

Essays in Corporate Finance

by

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Declaration

I declare that any material contained in this thesis has not been submitted for a degree to any other university. I further declare that one paper titled “Does Derivatives Use Reduce the Cost of Equity?” drawn from Chapter One of this thesis is under review with the *International Review of Financial Analysis*. This paper is co-authored with Shamim Ahmed and Amrit Judge. Previously this paper was revised and re-submitted to the *Journal of Business Finance & Accounting* under the title “Derivatives Use and the Cost of Equity: Evidence from Germany”.

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Abstract

This thesis comprises three essays in corporate finance, with a focus on corporate risk management and debt diversity. The first chapter examines the impact of derivatives use on the cost of equity for German non-financial firms. Using hand-collected data on derivatives use for a sample of German non-financial firms, I find that user firms have a 306 basis point lower cost of equity than non-users. This reduction in the cost of equity of users is attributable to their lower market, size, and value risk factor exposures. The observed negative relation between derivatives use and the cost of equity remains robust to specifications that account for potential endogeneity arising from a firm's derivatives hedging and capital structure decisions. I find that the reduction in the cost of equity is largest for smaller firms and for firms making use of foreign currency and interest rate derivatives. Moreover, new derivatives users experience a significant reduction in the cost of equity capital in the first year of adoption.

In second chapter, I empirically examine the impact of derivatives use on firms' distress risk using hand-collected data from the annual reports of German non-financial firms. Time period of this empirical analysis spans from 1999 to 2010. I find that derivatives using firms have lower distress risk. I use Heckman's two-stage treatment effect model to account for the unobservable factors that could affect the decision of the firm to use derivatives. Even after accounting for the unobservable factor bias, the results confirm that hedging reduces financial distress risk significantly. Moreover, I find that firms using foreign currency and interest rate derivatives can benefit via reduction in financial distress risk.

Using a comprehensive data for 46 countries firm's choice of debt instrument, I find

that firms use debt from many sources. Firms those sources debt from only one source or more specifically from the Bank, significantly lower their investment during the financial crisis. However, the firms those source debt from public market shows insignificant negative impact during the financial crisis. Later, I find that during the financial crisis time firms with higher financial distress exhibit negative impact on the bank debt. Whereas, firms with higher financial distress during the financial crisis shows positive association with public debt. Findings of this study suggests that during the crisis period firms with access to the bond market issue bonds to substitute bank debt. However, this substitution is not one-for-one, so the firms experience deleveraging and consequently underinvestment.

Introduction

Importance of Risk Management

The importance of corporate risk management has become increasingly important in recent years ([Campello, Lin, Ma, and Zou \(2011\)](#)). For example, a survey by the International Swaps and Derivatives Association (ISDA) in 2009 reports that about 94% of Fortune Global 500 companies across 32 countries use derivatives to hedge their business and financial risks. This risk management activities by the firm aligns with the corporate risk management theories proposed by [Smith and Stulz \(1985\)](#) and [Froot, Scharfstein, and Stein \(1993\)](#). Their theories suggest that hedging reduces financial distress risk and mitigate the underinvestment problem.

Corporate risk management focuses on the reduction of financial distress. Financial distress comprise of direct and indirect financial distress costs. Costs related to bankruptcy proceeding (e.g. lawyer fees, expert witnesses, administrative and accounting fee) are the direct costs. On the other hand, the indirect costs arises as soon as stakeholders perceive the firm as financially distressed firm (e.g. product warranty, extended installment payment term from suppliers). This expected cost of financial distress increases with increased leverage and volatile cash flows as both factors eventually amplify the likelihood of winding up in the future [Aretz, Bartram, and Dufey \(2007\)](#). Volatility of the cash flows of the firm could be reduced through corporate hedging activities. Therefore, researchers argues that hedging reduces the financial distress and bankruptcy costs ([Smith and Stulz, 1985](#); [Leland, 1998](#); [Aretz, Bartram, and Dufey, 2007](#); [Purnanandam, 2008](#); [Bartram, Brown, and Fehle, 2009](#); [Fauver and Naranjo, 2010](#); [Campello, Lin, Ma, and Zou, 2011](#)).

Reduced financial distress will increase the net income which is taxable. Therefore, the question arises whether hedging reduces tax liability of the firm.

Expected post-tax value of the firm is appreciated, if the firm reduces the variability of pre-tax firm values which reduces the corporate tax liability [Smith and Stulz \(1985\)](#). Core assumption behind this is the corporate tax function convexity. Another benefit arises due to hedging is increase of debt financing option of the firm. Debt financing increases the firm value by decreasing taxable income [Leland \(1998\)](#). Incremental debt capacity of the firms using derivatives eventually helps to reduce the tax liability of the firm through more use of debt. Therefore, there is existence of persistence inter-relationship among derivatives, debt capacity, and tax incentives ([Stulz, 1996](#); [Leland, 1998](#); [Graham and Rogers, 2002](#)). In accordance to ([Froot, Scharfstein, and Stein, 1993](#); [Stulz, 1996](#)) equity financing can be substituted by debt when the firm use hedging tools. Therefore, tax burden could be lowered by derivatives use. This resulting lower tax payments from smoothing out earnings by increasing present value of tax shields [Supanvanij and Strauss \(2006\)](#). [Leland \(1998\)](#) argues that there are two potential channels through which the firm value is increased through hedging. Firstly, firm lowers income volatility whereby increases debt capacity which consequently allow the firm to enjoy tax benefits. Secondly, benefit arises as the firm default probability and distress cost is reduced due to unused debt capacity.

[Froot, Scharfstein, and Stein \(1993\)](#) and [Bessembinder \(1991\)](#) argue that hedging could lessen the problem of underinvestment by reducing the cash flow variability of the firm. Even when the industry is in distress, derivatives could rescue the firm from sub-optimal investment and hence maximize the wealth of the shareholders ([Carter, Rogers, and Simkins \(2006\)](#)). [Campello, Lin, Ma, and Zou \(2011\)](#) suggest that firm using derivatives enjoys lower cost of borrowing due to reduction in distress risk. Therefore, corporate hedging could ensure shareholders wealth maximization through minimization of cost of debt and increasing debt capacity. [Morellec and Smith \(2007\)](#) showed that shareholders typically benefit from negotiating the issuance of debt and the hedging strategy simultaneously because lenders provide the same funds at a lower rate. Therefore, many firms appear to arrange credit lines as well as hedging programmes through the same financial in-

stitution, which enables the financial institution to monitor the borrowers hedging programmes. Consequently, other financial institutions or contracting parties may also offer more favourable terms to companies that establish lines of credit and hedge positions with the same financial institution. Therefore, hedging could mitigate the underinvestment problem via lower cost debt facility and cash-flow management. [Aretz and Bartram \(2010\)](#) argue that, hedging not only reduces the problem of underinvestment but also overinvestment by managing the probability of both high and low cash flow.

