: Descriptive statistics

No.	Variable name	Panel A: Full sample			Panel B: Pre-Basel III subsample			Panel C: Post-Basel III subsample			Panel D: Test of difference
		No. Obs.	Mean	Std. Dev	No. Obs.	Mean	Std. Dev	No. Obs.	Mean	Std. Dev	Differences
1	Total leverage	2 045	0.1863	0.1478	847	0.1757	0.1522	1 198	0.1939	0.1442	0.0182***
2	Long-term leverage	2 045	0.1145	0.1218	847	0.1051	0.1213	1 198	0.1212	0.1217	0.0161***
3	Short-term leverage	2 045	0.0709	0.0755	847	0.0698	0.0755	1 198	0.0716	0.0755	0.0018
4	Debt maturity structure	2 045	0.2136	0.1853	847	0.1933	0.1771	1 198	0.2279	0.1896	0.0347***
5	Post-Basel III	2 045	0.5858	0.4927	847	0.0000	0.0000	1 198	1.0000	0.0000	1.0000***
6	Growth opportunities	2 045	1.6124	0.9428	847	1.5662	0.8071	1 198	1.6451	1.0270	0.0789*
7	Firm size (assets)	2 045	15.5416	1.8638	847	15.3703	1.8434	1 198	15.6627	1.8693	0.2924***
8	Asset tangibility	2 045	0.3547	0.2241	847	0.3513	0.2218	1 198	0.3571	0.2258	0.0058
9	Profitability	2 045	0.0952	0.0984	847	0.1006	0.0997	1 198	0.0914	0.0973	-0.0092**
10	Non-debt tax shield	2 045	0.0423	0.0268	847	0.0420	0.0257	1 198	0.0424	0.0275	0.0004
11	Research & development expenditure	2 045	0.0007	0.0021	847	0.0008	0.0023	1 198	0.0007	0.0019	-0.0001
12	WW Index	2 045	-0.7361	0.0945	847	-0.7294	0.0947	1 198	-0.7409	0.0942	-0.0115***
13	Firm age	2 045	2.8215	0.4947	847	2.7292	0.5316	1 198	2.8868	0.4559	0.1577***
14	Market capitalization	2 045	15.8877	2.0227	847	15.7062	2.0329	1 198	16.0161	2.0065	0.3099***
15	Dividend ratio	2 045	0.0334	0.0447	847	0.0328	0.0437	1 198	0.0338	0.0455	0.0010
16	Log (sales)	2 045	15.6011	1.7936	847	15.4378	1.7974	1 198	15.7165	1.7826	0.2787***

Note: The table provides descriptive statistics for all the variables included in the study: a) for the whole sample (Panel A); b) for the pre-Basel III subsample (Panel B); and c) for the post-Basel III subsample. Panel D presents results of tests of differences between means of variables for the pre-Basel III and post-Basel III subsamples. All the other variables are as defined in the annexure. Test statistics that are significantly different from zero at the 10%, 5%, and 1% level are marked with *, **, and ***, respectively.

The results presented in Table 1 (Panel D) indicate that the post-Basel III overall average and long-term debt ratios (19.4% and 12.1% respectively) are significantly higher than the pre-Basel III ratios (17.6% and 10.5% respectively). These findings are further supported by the positive and significant pairwise correlations between post-Basel III and total and long-term debt ratios (0.0607 and 0.0653 respectively) presented in Table 2. Overall, the results of the univariate analyses suggest that the more stringent, higher capital requirements under Basel III regulations would boost banks' loss-absorbing capacity and promote bank lending (Deli and Hasan 2017; Hellwig and Admati 2014; Jiménez et al. 2017). Additionally, the results are consistent with the contention that the potential increase in the cost of borrowing in the post-Basel III period would increase the value of the tax-shield benefit offered by debt financing to firms (Avezum, Huizinga and Raes 2022; De Jonghe, Dewachter and Ongena 2020). Caution is required, however, as the univariate analyses do not account for several factors that could drive the observed changes in financing decisions. We also find that the correlations between model variables are not too high to indicate apparent multicollinearity problems (Kutner et al. 2005). Consequently, we tested our hypotheses using multivariate regressions, controlling for several covariates associated with financing decisions identified in the literature.