Following this, many academics taken keen interest to empirically identify the tangible economic benefit a firm could achieve from derivatives use. They empirically examine the impact of derivatives use on a number of issues (e.g. firm value, investment, cost of debt, cost of equity, financial distress risk). The recent studies focus on the US non-financial firms (see [Purnanandam \(2008\)](#), [Campello, Lin, Ma, and Zou \(2011\)](#), [Gay, Lin, and Smith \(2011\)](#), and [Chen and King \(2014\)](#)). However, risk management and its impact depends not only on the firm-level corporate governance but also on the country-level corporate governance (see [Fauver and Naranjo \(2010\)](#) and [Allayannis, Lel, and Miller \(2012\)](#)). In the US, firms' shareholdings are disbursed, shareholders have higher level of rights enforcement and the economy is market-based. On the other hand, shareholdings in German firms shareholders are usually concentrated, blockholding is a common phenomenon and shareholders have lower level of rights enforcement. Owing to these significant differences between the US market based economy and the bank-based German economy, the first and second chapter of this thesis investigate the benefit of financial hedging on firms cost of equity capital and distress risk. This study attempts to verify if any tangible benefit is attainable for derivatives using non-financial firms in Germany. This is important to know as this will have an impact on the firm's financial decision making and may also be implicable to similar countries (e.g. France, Italy, Japan).

Why Germany?

I consider the sample of German firms is due to several reasons. First, Germany represents one of the largest stock markets, by market capitalization, in the world outside

of the US. Second, according to the World Bank, at the end of December 2016, German firms export more than their US counterparts, which exposes them to higher levels of foreign exchange rate risk. Consistent with this observation, [Bodnar and Gebhardt \(1999\)](#) find that a higher proportion of German firms use derivative instruments compared to the US firms. Consequently, it is likely that German firms experience a larger impact of derivatives use on their cost of equity capital than those in the US. Third, institutional characteristics in Germany are considerably different from those in the US. For example, in [Table 1.1](#), I present some key institutional characteristics of Germany and US. From columns 1 and 2, it can be seen that German firms are less widely held, which implies a predominance of blockholder ownership structure.

[Gorton and Schmid \(2000\)](#) suggest that blockholding by German banks are very common. These banks can control the firms via their voting rights achieved due to blockholding. In addition to this, banks often can control the firm via proxy voting rights authorised by the individual shareholders. They suggest that the concentrated ownership by the German banks improve the performance of the firm. The firm enjoys such benefit due to reduction in agency problems between the manager and shareholders.

In addition to this, banks also provides loan to the firms whereby they have excessive control over the firm. This excessive control might not reduce the agency problems rather this could enlarge and perpetuate the agency problem. [Agarwal and Elston \(2001\)](#) suggest that the German banks seek rent seeking behavior. Therefore, the agency problem between shareholders and creditors rises due to this excessive control rights. This could cause to increase cost of equity of the firm too.

On one hand, this can lower the cost of equity following the argument of [Shleifer and Vishny \(1997\)](#) that blockholders have greater incentives to monitor a firm's management in an unbiased way and thereby leading to a reduction of agency costs and a lower cost of equity. On the other hand, the cost of equity rises in the presence of large blockholders due to their extraction of private benefits of control ([Ashbaugh, Collins, and LaFond, 2004](#)). Because of these two competing views, it is unclear what would be the ultimate impact of derivatives use on the cost of equity capital in the presence of a concentrated ownership

structure. Columns 3 and 4 suggest that shareholders in Germany have lower levels of rights and right enforcement than those in the US. In the absence of higher levels of shareholder rights and right enforcement, the likelihood of an out-of-court reorganization of the firm is very low (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998). Thus, the cost of equity for German firms are likely to be higher (Hail and Leuz, 2006), which suggests larger potential benefits from the use of derivatives in terms of cost of equity reduction.

Table 1.1 also shows that financial transparency in Germany is much lower due to less stringent equity disclosure requirements by the Federal Financial Supervisory Authority (column 5). A lower level of financial transparency increases out-of-pocket monitoring costs borne by shareholders, which in turn increases the cost of equity capital (Hail and Leuz, 2006; Lombardo and Pagano, 2002). Looking at column 6, this can be argued that firms in Germany face higher corporate effective tax rates than firms in the US. In the presence of financial market frictions, taxation allows a firm to achieve tax-shield benefits from debt financing. Hence, firms in Germany are likely to be more leveraged and therefore face greater financial distress risk. The use of derivative instruments is then expected to reduce the cost of equity to a greater extent. German firms also experience a lower level of bankruptcy efficiency (column 7). In this connection, Davydenko and Franks (2008) note that borrowing from multiple banks is much more common for German firms due to a bank-oriented financial system. As a result, the direct bankruptcy costs associated with debt renegotiation at the time of default is higher and the renegotiation process is more difficult, both of which reduce the terminal value of a firm in bankruptcy. In such case, it is likely that shareholders would require additional risk premiums for bearing higher financial distress risk than those in a market-oriented financial system. Therefore, in a German setting we would expect a larger impact of derivatives use in reducing the cost of equity. The last column of Table 1.1 shows that the block premium is considerably higher for firms in Germany. This implies a higher level of private benefits of control by blockholders and a consequent agency problem between blockholders and minority/retail shareholders. In such case, the use of derivatives is expected to cause a larger reduction

in the cost of equity capital. Taken together, all of the above attributes make Germany an interesting laboratory to examine the relation between firms' derivatives use and the cost of equity capital.

Summary of Chapter 1 & 2

In chapter one, the main goal is to investigate the impact of derivatives activities on a firm's cost of equity capital by utilizing hand-collected data comprising derivatives instruments usage by a sample of German non-financial firms. Findings of this chapter suggest that derivatives using firms have a 306 basis point lower cost of equity than non-users. For the users of derivatives such benefit stems from lowering market, size and value risk factor exposures. Hence, I find a significant negative relationship between derivatives use and the cost of equity of the firm. The results of this study are robust after accounting for the endogeneity issue. I also find that foreign currency and interest rate derivatives help to reduce the cost of equity capital. In addition to this, the new users of derivatives benefit via a significant reduction in the cost of equity capital in the first year of adoption.

There is a strand of literature that suggests that the derivatives use reduces financial distress risk. Following this argument, the studies that examine the impact of derivatives use on the cost of debt or equity suggest that the plausible reason for the derivatives user to have lower cost of debt or equity than the non-users is due to reduction in distress risk. Therefore, after finding that the derivatives use lower the cost of equity for German non-financial firms, the second chapter investigates if hedging leads to a reduction in the likelihood of financial distress risk of the firm. In doing so, I use 1- and 5-year Expected Default Frequency (EDF) data that measures the probability that the firm will become bankrupt within one or five years. This EDF data has been collected from Moody's Analytics. Findings of this paper support the argument made by [Smith and Stulz \(1985\)](#) and [Froot, Scharfstein, and Stein \(1993\)](#) that hedging reduces financial distress risk of the firm. I find that the firms making use of foreign currency and interest rate derivatives benefit via reduction in financial distress risk.

Sources of Debt

Many researchers empirically examine the impact of leverage on investment of the firm (see (Whited, 1992; Denis and Denis, 1993; McConnell and Servaes, 1995; Lang, Ofek, and Stulz, 1996; Kahle and Stulz, 2013)). However, the findings are inconclusive. For instance, Lang, Ofek, and Stulz (1996) suggest that there is negative relationship between leverage and future growth of the firm. Therefore, firms with higher growth opportunities should have lower leverage to avoid underinvestment. On the other hand McConnell and Servaes (1995) suggest that high growth firms exhibit negative relationship with leverage whereas low growth firms exhibit positive relationship.

However, these studies consider the firm uses only one type of debt. Whereas, in reality firm uses many types of debt (e.g., term loans, senior bonds, subordinated bonds). Recently, Crouzet (2017) argues that during the financial crisis firms experience substitute costly bank debt with the bonds. However, this substitution is not one-in-one. In other words, firms do not issue the amount of bonds that is equivalent to the retired bank debt. Most studies those do not account the type of debt firm uses are the indirect test to identify the impact of leverage on investment.