Table 2: Correlation matrix

	Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
1	Total debt	1															
2	Long-term debt	0.8456***	1														
3	Short-term debt	0.5613***	0.0396*	1													
4	Long-term debt-to-total debt	0.7295***	0.9179***	-0.0512**	1												
5	Post-Basel III	0.0607***	0.0653***	0.0119	0.0922***	1											
6	Growth opportunities	-0.0960***	-0.0377*	-0.1198***	-0.0415*	0.0413*	1										
7	Firm size	0.1494***	0.2626***	-0.1249***	0.2930***	0.0773***	0.1514***	1									
8	Asset tangibility	0.2012***	0.3453***	-0.1545***	0.3723***	0.0128	-0.1290***	0.3462***	1								
9	Profitability	-0.0897***	-0.0307	-0.1124***	-0.0477**	-0.0463**	0.5925***	0.1020***	-0.0550**	1							
10	Non-debt tax shield	0.1244***	0.1974***	-0.0638***	0.1565***	0.0071	-0.0429*	0.1079***	0.4691***	0.0017	1						
11	R&D expenditure	-0.0198	-0.0486**	0.0439**	-0.0782***	-0.0329	-0.0084	0.0697***	-0.0428*	0.0466**	-0.0044	1					
12	WW index	-0.0799***	-0.1921***	0.1466***	-0.2281***	-0.0598***	-0.2561***	-0.9411***	-0.3000***	-0.2528***	-0.1043***	-0.0620***	1				
13	Market capitalisation	0.1240***	0.2427***	-0.1413***	0.2710***	0.0755***	0.3708***	0.9710***	0.2886***	0.2340***	0.0868***	0.0719***	-0.9427***	1			
14	Firm age	0.0121	0.0722***	-0.0844***	0.0490**	0.1570***	0.0584***	0.4476***	0.1803***	-0.0149	0.0773***	0.1249***	-0.4515***	0.4426***	1		
15	Dividend ratio	-0.1350***	-0.0860***	-0.1194***	-0.1121***	0.0108	0.7043***	0.0443**	-0.0504**	0.6620***	0.0350	-0.0007	-0.2245***	0.1982***	0.0065	1	
16	Log (Sales)	0.1062***	0.1754***	-0.0675***	0.1578***	0.0766***	0.2335***	0.9370***	0.1929***	0.1694***	0.1046***	0.0957***	-0.9062***	0.9329***	0.4440***	0.1261***	1

Note: The table presents the Pearson pairwise correlation coefficients and their corresponding significance levels for each variable considered in the study. Correlation coefficients that are significantly different from zero at 10%, 5% and 1% are marked with *, **, ***, respectively. All variables are as defined in the annexure.

4.2 Multivariate results

4.2.1 Implementation of Basel III and corporate financing

In this section, we examine the impact of the Basel III framework on the financing decisions of non-financial firms in South Africa. To achieve this, we estimate Equation (1), which relates the three proxies of financing decisions to the post-Basel III dummy and control variables. These results are summarised in Table 3. The models are well specified, with the F-statistics indicating significance at the 1% level. The adjusted R-square statistic suggests that our models have good explanatory power, with values up to 83.8% for total debt ratios, 82.1% for long-term debt ratios and 62% for short-term debt ratios. These statistics compare favourably with model estimates reported in Machokoto, Areneke and Ibrahim (2020), which explain only about 19.9% of the variation in debt ratios.

Table 3: OLS estimation results of regressing debt ratios on the post-Basel III variable and control variables

Dependent variables	Panel A: Total leverage ratio			Panel B: Long-term leverage ratio			Panel C: Short-term leverage ratio		
Independent variables	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
$POST_t$	0.0182***	0.0149***	0.0047	0.0161***	0.0115***	0.0041	0.0018	0.0032	0.0011
	(0.0044)	(0.0045)	(0.0051)	(0.0034)	(0.0035)	(0.0042)	(0.0030)	(0.0030)	(0.0039)
$F\_GROW_{i,t-1}$		-0.0104	-0.0166***		-0.0027	-0.0177***		-0.0077**	0.0014
		(0.0072)	(0.0049)		(0.0057)	(0.0041)		(0.0030)	(0.0029)
$F\_SIZE_{i,t-1}$		0.0090**	0.0652***		0.0114***	0.0541***		-0.0023	0.0081
		(0.0038)	(0.0124)		(0.0029)	(0.0117)		(0.0017)	(0.0096)
$A\_TANG_{i,t-1}$		0.0829**	0.0818*		0.1363***	0.1107***		-0.0518***	-0.0315
		(0.0395)	(0.0489)		(0.0314)	(0.0369)		(0.0153)	(0.0358)
$F\_PRFT_{i,t-1}$		-0.0782	-0.0849*		-0.0224	-0.0706**		-0.0456	0.0003
		(0.0771)	(0.0468)		(0.0595)	(0.0333)		(0.0319)	(0.0342)
$NDTS_{i,t-1}$		0.2759	-0.6046**		0.2711	-0.5703***		0.0296	0.0035
		(0.2813)	(0.2595)		(0.2089)	(0.1951)		(0.1227)	(0.1541)
$R\&D_{i,t-1}$		-1.3246	-1.4301		-2.7841*	-1.4529		1.5992	0.5440
		(1.8823)	(1.1242)		(1.6215)	(1.3057)		(1.1043)	(1.6084)
Constant	0.1757***	0.0221	-0.7968***	0.1051***	-0.1202***	-0.7080***	0.0698***	0.1374***	-0.0477
	(0.0072)	(0.0530)	(0.1911)	(0.0057)	(0.0405)	(0.1790)	(0.0034)	(0.0265)	(0.1471)
Firm fixed effects	No	No	Yes	No	No	Yes	No	No	Yes
Year fixed effects	No	No	No	No	No	No	No	No	No
No. of observations	2 045	2 045	2 045	2 045	2 045	2 045	2 045	2 045	2 045
Adj. R-squared	0.003	0.060	0.838	0.004	0.148	0.821	0.000	0.047	0.620

Note: This table presents model estimates based on ordinary least squares (OLS) regression. We report robust standard errors in parenthesis. *, **, and *** respectively denote estimates that are significantly different from zero at the 10%, 5% and 1% levels. The definitions of variables are presented in the annexure.

Firstly, we estimated an unconditional model to explore the relationship between the post-Basel III variable and corporate financing decisions. The results, presented in Table 3 (columns I, IV and VII), indicate a positive and statistically significant association between the post-Basel III variable and the total and long-term debt ratios at the 1% level. We subsequently controlled for firm-level attributes documented in prior studies to have a relationship with corporate financing decisions. These conditional models with control variables (columns II, V and VIII) show that the association between the post-Basel III variable and the total and long-term debt ratios remains positive and statistically significant at the 1% level. Next, we introduced firm fixed effects to account for unobservable heterogeneity across firms and potential time-invariant confounding factors. In this specification, the post-Basel III variable is no longer statistically significant (columns III, VI and IX). This suggests that unobserved time-invariant factors might impact the interaction between the Basel III framework implementation and financing decisions in the real sector. Incorporating firm fixed effects thus plays a critical role in our understanding of the corporate financing consequences of implementing Basel III.

4.2.2 Implementation of Basel III, constrained firms and financing decisions

Once the impact of the implementation of the Basel III framework on financing decisions in non-financial firms had been established, we used DiD analyses to investigate whether there is a disparity in the interaction between the Basel III framework and corporate financing decisions of financially constrained (treated) and unconstrained (untreated or control) firms. For our primary analysis, we drew on prior research (Gopalakrishnan, Jacob and Mohapatra 2021) and considered a five-year event window spanning from t-2 to t+2 years around the Basel III implementation year in South Africa, which is 2013. The results of the DiD estimation for Equation (2) are presented in Table 4.[2]

[2] In addition to the robustness checks reported in section 4.3, we augmented our baseline model by including cash flow and cost of debt as additional control variables. Our results were unchanged.

Table 4: Implementation of Basel III, constrained firms, and corporate debt financing

Panel A: Total leverage ratio					
	Categorisation basis				
	I	**II**	**III**	**IV**	**V**
Independent variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$\mathrm{POST_t} * \mathrm{TREATED_i}$	-0.0373***	-0.0410***	-0.0260***	-0.0381***	-0.0407***
	(0.0108)	(0.0097)	(0.0089)	(0.0089)	(0.0101)
Controls	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1 357	1 360	1 302	1 357	1 370
Adj. R-squared	0.798	0.814	0.849	0.859	0.821
Panel B: Long-term leverage ratio					
	Categorisation basis				
	I	**II**	**III**	**IV**	**V**
Independent variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$\mathrm{POST_t} * \mathrm{TREATED_i}$	-0.0353***	-0.0314***	-0.0198***	-0.0239***	-0.0260***
	(0.0084)	(0.0079)	(0.0072)	(0.0066)	(0.0079)
Controls	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1 357	1 360	1 302	1 357	1 370
Adj. R-squared	0.778	0.809	0.834	0.849	0.817
Panel B: Short-term leverage ratio					
	Categorisation basis				
	I	**II**	**III**	**IV**	**V**
Independent variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$\mathrm{POST_t} * \mathrm{TREATED_i}$	-0.0057	-0.0125**	-0.0079	-0.0136**	-0.0178***
	(0.0072)	(0.0063)	(0.0075)	(0.0063)	(0.0064)
Controls	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1 357	1 360	1 302	1 357	1 370
Adj. R-squared	0.640	0.652	0.637	0.662	0.661

Note: This table presents summaries of results of DiD estimations using total leverage (Panel A), long-term leverage (Panel B), and short-term leverage (Panel C) as dependent variables. Results in each column were obtained using the different criteria discussed in section 3.2 to identify financial constrained and unconstrained firms. We report robust standard errors in parenthesis. *, **, and ***, respectively, denote estimates that are significantly different from zero at the 10%, 5% and 1% levels. All the control variables included in the models in Table 3 are also included in the models in this table. The definitions of variables are presented in the annexure.