Rauh and Sufi (2010) and Colla, Ippolito, and Li (2013) were among the first to empirically examine the corporate debt structure in terms of the different sources of debt firms use. However, the focus of their studies were the US non-financial firms. The theories developed by Bolton and Scharfstein (1990), Chemmanur and Fulghieri (1994) and Bolton and Scharfstein (1996) argue that the firm decision to choose between public or private debt could affect the firm likelihood of liquidation at the time of financial distress. Generally speaking, a firm's public debt (bonds) is held by a large number of investors, which can cause the firm to be liquidated at the time of financial distress due to lack of renegotiation opportunity with many creditors. In relation to this, the default of the firm is also dependent on the debt enforcement of the country. Most importantly, the choice of debt is a source of external financing which can also affect the firm's decision to invest. However, the extant literature examining the impact of leverage on investment do not consider debt specialization and debt enforcement of the country.

Previous studies disregard the fact that a firm can source debt from different sources and such choice is not only dependent on a firm's characteristics but also dependent on degree of debt enforcement index in jurisdiction of the firms' location. Debt enforcement index is constructed based on the guideline suggested by Favara, Schroth, and Valta (2012) and further used by Favara, Morellec, Schroth, and Valta (2017), which suggest the ease of renegotiation process. Different jurisdiction have different degrees of debt enforcement.

A recent study by Favara, Morellec, Schroth, and Valta (2017) suggests that the debt enforcement affects firm investment. Following this, I examine how the variation in debt enforcement across many countries impact on the choice of debt types and firm value via its impact on the level of investment. I use a comprehensive database on publicly listed firm's choice of debt instruments. Firms in the higher debt enforcement countries with higher debt specialization have a positive impact on investment. However, during the time of financial crisis the firms with specialized debt have a negative impact on investment. I also find that during the crisis period when the default probability of the firm increases, it leads to a reduction in bank debt which consequently leads the firm to reduce investment.

Chapter 1

Derivatives Use and the Cost of Equity: Evidence from Germany

1.1 Introduction

The capital structure theory of [Modigliani and Miller \(1958\)](#) suggests that hedging activities would be irrelevant if investors (shareholders) can replicate hedging by themselves. However, active corporate risk management has grown rapidly due to frictions in the capital market whereby the investors cannot replicate hedging themselves ([Campello, Lin, Ma, and Zou \(2011\)](#)). In this backdrop, one of the important questions from both an academic and practitioner perspectives is whether derivatives users experience a lower cost of equity capital than do non-users. Using a large sample of non-financial firms in the United States (US), the study by [Gay, Lin, and Smith \(2011\)](#) was the first to provide evidence that the cost of equity of derivatives users is significantly lower than non-users. However, little is known about whether such relationship holds outside of the US, especially in countries where firms face different regulatory and institutional arrangements including stricter policies of controlling and monitoring derivative-related activities. The ultimate benefit of financial hedging in terms of a lower cost of equity capital may not materialize for firms in other countries and knowing this is important within the context of a firm's financial policy decision.

In this paper, our main goal is to investigate the impact of derivatives activities on firms' cost of equity capital by utilizing hand-collected data comprising derivative instruments usage by a sample of German non-financial firms. Specifically, we compute the

relative cost of equity of users and non-users and analyze the source of any difference between the two groups if it exists. We next explore whether firm size and type of derivatives matter in the relation between derivatives use and the cost of equity capital. Furthermore, we examine whether there is any significant change in the cost of equity experienced by firms that were non-users of derivative instruments and later initiated derivatives programs for risk management purpose.

Table 1.1: Institutional characteristics

The table reports some key country-specific institutional characteristics. Widely held indicates the proportion of firms that are owned by large number of shareholders and not restricted to handful of shareholders. Columns 1 and 2 showing proportions, respectively, for large and medium sized firms are sourced from [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1999\)](#). Column 3 shows the index of shareholder rights, which ranges between zero and five, and is sourced from [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1998\)](#). Column 4 shows the quality of shareholder right enforcement, which is the average of ex ante and ex post private control of self-dealing. Column 5 shows the index of equity disclosure, which is the arithmetic average of compensation, prospectus, shareholders, inside ownership, contracts irregular, and transactions. Country-specific institutional characteristics reported in columns 4 and 5 are, respectively, sourced from [Djankov, La Porta, Lopez-de-Silanes, and Shleifer \(2008\)](#) and [La Porta, Lopez-de-Silanes, and Shleifer \(2006\)](#). Column 6 shows the first-year effective tax rate (in %). Column 7 reports the bankruptcy efficiency, which is the present value of the terminal value of the firm after bankruptcy costs. Country-specific institutional characteristics reported in columns 6 and 7 are sourced from [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#). Column 8 reports the block premium, which is the difference between the price per share for the control block at announcement day t and the price on the Exchange at day $t + 2$, divided by the price on the Exchange after the announcement and multiplied by the proportion of cash flow rights in the controlling block. Block premia reported in column 8 are sourced from [Dyck and Zingales \(2004\)](#).

	Widely held		Shareholder	Shareholder right	Equity	Tax	Bankruptcy	Block
	Large	Medium	rights	enforcement	disclosure	rate	efficiency	premium
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Germany	0.50	0.10	1	0.28	0.42	23.50	57.00	0.10
United Kingdom	1.00	0.60	5	0.95	0.83	18.61	92.30	0.01
United States	0.80	0.90	5	0.65	1.00	18.19	85.80	0.01

Our choice of a sample of German firms is due to several reasons. First, Germany represents one of the the largest stock markets, by market capitalization, in the world outside of the US. Second, institutional characteristics in Germany are considerably different from those in the US as well as in the United Kingdom (UK). In particular, Table 1.1 shows that in Germany: (1) firms are less widely held, which suggests predominance of a blockholder ownership structure (columns 1 and 2); (2) shareholders have lower levels

of rights and rights enforcement (columns 3 and 4); (3) financial transparency is lower due to less stringent equity disclosure requirements by the Federal Financial Supervisory Authority (column 5); (4) firms face higher effective tax rates and lower bankruptcy efficiency (columns 6 and 7); and (5) block premium is considerably high (column 8). Third, bank intermediated finance is a dominant means of financing investment projects in Germany and therefore banks show rent seeking behavior by charging higher interest rates (see [Agarwal and Elston \(2001\)](#)). Fourth, German banks maintain big equity stakes in non-financial firms. Fifth, the most important objective of using derivatives in risk management by German firms is to minimize accounting earnings variability, whereas firms in the US focus on reducing cash flow variability (see [Bodnar and Gebhardt \(1999\)](#)). In sum, all of these attributes make Germany a natural laboratory to examine the relation between firms' derivatives use and the cost of equity capital.