Table 4 (Panel A) presents the DiD estimates of Equation (2) using the total leverage ratio as the dependent variable. The results in column I, where we identify treated firms based on the WW Index, show that the coefficient of the cross-product interaction term (*POST*TREATED*) is negative (-0.0373) and statistically significant (at the 1% level). This statistically significant interaction term coefficient in our DiD framework indicates that financially constrained firms reduced debt financing by approximately 3.73% relative to their unconstrained peers between the pre-and post-Basel III periods. In other words, financially constrained firms used about 3.73% less debt financing in the period following the implementation of Basel III than their unconstrained counterparts. Similarly, in columns II to V, we repeat our analysis using firm size (proxied by market capitalisation and sales), firm age and dividend ratio to categorise firms as constrained or unconstrained. Consistent with the results obtained using the WW Index (column I), we observe negative and statistically significant (at the 1% level) coefficients for the interaction term (*POST*TREATED*) across the models in columns II to V. Specifically, the reduction in debt financing for financially constrained firms in the post-Basel III period ranges, on average, between 2.60% and 4.07% relative to unconstrained firms. These findings suggest that the implementation of Basel III led to a decrease in the use of debt financing by financially constrained firms relative to their unconstrained peers.

We further examine the data to establish whether the results vary when long- and short-term debt ratios are considered as separate proxies for the dependent variable. Panel B of Table 4 presents the DiD estimates of Equation (2) using the long-term ratio as outcome variables. The results demonstrate that, relative to financially unconstrained firms, constrained firms employ significantly lower levels of long-term debt financing in the post-Basel III period, regardless of the method used to identify constrained firms. Specifically, the reduction in long-term financing for financially constrained firms in the post-Basel III period ranges from 1.98% to 3.53% relative to their unconstrained counterparts. Additionally, our results were consistent when we used short-term leverage as the dependent variable (see Panel C of Table 4). However, we found that the statistical significance of the cross-product interaction term (*POST*TREATED*) with short-term leverage as the dependent variable is sensitive to the method used to identify constrained firms. Specifically, we found statistically

significant results only when firm size (proxied by both market capitalisation and sales) and the dividend payout ratio were used to identify constrained firms.

4.3 Robustness check

4.3.1 Alternative event window periods

In our previous analyses, we used a five-year event window, defined between 2011 and 2015, using 2013 as the implementation year of Basel III. To evaluate the sensitivity of our results to the choice of the event window, we conducted additional analyses using 7-, 9- and 11-year event window periods. The re-estimated results of Equation (2) are presented in Table 5 and summarised under the three panels.[3]

[3] For reasons of brevity, we present the results based on using the total leverage ratio as our dependent variable. Nonetheless, we observe broadly similar results in untabulated results.

Table 5: Implementation of Basel III, constrained firms, and corporate debt financing (alternative event windows)

Panel A: 7-year event window (i.e. t-3 to t+3)					
	Categorisation basis				
	I	**II**	**III**	**IV**	**V**
Independent variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	-0.0407***	-0.0389***	-0.0234**	-0.0356***	-0.0452***
	(0.0100)	(0.0097)	(0.0091)	(0.0090)	(0.0100)
Controls	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1 840	1 831	1 755	1 859	1 840
Adj. R-squared	0.786	0.800	0.839	0.840	0.808
Panel B: 9-year event window (i.e. t-4 to t+4)					
	Categorisation basis				
	I	**II**	**III**	**IV**	**V**
Independent variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	-0.0487***	-0.0379***	-0.0268***	-0.0337***	-0.0569***
	(0.0099)	(0.0103)	(0.0088)	(0.0093)	(0.0100)
Controls	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	2 292	2 297	2 758	2 283	2 280
Adj. R-squared	0.768	0.785	0.819	0.815	0.781
Panel C: 11-year event window (i.e. t-5 to t+5)					
	Categorisation basis				
	I	**II**	**III**	**IV**	**V**
Independent variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	-0.0516***	-0.0317***	-0.0243***	-0.0321***	-0.0553***
	(0.0100)	(0.0107)	(0.0093)	(0.0097)	(0.0102)
Controls	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	2 697	2 702	3 195	2 668	2 685
Adj. R-squared	0.739	0.763	0.794	0.780	0.754

Note: This table presents summaries of results of DiD estimations using a seven-year event window (Panel A), a nine-year event window (Panel B), and an 11-year event window (Panel C). The table presents results generated using the total leverage ratio as our dependent variable. We report robust standard errors in parenthesis. *, **, and ***, respectively, denote estimates that are significantly different from zero at the 10%, 5% and 1% levels. All the control variables included in the models in Table 3 and 4 are also included in the models in this table. The definitions of variables are presented in the annexure.

The data presented in Table 5 confirm our previous assertion that financially constrained firms use significantly less debt financing in the post-Basel III implementation period than their unconstrained counterparts. Specifically, the results demonstrate that relative to their unconstrained peers, financially constrained firms decrease their debt financing by approximately 2.34% to 5.69% in the post-Basel III period. These findings imply that the implementation of Basel III has led to a decrease in debt financing among financially constrained firms relative to their unconstrained peers.

4.3.2 Alternative categorisation of constrained firms

Up till now, we have used the lower and higher terciles to establish cut-off points for firms classified as financially constrained or unconstrained. To assess the sensitivity of our results to the choice of cut-off points, we employ the lower and upper quartiles as a basis for firm categorisation. Specifically, we classify a firm as financially constrained (unconstrained) if it is in the lower (upper) quartile of the distribution of firm size, dividend payout ratio or firm age. Conversely, we classify a firm as unconstrained (constrained) if it is in the upper (lower) quartile of the distribution of the WW Index. The re-estimated results are presented in Table 6 under the two panels.[4]

[4] Once again, for reasons of brevity, we present the results based on using the total leverage ratio as our dependent variable. Nonetheless, we observe broadly similar results in untabulated results.

Table 6: Implementation of Basel III, constrained firms and corporate debt financing (quartile categorisation of constrained firms)

	5-year event window (i.e. t-2 to t+2)					7-year event window (i.e. t-3 to t+3)				
	I	II	III	IV	V	I	II	III	IV	V
Categorisation basis	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
Independent variables										
$\mathrm{POST}_t * \mathrm{TREATED}_i$	-0.0434***	-0.0417***	-0.0333***	-0.0335***	-0.0440***	-0.0419***	-0.0451***	-0.0325***	-0.0380***	-0.0627***
	(0.0120)	(0.0126)	(0.0088)	(0.0099)	(0.0127)	(0.0122)	(0.0122)	(0.0091)	(0.0111)	(0.0095)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1 031	1 018	996	1 037	1 017	1 380	1 365	1 336	1 384	1 381
Adj. R-squared	0.805	0.830	0.854	0.850	0.803	0.782	0.819	0.846	0.842	0.809

Note: The table presents summaries of results of DiD estimations using a five-years event window (Panel A) and a seven-years event window (Panel B). Results are generated using the total leverage ratio as our dependent variable. Robust standard errors are in parenthesis. *, **, and ***, respectively, denote estimates that are significantly different from zero at the 10%, 5%, and 1% levels. All the control variables included in the models in Table 3, 4, and 5 are also included in the models in this table. The definitions of variables are presented in the Appendix.

Again, our findings from the new categorisations align with those of our primary analyses. That is, firms subject to financial constraints use significantly less debt financing than their unconstrained counterparts following the implementation of Basel III. In particular, the results indicate that relative to their unconstrained counterparts, financially constrained firms decreased debt financing by approximately 3.25% to 6.27% in the post-Basel III period.

4.3.3 Falsification tests

Our analysis thus far has demonstrated that the implementation of Basel III has a differentiated impact on the corporate financing decisions of financially constrained and unconstrained real sector firms. As it is crucial to design tests to determine the validity of this finding, we conducted two falsification tests to verify the fundamental assumption that trends in debt financing are similar between treated and non-treated firms in the absence of the implementation of the Basel III framework. We randomly assigned firms to financially constrained and unconstrained subgroups in the first test. We selected a year other than 2013 as the Basel III implementation year in the second test. Our results from these tests are presented in Table 7.