We compute an estimate of a firm's cost of equity based on the [Fama and French \(1993\)](#) three-factor model.¹ Our empirical evidence suggests that hedging through derivatives use significantly reduces the cost of equity capital. We find from the univariate analysis that firms using derivatives have, on average, a 306 basis point lower cost of equity than non-users. Using an industry-adjusted estimate, user firms have, on average, a 109 basis points lower cost of equity as compared to non-users. We also find evidence that derivatives user firms have significantly lower [Fama and French \(1993\)](#) three-factor betas than do non-user firms. Specifically, user firms have on average, a 27.22% lower market factor beta, a 42.38% lower small-minus-big size (SMB) factor beta, and a 16.14% lower high-minus-low value (HML) factor beta than non-users. In conjunction with the corresponding positive factor risk premium estimates, these reductions in betas suggest that the lower cost of equity of derivatives users is driven by their lower exposures to the market, SMB, and HML risk factors. [Fama and French \(1996\)](#) and [Vassalou and Xing \(2004\)](#) provide evidence that the SMB and HML factors contain information regarding a firm's default risk. Hence, our empirical results on the contributions of the SMB and HML betas to the reductions in the cost of equity of user firms is consistent with the notion that hedging through derivatives

¹ In the context of German firms, [Schrimpf, Schröder, and Stehle \(2007\)](#) find that the [Fama and French \(1993\)](#) three-factor model performs well in explaining the cross-section of stock returns.

being linked with the mitigation of financial distress risk, which in turn leads to lower SMB and HML factor exposures.

Consistent with the findings of the univariate analysis, our results from the pooled regressions show that derivatives users experience a significantly lower cost of equity than non-users. One concern regarding the pooled regressions is that the results could be spurious due to potential endogeneity arising from a firm's financial hedging and capital structure decisions. We address this concern by examining firms' cost of equity, derivatives use, and leverage decisions within a simultaneous equations framework and find a significantly negative relation between derivatives use and the cost of equity capital. This suggests that the observed impact of financial hedging activities on the cost of equity cannot be attributed to endogeneity. Our empirical analysis also reveals that the reduction in the cost of equity capital is largest for smaller firms. A similar finding emerges for firms making use of foreign currency and interest rate derivative instruments. Lastly, we find that new user firms experience a reduction in the cost of equity of 246 basis points in the first year of adoption. The average reduction in the industry-adjusted cost of equity also remains markedly high at 286 basis points. Notably, these reductions in the cost of equity of new users stem from their lower market, size, and value risk factor exposures.

The main contribution of our paper is to shed light on the potential benefits of risk management through financial hedging for corporations in a country like Germany, which is largely characterized by an insider system of corporate governance and bank dominated financing. In other words, our examination of the impact of derivatives use on the cost of equity for German non-financial firms provides useful insights to corporations operating in Germany or in countries alike, in terms of institutional settings, that may consider using derivatives as a means to lowering their cost of financing capital. It is worth highlighting that empirical studies on the impact of hedging activities on financial distress risk focus almost exclusively on US firms.

The paper related to ours is [Gay, Lin, and Smith \(2011\)](#), who investigate a sample of US non-financial firms and find that the cost of equity of derivatives user firms is lower than non-users by 24 to 78 basis points. The authors also find that the reduction in the cost of

equity is attributable to lower market and SMB factor betas. Smaller firms and firms that use foreign currency and interest rate derivatives experience the largest reductions in the cost of equity. Although our empirical results are qualitatively similar to those in [Gay, Lin, and Smith \(2011\)](#), we find a larger impact of derivatives use in reducing the cost of equity capital in a German setting. Another important paper related to ours is [Campello, Lin, Ma, and Zou \(2011\)](#). They show that derivatives users pay lower interest spreads than non-users and are less likely to have capital expenditure restrictions in their loan agreements. Recently, [Chen and King \(2014\)](#) examine the impact of corporate hedging activities on the cost of public debt and provide evidence that derivatives use is associated with a lower cost of debt. A common finding of all these empirical studies is that the use of derivatives significantly reduces a firm's cost of capital.

Our paper also adds to an extant literature on financial hedging and corporate valuation. [Allayannis and Weston \(2001\)](#) examine the effect of financial hedging on a sample of US firms and find foreign currency derivatives use is associated with a 4.87% increase in firm value. Using a sample of firms in the US airline industry, [Carter, Rogers, and Simkins \(2006\)](#) also find that hedging increases firm value by as much as 10%. [Allayannis, Lel, and Miller \(2012\)](#) find evidence that the use of foreign currency derivatives increases firm value in the presence of a strong governance structure. Further, [Pérez-González and Yun \(2013\)](#) find that hedging increases firm value. [Jin and Jorion \(2006\)](#), however, provide empirical evidence that hedging does not affect the market value of firms operating in the US oil and gas industry. Similarly, [Fauver and Naranjo \(2010\)](#) find a significantly negative relation between derivatives use and firm value in the presence of greater agency and monitoring problems. We complement and extend this line of literature by empirically investigating the impact of derivatives hedging on the cost of equity capital outside of the US.

The remainder of this paper is organized as follows. Section [1.2](#) describes the data collection process and construction of the hedging variables and risk factors and outlines the methodology. Section [1.3](#) summarizes the substantive empirical results. Finally, Section [1.4](#) concludes. Some robustness check results are delegated to the Appendix at the end of this paper.

1.2 Data and empirical framework

1.2.1 Data description

To examine the relation between German firms’ derivatives use and the cost of equity capital, we use hand-collected data. In particular, we first obtain the annual reports of publicly listed German non-financial firms available in English from their respective official websites.² Our sample period spans from 1999 to 2009. We then use the following keywords to search for information on derivatives use and hedging strategies in each of the annual reports: “hedge”, “derivative”, “market risk”, “exposure”, “foreign”, “currency”, “interest rate”, “commodity”, “futures”, “option”, “swap”, “risk management”, “forward”, and “financial instrument”. When we find a keyword, we read the surrounding text to identify if the firm is a derivatives user or not for a given year. If the text surrounding a keyword provides any information on derivatives use or suggests that the respective firm is using derivative instrument(s) then we consider that firm-year as a user of derivatives and hand-code it to “1” for the “derivatives use” dummy variable. We classify a firm-year observation as derivatives non-user if there is no information on derivatives use available in the annual report and therefore hand-code it to “0” for the “derivatives use” dummy variable. Likewise, we also construct dummy variables for each broad category of the derivative instruments, namely, foreign currency, interest rate, and commodity derivatives.³

Our sample consists of 357 firms with 1984 firm-year observations of which 1388 firm-year observations show use of derivatives and 596 firm-year observations show non-use. These numbers indicate that about 70% of our firm-year observations use derivative instruments. This is notably a higher percentage of derivatives use compared to many recent studies (see, among others, [Adam, Dasgupta, and Titman \(2007\)](#), [Campello, Lin, Ma, and](#)

² We exclude financial firms from our empirical analysis since risk management incentives for financial and non-financial firms are not necessarily comparable. For example, proprietary trading activities by financial firms might motivate them to take on speculative derivative positions. Hence, inclusion of financial firms in our analysis could potentially lead to spurious results.

³ The reasons to use dummy variables instead of scaled total notional amounts or net derivatives positions are that the German domestic Generally Accepted Accounting Principle (GAAP) prior to 2010 did not have any specific hedge accounting disclosure requirement. In addition, many German firms adopted the International Financial Reporting Standards (IFRS) after 2009. However, hedge accounting is optional for firms following IFRS9. Furthermore, neither German GAAP nor IFRS9 requires to quantify the notional amount of derivatives holdings.

Zou (2011), and Gay, Lin, and Smith (2011)). Bodnar and Gebhardt (1999) also find from a survey that 78% of German firms use derivative instruments. Moreover, our sample composition differs from those of prior empirical studies, which predominantly consider large firms (see, for example, Adam and Fernando (2006) and Gay, Lin, and Smith (2011)). Said differently, our sample contains both small and large German non-financial firms. This allows us to avoid possible biased results due to the selection of large firms only in the empirical analysis.