Table 7: Results of falsification tests

Panel A: Results generated using a randomly generated pseudo sample										
	5-year event window (i.e. t-2 to t+2)					**7-year event window (i.e. t-3 to t+3)**				
	I	**II**	**III**	**IV**	**V**	**I**	**II**	**III**	**IV**	**V**
Categorisation basis	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	0.0048	0.0031	-0.0213***	-0.0029	0.0050	-0.0095	-0.0030	0.0011	0.0109	-0.0062
	(0.0067)	(0.0082)	(0.0067)	(0.0077)	(0.0076)	(0.0058)	(0.0059)	(0.0078)	(0.0066)	(0.0070)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.857	0.832	0.846	0.827	0.818	0.836	0.815	0.833	0.829	0.820
Panel B: Results generated using 2010 as the event year										
	5-year event window (i.e. t-2 to t+2)					**7-year event window (i.e. t-3 to t+3)**				
	I	**II**	**III**	**IV**	**V**	**I**	**II**	**III**	**IV**	**V**
Categorisation basis	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	0.0236**	0.0168	0.0103	0.0033	0.0111	-0.0126	0.0107	-0.0160	-0.0153	-0.0133
	(0.0115)	(0.0110)	(0.0089)	(0.0107)	(0.0109)	(0.0126)	(0.0112)	(0.0100)	(0.0115)	(0.0122)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1 266	1 251	1 518	1 245	1 250	1 681	1 660	1 982	1 643	1 671
Adj. R-squared	0.857	0.835	0.856	0.852	0.806	0.784	0.786	0.789	0.765	0.728
Panel B: results generated using 2016 as the event year										
	5-year event window (i.e. t-2 to t+2)					**7-year event window (i.e. t-3 to t+3)**				
	I	**II**	**III**	**IV**	**V**	**I**	**II**	**III**	**IV**	**V**
Categorisation basis	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	-0.0005	0.0087	0.0265***	0.0110	0.0166*	-0.0064	0.0063	0.0307**	0.0156	0.0054
	(0.0094)	(0.0094)	(0.0097)	(0.0105)	(0.0091)	(0.0108)	(0.0108)	(0.0119)	(0.0120)	(0.0103)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	1 208	1 209	1 248	1 206	1 207	1 653	1 634	1 699	1 651	1 641
Adj. R-squared	0.819	0.829	0.794	0.819	0.829	0.776	0.779	0.736	0.775	0.786

Note: This table presents summaries of results of DiD estimations using a randomly generated pseudo sample (Panel A), using 2010 as the event year (Panel B) and using 2016 as the event year (Panel C). The table presents results generated using the total leverage ratio as our dependent variable. We report robust standard errors in parenthesis. *, **, and ***, respectively, denote estimates that are significantly different from zero at the 10%, 5% and 1% levels. All the control variables included in the models in Table 3 and 4 are also included in the models in this table. The definitions of variables are presented in the annexure.

Should our empirical framework not capture any unobserved factors or events unrelated to the differences in financial constraints and the implementation of Basel III, the coefficient of the interaction term (*POST*TREATED*) should be equal to zero in the falsification tests. The results in Panel A of Table 7 indicate that the impact of the cross-product interaction term (*POST*TREATED*) on corporate financing decisions for the pseudo sample is statistically insignificant, except for one model. This suggests that our findings are not influenced by confounding effects or extraneous factors unrelated to the implementation of Basel III regulations. Furthermore, the coefficients of the interaction term (*POST*TREATED*) are consistently indistinguishable from zero except for one model in Panels B and C of Table 7. This suggests that the observed results are unlikely to be attributed to spurious or non-random unknown factors. Overall, these findings support the validity of our conclusions regarding the effects of Basel III regulations on corporate financing decisions.

4.4 Additional analyses

4.4.1 Implementation of Basel III and corporate debt maturity structure

The existing literature suggests that corporate debt maturity plays a significant role in resolving agency problems (Myers 1977), managing liquidity risks (Diamond 1991) and addressing information asymmetry and signalling challenges (Flannery 1986). Studies have shown that the corporate sector copes with the impact of implementing Basel II regulations by relying more on accounts payables (Gopalakrishnan, Jacob and Mohapatra 2021), which may lead to challenges in matching asset maturity structures with debt maturity structures (Cai, Fairchild and Guney 2008; Lemma and Negash 2012). We therefore investigate whether implementing the Basel III framework has different effects on debt maturity structure decisions between financially constrained and unconstrained firms (see Table 8). We use the same categorisation criteria as in our primary analysis. Table 8 presents the DiD estimation results based on five-year (i.e. t-2 to t-2 years) and seven-year (i.e. t-3 to t-3 years) event windows respectively.