We retrieve firm-level financial information from Thomson Reuters via Datastream. Standard practice in the literature (see, for example, Fama and French (2006)), all of our continuous explanatory variables are winsorized at the top and bottom 1% of each variable's distribution in order to mitigate the undue influence of outliers on the empirical results. We present descriptive statistics and a correlation matrix of the firm-level characteristic variables in Tables 1.10 and 1.11 of the Appendix, respectively.

1.2.2 Estimating a firm's cost of equity

Consistent with the literature (see, among others, D'Mello and Shroff (2000), Gay, Lin, and Smith (2011), and references therein), we use the Fama and French (1993) three-factor model to compute the equity premium for each non-financial German firm. More precisely, we first run the following time-series regression using daily returns for firm i in a given year:

$$R_{i,t} - R_{f,t} = a_i + \sum_{k=-1}^{k=1} b_{i,k}(R_{M,t+k} - R_{f,t+k}) + \sum_{k=-1}^{k=1} s_{i,k}SMB_{t+k} + \sum_{k=-1}^{k=1} h_{i,k}HML_{t+k} + e_{i,t}, \quad (1.1)$$

where $R_{i,t}$ is the return for firm i in period t ;⁴ $R_{f,t}$ is the return on the risk-free security in period t ;⁵ and $R_{M,t}$, SMB_t , and HML_t are the returns of the market, size, and value factor mimicking portfolios, respectively, in time period t .⁶ The beta coefficients (i.e., b_i , s_i , and h_i) represent the factor sensitivities or loadings and $e_{i,t}$ represents

⁴ In our case, daily returns for a given firm are computed using its daily total return index, which is adjusted for firm's stock splits and dividend payments.

⁵ We use one-month money market rate for Germany as a proxy for the return on the risk-free security.

⁶ Details on the construction of the market, size, and value factors for Germany are provided in Section 1.2.3.

the (zero-mean) regression residual. In the time-series regression specification given by equation (1.1), the rationale for including one lead and lag return in addition to the contemporaneous daily return is to account for infrequent trading (see Dimson (1979)). Accordingly, we obtain each market, SMB, and HML beta as the sum of the coefficient estimates on the lag, contemporaneous, and lead values of the corresponding factor risk premiums.

Following Fama and French (1997) and D’Mello and Shroff (2000), we then compute the cost of equity for each firm-year as an annual risk premium given by

$$CE_{i,t} = E(R_{i,t}) - R_f = \hat{B}_{i,t}[E(R_M) - R_f] + \hat{S}_{i,t}E(SMB) + \hat{H}_{i,t}E(HML), \quad (1.2)$$

where $CE_{i,t}$ is the cost of equity of firm i , and $\hat{B}_{i,t}$, $\hat{S}_{i,t}$, and $\hat{H}_{i,t}$ are the estimated betas for the market, SMB, and HML risk factors, respectively, in period t . For a given year, the expectations of the $R_M - R_f$, SMB, and HML are the arithmetic average of daily returns of each factor for the corresponding year. The cost of equity estimates are then annualized by multiplying by 252. We also compute the industry-adjusted cost of equity of a firm as the difference between its estimated cost of equity and the median industry cost of equity estimate for a given year.

1.2.3 Construction of factors

To construct the market, size, and value risk factor mimicking portfolios (i.e., R_M , SMB, and HML), we first collect daily total return indexes (adjusted for stock splits and dividend payments) of all listed common stocks in Germany irrespective of the Exchanges for the period between January 1998 to December 2009 from Datastream.^{7,8} Thereafter,

⁷ For Germany, the default search option for “total return index” in Datastream only retrieves the stocks listed in the Frankfurt Stock Exchange (FSE). To obtain return information for a stock that is not listed in the FSE, we first identify the Exchange in which the firm is listed and then use the Exchange code to collect the total return index data for that firm’s stock. If the firm is cross-listed in the FSE and other Exchanges then we consider the FSE data only.

⁸ The Fama and French (1993) three factors for Germany are publicly available in the Humboldt University of Berlin website (<https://www.wiwi.hu-berlin.de/de/professuren/bwl/bb/data/fama-french-factors-germany/fama-french-factors-for-germany>). However, these factors are constructed using both common and preferred stocks, and abandon bottom 20% market capitalization firms. This could potentially undermine the size effect. To overcome this issue, we construct the factors using all publicly listed common stocks. In an unreported exercise, we find that our empirical results hold even with the three factors available in the aforementioned source.

we calculate market capitalization and book-to-market ratio of a firm's common stock by following the methods suggested in [Fama and French \(1993\)](#). Market capitalization is therefore computed as the number of equity shares outstanding times the price of one share at the end of June in each year t . In June of year $t + 1$, we recalculate market capitalization. The book-to-market ratio is calculated in June of each year t as the ratio of the book value of a firm's common equity at the end of the fiscal year ending in the calendar year $t - 1$ to the market capitalization of the stock at the end of December in calendar year $t - 1$. Similar to market capitalization, we also recalculate book-to-market ratio in June of year $t + 1$.

We compute the daily return for the market risk factor mimicking portfolio as the value-weighted portfolio return of all aforementioned common stocks. The market capitalization defined above is used as the weight variable. To construct the size and value risk factor mimicking portfolios, SMB and HML, in any day as per [Fama and French \(1993\)](#), we begin by sorting all common stocks into two groups. On the last trading day of June in each year t , stocks with market capitalizations that are lower than the median market capitalization among all available stocks are assigned to the *Small* group, while stocks with market capitalizations that are above the median market capitalization are assigned to the *Big* group. At the end of June in each year t , the entire universe of German common stocks is also independently sorted into three groups based on the book-to-market ratio defined above. The *High* group holds stocks with book-to-market ratios above the 70th percentile of book-to-market ratios for all available stocks. The *Medium* group contains stocks with book-to-market ratios between the 30th and 70th percentiles. The *Low* group comprises stocks with book-to-market ratios below the 30th percentile. We then intersect the two market capitalization-based groups and three book-to-market-based groups to create six portfolios. These portfolios are denoted as *Small High*, *Small Medium*, *Small Low*, *Big High*, *Big Medium*, and *Big Low*. The *Small High* portfolio holds stocks in the intersection of the *Small* market capitalization group and the *High* book-to-market ratio group. Stock compositions of the other five portfolios are analogous. We calculate the daily return of each of the six portfolios. The stocks within each portfolio are value-weighted,

with the market capitalization at the end of June of year t , used as the weight variable.⁹

The return of the size factor mimicking portfolio in any trading day is then obtained as $SMB = 1/3(Small\ High + Small\ Medium + Small\ Low) - 1/3(Big\ High + Big\ Medium + Big\ Low)$. On the other hand, the daily return of the value factor mimicking portfolio is computed as $HML = 1/2(Small\ High + Big\ High) - 1/2(Small\ Low + Big\ Low)$. By construction, the HML portfolio isolates the relation between book-to-market ratio and stock returns while controlling for the market capitalization effect.

1.2.4 Multivariate framework

We resort to a multivariate regression framework in which the relation between firms' cost of equity capital and their use of derivatives is specified as

$$CE_{i,t} = f(Derivatives\ use_{i,t}, Leverage_{i,t}, Book-to-market_{i,t}, Illiquidity_{i,t}, Size_{i,t}, \\ Number\ of\ segments_{i,t}, \% \text{ Segment sales}_{i,t}, Ownership30_{i,t}, Ownership30_{i,t}^+)(1.3)$$

The derivatives use is a dummy variable defined earlier in Section 1.2.1. Our rationale for using leverage is to proxy for default risk (see [Campello, Lin, Ma, and Zou \(2011\)](#), [Lin, Ma, Malatesta, and Xuan \(2011\)](#), [Purnanandam \(2008\)](#), and references therein). Leverage is defined as long-term debt plus current portion of long-term debt scaled by total assets. We expect a positive link between the cost of equity and the level of leverage. Importantly, leverage of a firm depends on industry-specific characteristics (see [Lang, Ofek, and Stulz \(1996\)](#)). Considering the fact, we also calculate the industry-adjusted leverage of a firm. For a given year, this is computed as the difference between a firm's leverage estimate defined above and the median industry leverage estimate. In this case, we repeat our empirical analysis using the industry-adjusted cost of equity, defined in Section 2.2, for consistency. The book-to-market ratio, defined previously, is included to proxy for a firm's growth opportunities (see, among others, [Bartram, Brown, and Conrad \(2011\)](#) and [Gay, Lin, and Smith \(2011\)](#)). Illiquidity is the [Amihud \(2002\)](#) liquidity measure, computed as the ratio of the absolute value of the daily stock return to the daily euro trading volume

⁹ Although we update the weights as of the end of June in each year t , the return data for all common stocks are updated on a trading day basis to compute the daily returns of the market, size, and value risk factor mimicking portfolios used in the empirical analysis.

of the stock, averaged over all trading days (with non-zero volume) available in a given year. We expect a positive relation between the cost of equity and illiquidity. Size is defined as the natural logarithm of total assets. Firm size is expected to be negatively related to the cost of equity since small firms tend to have higher risk than large firms. [Fama and French \(1993\)](#) suggest that small firms have higher distress risk compared to the large firms, so have higher return. We consider the number of segments in which a firm operates to proxy for firm's operational risk diversification (see [Chod, Rudi, and Mieghem \(2010\)](#)). Diversified firms are exposed to lower level of risk than those of non-diversified firms. We, therefore, expect a negative relation between the cost of equity capital and the number of segments. We also include the percentage segment sales to control for potential industry effects. Unlike the US and the UK, blockholder ownership is a common phenomenon in Germany (see [Franks and Mayer \(2001\)](#) and [Gorton and Schmid \(2000\)](#)).¹⁰ Hence, we control for blockholder ownership by incorporating two ownership dummy variables, namely, `ownership30` and `ownership30+`. `Ownership30` takes the value equal to 1 if a firm's blockholder ownership is between 10% and 30% and zero otherwise. Likewise, `ownership30+` is a dummy variable that takes the value equal to 1 if a firm's blockholder ownership is above 30% and zero otherwise. Our choice of blockholders dummy is similar to [McConnell and Servaes \(1995\)](#).

We conduct our baseline multivariate analysis using the pooled ordinary least squares (OLS) regression method. However, our statistical inferences can be criticized due to potential endogeneity resulting from a firm's financial hedging and capital structure decisions. In other words, the pooled OLS estimation of the relation specified by equation (1.3) assumes that the decision by a firm to use derivative instruments is exogenous. But in reality it is more likely to be an endogenous decision ([Gay, Lin, and Smith \(2011\)](#)). This follows from the well-known debt capacity argument, put forth in [Leland \(1998\)](#) and [Stulz \(1986\)](#), that hedging increases a firm's debt capacity and therefore reduces tax liabilities

¹⁰ The relation between the cost of equity and blockholder ownership is ambiguous in the literature due to mixed evidence. For example, [Ashbaugh, Collins, and LaFond \(2004\)](#) suggest a positive relation between the concentrated ownership and cost of equity due to extraction of private benefits of control by the blockholders. In contrast, [Attig, Guedhami, and Mishra \(2008\)](#) show that blockholder ownership reduces the cost of equity capital by reducing a firm's agency and information related problems.

due to increases in the level of leverage. Along the lines of this reasoning, [Graham and Rogers \(2002\)](#) provide evidence that firms with higher leverage are more likely to hedge for risk management purpose and that hedging also leads to a higher level of leverage. Hence, to address the above potential endogeneity problem, we also examine the cost of equity capital, derivatives use, and leverage decisions of our sample of non-financial German firms within a simultaneous equations framework. This enables us to avoid spurious statistical inferences of causality among these crucial decisions.

In line with [Gay, Lin, and Smith \(2011\)](#) and [Géczy, Minton, and Schrand \(1997\)](#), we consider the following specification to model derivatives use decision:

$$\begin{aligned} \text{Derivatives use}_{i,t} = f(\text{Leverage}_{i,t}, \text{Book-to-market}_{i,t}, \text{Size}_{i,t}, \text{Number of segments}_{i,t}, \\ \% \text{ Segment sales}_{i,t}, \text{Quick ratio}_{i,t}, \text{Foreign sales to net sales}_{i,t}, \\ \text{Ownership30}_{i,t}, \text{Ownership30}^+_{i,t}, \text{Year dummies}). \end{aligned} \quad (1.4)$$

A strand of literature (see, among others, [Bessembinder \(1991\)](#), [Froot, Scharfstein, and Stein \(1993\)](#), and [Rampini and Viswanathan \(2010\)](#)) suggests that the use of derivative instruments can help reduce the underinvestment problem of a firm. The book-to-market ratio is incorporated on the grounds that firms with lower book-to-market ratios (i.e., higher growth opportunities) are more likely to engage in hedging activities. Hence, similar to [Allayannis and Weston \(2001\)](#) we expect a negative link between derivatives use and the book-to-market ratio. Size is included in our analysis to proxy for economies of scale in the costs of risk management.¹¹ We make use of a firm's number of business segments in which it operates as well as quick ratio. Both of these firm-level characteristics can proxy as substitutes for derivative instruments use. Firms operating in different business segments are likely to have lower risk due to diversification ([Gay, Lin, and Smith \(2011\)](#)). We therefore expect a negative association between derivatives use and number of segments. The quick ratio, defined as the ratio of cash and short-term investments to current

¹¹ The relation between derivatives use and firm size is inconclusive in the literature. In one hand, [Warner \(1977\)](#) shows that the direct costs related to financial distress are less than proportional to firm size. This suggests that small firms are more likely to participate in hedging activities. On the other hand, [Block and Gallagher \(1986\)](#) argue that hedging exhibits informational scale economies and that larger firms are more likely to hedge.

liabilities. Similar to [Bartram, Brown, and Fehle \(2009\)](#) we expect it to be negatively related to derivatives use. We utilize the ratio of foreign sales to net sales in order to account for the foreign currency risk exposure of a firm, which is expected to be positively related to derivatives use (see [Allayannis and Weston \(2001\)](#) and [Lin, Phillips, and Smith \(2008\)](#)). Once again, we include ownership30 and ownership30⁺ dummy variables in order to control for blockholder ownership. Furthermore, the percentage of segment sales and year dummies are incorporated to control for industry and time effects, respectively.