Table 8: Implementation of Basel III, constrained firms and corporate debt maturity structure

	5-year event window (i.e. t-2 to t+2)					7-year event window (i.e. t-3 to t+3)				
	I	**II**	**III**	**IV**	**V**	**I**	**II**	**III**	**IV**	**V**
Categorisation basis	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$POST_t * TREATED_i$	-0.0798***	-0.0597***	-0.0362***	-0.0378***	-0.0547***	-0.0736***	-0.0668***	-0.0331**	-0.0242**	-0.0636***
	(0.0118)	(0.0102)	(0.0136)	(0.0107)	(0.0103)	(0.0117)	(0.0105)	(0.0137)	(0.0117)	(0.0112)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1 357	1 360	1 302	1 357	1 370	1 840	1 831	1 755	1 859	1 840
Adj. R-squared	0.773	0.808	0.777	0.795	0.798	0.743	0.773	0.738	0.760	0.760

Note: This table presents summaries of results of DiD estimations using debt maturity structure as the dependent variable. Panel A reports results based on a five-year event window while Panel B presents results based on a seven-year event window. Results in each column were obtained using the different criteria discussed in section 3.2 to identify financial constrained and unconstrained firms. We report robust standard errors in parenthesis. *, **, and ***, respectively, denote estimates that are significantly different from zero at the 10%, 5% and 1% levels. All the control variables included in the models in Table 3, 4, 5 and 6 are also included in the models in this table. The definitions of variables are presented in the annexure.

Table 8 indicates that the coefficient of the cross-product interaction term (*POST*TREATED*) is consistently negative and statistically significant at the 1% level. These findings suggest that financially constrained firms have reduced debt maturity by an estimated 2.42% to 7.98% relative to unconstrained firms in the post-Basel III period. These results indicate that implementing Basel III has led to a decrease in debt maturity among financially constrained firms relative to their unconstrained counterparts.

4.4.2 Implementation of Basel II and corporate financing decisions

The motivation behind the introduction of the Basel III framework was to overcome the excessive procyclicality of Basel II regulations on credit supply; thus, it is expected to have positive real effects at the firm level (Drumond 2009; Jiménez et al. 2017). The results presented so far indicate that Basel III has a more pronounced negative effect on financially constrained firms' debt financing than their unconstrained counterparts. To investigate whether the implementation of Basel II in South Africa in 2008 had a different impact, we re-estimated Equation (2) using a series of event window periods defined around 2008. The estimation results are presented in Table 9, where we summarise DiD estimation results based on five-year and seven-year event windows. For the sake of brevity, we only present the results based on the five-year and seven-year event windows.

Table 9: Implementation of Basel II, constrained firms and corporate financing

	5-year event window (i.e. t-2 to t+2)					7-year event window (i.e. t-3 to t+3)				
	I	II	III	IV	V	I	II	III	IV	V
Categorisation variables	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**	**WW Index**	**Log (Mkt. Cap.)**	**Log (Age)**	**Dividend ratio**	**Log (Sales)**
$\mathrm{POST_t} * \mathrm{TREATED_i}$	-0.0545***	-0.0164	-0.0615***	-0.0676***	-0.0345***	-0.0439***	-0.0078	-0.0458***	-0.0728***	-0.0201
	(0.0146)	(0.0124)	(0.0134)	(0.0148)	(0.0132)	(0.0146)	(0.0124)	(0.0146)	(0.0159)	(0.0130)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1 044	1 035	1 227	1 061	1 042	1 445	1 432	1 633	1 436	1 437
Adj.R-squared	0.700	0.736	0.712	0.710	0.704	0.675	0.702	0.661	0.660	0.685

Note: This table presents summaries of results of DiD estimations using total leverage ratio as the dependent variable and Basel II as a point of reference to define the $POST_t$ variable. Panel A reports results based on a five-year event window while Panel B presents results based on a seven-year event window. Results in each column were obtained using the different criteria discussed in section 3.2 to identify financial constrained and unconstrained firms. We report robust standard errors in parenthesis. *, **, and ***, respectively, denote estimates that are significantly different from zero at the 10%, 5% and 1% levels. All the control variables included in the models in the previous tables are also included in the models in this table. The definitions of variables are presented in the annexure.

We observe in Table 9 that the use of debt financing was significantly lower among financially constrained firms in the post-Basel II implementation period than among their unconstrained peers. Specifically, the results indicate that financially constrained firms reduced their debt financing by approximately 3.45% to 7.28% in the post-Basel II period. Furthermore, the changes in financing patterns among financially constrained firms were similar to those of their unconstrained counterparts in both the post-Basel II and post-Basel III periods.

5. Conclusion

In this study, we examined the impact of implementing the Basel III framework on the financing decisions of non-financial firms in South Africa. Our analysis, which employed a difference-in-differences approach, suggests that the implementation of the Basel III regulations had a heterogeneous effect on debt financing decisions across firms. Specifically, we found that financially constrained firms reduced their debt financing by about 1.25% to 6.27% after implementing the Basel III framework relative to their unconstrained counterparts. Furthermore, our analysis revealed similar changes in corporate debt maturity structures, indicating that firms' financial positions before introducing the Basel III framework influenced how the regulations affected their debt maturity decisions. Our findings also suggest that the effects of Basel III regulations on financing activities persist and may have long-term consequences for firms. This study provides policymakers with valuable insights by shedding light on the spillover effects of bank regulations on the real sector.

Prior studies suggest the impact of exogenous shocks to bank capital regulation on a firm's financing strategy might be driven by the firm's risk profile (De Jonghe, Dewachter and Ongena 2020; Gopalakrishnan, Jacob and Mohapatra 2021) and banking relationships (Behr, Entzian and Güttler 2011). Future studies of potential heterogeneity in the impact of the implementation of the Basel III standards on financing decisions across a sample of firms with varying degrees of banking relationships and risk profiles could provide additional insight into our understanding of the impact of bank regulations. Future research might also look into the potential effects of implementing the Basel III framework on real sector investment and innovation.

Annexure A: Definition of variables

No.	Variable label	Variable name	Definition
1	$LEVER_{i,t}$	Total leverage	The ratio of total debt to total assets of firm *i* in year *t*.
		Long-term leverage	The ratio of long-term debt to total assets of firm *i* in year *t*.
		Short-term leverage	The ratio of short-term debt to total assets of firm *i* in year *t*.
2	$D\_MAT_{i,t}$	Debt maturity structure	The ratio of long-term debt to total debt of firm *i* in year *t*.
3	$POST_t$	Post-Basel III	A dummy variable set to 1 for the post-2013 years in the sample, and 0 otherwise. 2013 is the year in which South Africa implemented the Basel III regulations.
4	$TREATED_i$	Constrained firms	A dummy variable set to 1 if firm *i* is classified as a constrained firm in year *t*. firms are classified as constrained and unconstrained based on firm size, firm age, dividend ratio, and the Whited and Wu (WW) Index, as discussed in section 3.2.
5	$F\_GROW_{i,t-1}$	Growth opportunities	This variable is proxied by *Tobin's Q* ratio (Book value of total assets - Book value of equity + Market value of equity] / Book value of total assets) of firm *i* in year *t-1*.
6	$F\_SIZE_{i,t-1}$	Firm size (assets)	The natural logarithm of total assets of firm *i* in year *t-1*.
		Firm size (sales)	The natural logarithm of total sales of firm *i* in year *t-1*.
		Firm size (market capitalisation)	The natural logarithm of market capitalization of firm *i* in year *t-1*.
7	$A\_TANG_{i,t-1}$	Asset tangibility	The ratio of net property, plant and equipment (PPE) to total assets firm *i* in year *t-1*.
8	$F\_PRFT_{i,t-1}$	Profitability	The ratio of net income to total assets of firm *i* in year *t-1*.
9	$NDTS_{i,t-1}$	Non-debt tax shield	The ratio of depreciation expense to total assets of firm *i* in year *t-1*.
10	$R\&D_{i,t-1}$	Research & development expenditure	The ratio of research & development expenditure to total assets of firm *i* in year *t-1*.
11	$F\_AGE_{i,t-1}$	Firm age	The natural logarithm of the age of firm *i* in year *t-1*. Age is defined as current year minus year of registration on the database.
12	$DIV_{i,t-1}$	Dividend ratio	The ratio of dividends paid to total assets of firm *i* in year *t-1*.
13	$WWI_{i,t-1}$	WW Index	Proxied by one-year lagged value of the WWI. Following Whited & Wu (2006), we compute the WW Index using the following formula: − 0.091*CF − 0.062*DivPos + 0.021*Lev −0.044*Size + 0.102*ISG − 0.035*SG, where CF is net cash flows from operating activities divided by total assets; DivPos is an indicator variable that is equal to one if a firm pays dividend payout, and zero otherwise; Lev is total debt divided by total assets; Size is the natural logarithm of total assets; ISG is average industry sales growth; SG is firm sales growth.
14	Log (Mkt. Cap)	Market capitalisation	Natural logarithm of the market capitalization of a firm.
15	Log (sales)	Sales	Natural logarithm of the annual sales revenue of a firm.

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