We follow studies by [Gay, Lin, and Smith \(2011\)](#), [Géczy, Minton, and Schrand \(1997\)](#), and [Titman and Wessels \(1988\)](#) for the leverage specification. This is given by

$$\begin{aligned} Leverage_{i,t} = f(&Derivatives\ use_{i,t}, Book\text{-}to\text{-}market_{i,t}, Size_{i,t}, Depreciation_{i,t}, \\ &Property, \text{ plant, and equipment}_{i,t}, Return\ on\ assets_{i,t}, SGA\ expenses_{i,t}, \\ &\% \text{ Segment sales}_{i,t}, Ownership30_{i,t}, Ownership30^+_{i,t}, Year\ dummies). \end{aligned} \quad (1.5)$$

[Leland \(1998\)](#) argues that firms using derivatives can increase their debt capacity by reducing financial distress. Recent empirical evidence provided by [Purnanandam \(2008\)](#) complements this argument. We, therefore, expect a positive relation between the level of leverage and derivatives use. [Myers \(1977\)](#) argues that firms with investment opportunities that could make a positive net contribution to their market values are more likely to have a lower level of debt. Consistent with this argument, we expect a positive association between the book-to-market ratio and leverage. Financial constraints of a firm are proxied by its size (see [Adam \(2009\)](#)). Thus we expect firm size to exhibit a positive relation to the level of leverage. Tax related motive is proxied by the ratio of depreciation expenses to total assets. Depreciation acts as a non-debt tax shield for firms ([DeAngelo and Masulis \(1980\)](#)). Hence, firms with higher depreciation expenses will have less incentives to increase their leverage levels. Leverage is dependent on a firm's profitability. We include return on assets as a proxy for firm's profitability. Return on assets is computed as the ratio of earnings before extraordinary items to total assets. We expect return on assets to be negatively related to leverage (see ([Bartram, Brown, and Fehle, 2009](#); [Gay, Lin, and Smith, 2011](#))). Further, we compute the ratio of selling, general, and administrative expenses to

total assets (referred to as SGA expenses) as a proxy for the uniqueness of the firm’s products. Firms with relatively unique line of products are exposed to higher bankruptcy costs (Titman and Wessels (1988)). Hence, a negative relationship between the level of leverage and the degree of a firm’s uniqueness is expected. We consider property, plant, and equipment scaled by total assets as a proxy for collateral value. Firms with higher collateral value can have higher leverage and therefore a positive association between leverage and property, plant, and equipment is expected. Similar to the model of derivatives use decision given by equation (1.4), we also control for blockholder ownership, industry, and time effects. In other words, we include the percentage segment sales variable, and ownership30, ownership30⁺, and year dummies in our analysis.

1.3 Empirical results

1.3.1 Univariate results

Table 1.2 presents mean and median values of the cost of equity, industry-adjusted cost of equity, and market (i.e., $R_M - R_f$), SMB, and HML factor betas separately for all firm, derivatives user, and non-user groups. We also report differences in mean and median values between users and non-users in relation to the aforementioned variables. Our univariate comparison provides strong evidence that derivatives user German non-financial firms have, on average, a lower cost of equity over the sample period. A similar empirical finding emerges when we focus on the industry-adjusted cost of equity estimates. Specifically, derivatives users markedly have a 306 (299) basis point lower cost of equity than do non-users based on mean (median) values. Looking at the industry-adjusted estimates, we find that user firms have a 109 (118) basis point lower cost of equity compared to non-users based on mean (median) values. All of these mean and median difference estimates are economically large and statistically significant at the 1% level. Further, the mean and median differences in risk factor betas affirm that derivatives user firms have significantly lower market, SMB, and HML betas than non-users. Considering the market beta, we observe that derivatives users have an

Table 1.2: Univariate comparison of derivatives users and non-users

The table reports mean and median values of the cost of equity, industry-adjusted cost of equity, and market, small-minus-big (SMB), and high-minus-low (HML) factor betas for a sample of derivatives user and non-user German non-financial firms. The cost of equity of a firm is computed as the difference between its expected return and the risk-free rate using the [Fama and French \(1993\)](#) three-factor model. The industry-adjusted cost of equity of a firm is obtained as the difference between its estimated cost of equity and the median industry estimate for a given year. Market, SMB, and HML betas are the betas, respectively, related to the market risk premium, and SMB and HML risk factors. N is the number of firm-year observations. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. The sample period is from 1999 to 2009.

Variable	All firms			Derivatives users			Derivatives non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
Cost of equity	1984	0.0856	0.0851	1388	0.0765	0.0761	596	0.1070	0.1060	−0.0306***	−0.0299***
Industry-adjusted cost of equity	1984	0.0054	0.0061	1388	0.0021	0.0025	596	0.0130	0.0143	−0.0109***	−0.0118***
Market beta	1984	0.9041	0.9398	1388	0.8128	0.8334	596	1.1169	1.1876	−0.3040***	−0.3542***
SMB beta	1984	0.6133	0.5668	1388	0.5023	0.4543	596	0.8718	0.8289	−0.3695***	−0.3746**
HML beta	1984	0.3480	0.3337	1388	0.3289	0.3310	596	0.3922	0.3401	−0.0633**	−0.0092*

average of 0.8128 versus 1.1169 for non-users. For the SMB beta, user firms have an average of 0.5023 as compared to the non-user average of 0.8718. Similarly, for the HML beta, derivatives users have an average of 0.3289 versus 0.3922 for non-users. These perceived differences suggest that user firms experience their largest reductions in risk factor betas over non-users from the SMB beta, which is 0.3695 (or 42.38%) on average. This is followed by reductions in the market and HML factor betas by 0.3040 (or 27.22%) and 0.0633 (or 16.14%), respectively.

We now elaborate on the relative effect of the differences in the mean values of the factor betas on the overall difference in the average cost of equity capital between user and non-user groups. To do so, we first compute the average annual risk premiums over our sample period for the market, SMB, and HML risk factors. The average annual risk premiums of these factors are 0.0497, 0.0312, and 0.0620 respectively. We then

multiply the risk premium estimate for each factor by the difference in the mean values of the corresponding factor betas between users and non-users. This provides us the approximate contribution of each beta component to the overall difference in the cost of equity. We find that the market beta component contributes to the reduction in the cost of equity by 151 basis points (-0.3040×0.0497) for derivatives user firms. The contribution of the SMB beta component to the reduction in the cost of equity is 115 basis points (-0.3695×0.0312) for derivatives users, whereas the contribution of the HML beta component is 39 basis points (-0.0633×0.0620). These results suggest that the lower cost of equity for derivatives user firms is driven by their lower exposures to the market, SMB, and HML risk factors. Our empirical finding on the contributions of the SMB and HML betas to the significant reduction in the cost of equity of derivatives users is also consistent with the notion that hedging through the use of derivatives is associated with the alleviation of financial distress risk, which in turns leads to lower SMB and HML betas.

1.3.2 Multivariate results

1.3.3 Pooled OLS regression results

We present the results of the estimated relation between firms' industry-adjusted cost of equity and their use of derivatives in Table 1.3.^{12,13} The specification of our first model (referred to as model 1) excludes blockholder ownership dummy variables whereas the specification of the second model (referred to as model 2) includes them. Starting with model 1, we observe that the derivatives use dummy is significantly negative at the 1% level. The estimated coefficient of -0.0160 indicates that derivatives user firms have a 160 basis point lower cost of equity than non-users. Said differently, firms that use derivative instrument(s) indeed experience a sizeable reduction in the cost of equity. It is worth mentioning that Gay, Lin, and Smith (2011) provide qualitatively similar empirical evidence based on a large sample of US non-financial firms. We also notice that the estimated coefficients on the control variables have their expected signs as discussed in

¹² The results based on the unadjusted cost of equity are qualitatively similar to those reported in this section. For brevity, we report them in Table 1.12 of the Appendix.

¹³ All standard errors of coefficient estimates are adjusted for simultaneous clustering on firm and year to avoid inflated t -statistics.

Table 1.3: Derivatives use and the industry-adjusted cost of equity: Pooled OLS regressions

The table reports the pooled ordinary least squares (OLS) regression results of the relation between a sample of German non-financial firms' industry-adjusted cost of equity and their use of derivatives. The dependent variable is the industry-adjusted cost of equity. Derivatives use is a dummy variable that takes the value 1 if a firm reports the use of any type of derivatives (i.e., foreign currency, interest rate, or commodity derivatives) and zero otherwise. The industry-adjusted leverage of a firm is computed as the difference between its leverage, measured as the ratio of long-term debt plus the current portion of long-term debt to total assets, and the median industry leverage for a given year. Book-to-market is the ratio of the book value of a firm's common stock to its market value. Illiquidity is the [Amihud \(2002\)](#) measure of liquidity, obtained as the ratio of the absolute value of the daily stock return to the daily euro trading volume of the stock, averaged over all trading days (with non-zero volume) in a given year. Size is the natural logarithm of total assets. Number of segments is the number of business segments in which a firm operates. Ownership30 is a dummy variable that takes the value 1 if a firm's blockholder ownership is between 10% and 30% and zero otherwise. Ownership30⁺ is a dummy variable that takes the value 1 if a firm's blockholder ownership is above 30% and zero otherwise. The ratio of each segment sales to total sales is also incorporated in the pooled OLS regressions. Numbers in parentheses are standard errors corrected for simultaneous clustering on firm and year. Model 1 excludes the blockholder ownership variables, whereas model 2 includes them. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. See also notes to Table 1.2.

	Model 1	Model 2
Intercept	0.0281*** (0.0074)	0.0273*** (0.0077)
Derivatives use	-0.0160*** (0.0025)	-0.0139*** (0.0024)
Industry-adjusted leverage	0.0499*** (0.0033)	0.0562*** (0.0041)
Book-to-market	0.0704*** (0.0086)	0.0640*** (0.0091)
Illiquidity	0.0411*** (0.0074)	0.0365*** (0.0073)
Size	-0.0389*** (0.0082)	-0.0370*** (0.0077)
Number of segments	-0.0030 (0.0020)	-0.0033 (0.0021)
Ownership30		-0.0069 (0.0102)
Ownership30 ⁺		-0.0183*** (0.0053)
Number of observations	1855	
Number of derivatives users	1331	
Number of derivatives non-users	524	
Adjusted R^2	0.0441	0.0549

Section 1.2.4. With the exception of the number of segments, all of them are statistically significant even at the 1% level. Similar empirical findings emerge while focusing on model 2, which also controls for blockholder ownership. Importantly, the estimated coefficient of -0.0139 on the derivatives use dummy variable is statistically significant at the 1% level. Consistent with [Attig, Guedhami, and Mishra \(2008\)](#), we find a negative relation between

Table 1.4: Derivatives use and the industry-adjusted cost of equity: Simultaneous equations analysis

The table reports results of the relation between firms' industry-adjusted cost of equity, derivatives use, and industry-adjusted leverage, estimated within a simultaneous equations framework. In the first stage, ordinary least squares (OLS) regression for the industry-adjusted leverage and probit regression for the derivatives use decision are run separately. In the second stage, structural equations are estimated where the relevant explanatory variables are replaced with the predicted values from the first-stage regressions. Quick ratio is the ratio of cash and short-term investments to current liabilities. Foreign sales to net sales is the percentage of foreign sales to net sales. Property, plant, and equipment is the ratio of property, plant, and equipment to total assets. Depreciation is the ratio of depreciation expenses to total assets. Return on assets is computed as the ratio of income before extraordinary items to total assets. SGA expenses are computed as the ratio of selling, general, and administrative expenses to net sales. The regressions also include the ratio of each segment sales to total sales as well as year dummies to control for industry and time effects. Numbers in parentheses are standard errors. See also notes to Tables 1.2 and 1.3.

Dependent variable: Variable/estimation method	Model 1			Model 2		
	Cost of equity OLS	Derivatives Probit	Leverage OLS	Cost of equity OLS	Derivatives Probit	Leverage OLS
Intercept	0.0330*** (0.0130)	-1.7374*** (0.3579)	0.0764* (0.0393)	0.0315*** (0.0127)	-1.7747*** (0.3628)	0.0588* (0.0314)
<i>Endogenous variables</i>						
Derivatives use	-0.0275*** (0.0095)		0.0434*** (0.0178)	-0.0236*** (0.0095)		0.0446*** (0.0191)
Industry-adjusted leverage	0.1168*** (0.0064)	0.2331*** (0.0631)		0.1240*** (0.0058)	0.2406*** (0.0558)	
<i>Exogenous variables</i>						
Book-to-market	0.0854*** (0.0134)	-0.1943 (0.1534)	0.0736*** (0.0165)	0.0640*** (0.0160)	-0.1883 (0.1526)	0.0559*** (0.0171)
Illiquidity	0.0478*** (0.0149)			0.0406*** (0.0152)		
Size	-0.0829*** (0.0131)	0.4764*** (0.0769)	0.0424*** (0.0045)	-0.0997*** (0.0199)	0.4840*** (0.0783)	0.0373*** (0.0045)
Number of segments	-0.0023 (0.0023)	-0.0055 (0.0059)		-0.0037 (0.0033)	-0.0056 (0.0071)	
Quick ratio		-0.0733** (0.0343)			-0.0693** (0.0321)	
Foreign sales to net sales		1.6470*** (0.3145)			1.6216*** (0.3375)	
Property, plant, and equipment			0.2320*** (0.0434)			0.2363*** (0.0424)
Depreciation			-0.4462** (0.2211)			-0.4206* (0.2216)
Return on assets			-0.1498*** (0.0630)			-0.1460*** (0.0626)
SGA expenses			-0.0684 (0.0498)			-0.0686 (0.0494)
Ownership30				-0.0103 (0.0124)	-0.0187 (0.0198)	0.0277 (0.0179)
Ownership30 ⁺				-0.0265** (0.0135)	0.0399** (0.0181)	0.0216 (0.0153)
Number of observations	1855					
Number of derivatives users	1331					
Number of derivatives non-users	524					
Adjusted R^2	0.0819		0.1289	0.0943		0.1296
Log-likelihood		-780.2712			-781.1006	

the cost of equity capital and large blockholder ownership. The estimated coefficient of -0.0183 on the `ownership30+` dummy is statistically significant at the 1% level. We note that these baseline empirical findings also hold when we repeat the entire analysis using lagged firm-level control variables. To conserve space, these results are not reported in this paper.

1.3.4 Simultaneous equations results

As pointed out earlier that our empirical findings based on the pooled OLS regressions can be criticized due to the possibility of a firm’s financial hedging decision being endogenous. In this section, we address this concern by estimating the industry-adjusted cost of equity, derivatives use, and industry-adjusted leverage equations within a simultaneous equations framework.¹⁴ We utilize a two-stage estimation procedure to obtain the parameter estimates. The first stage proceeds by separately running OLS regression for the industry-adjusted leverage and a probit regression for the derivatives use decision. The second stage involves estimating structural equations where the relevant explanatory variables are replaced with the corresponding predicted values obtained from the first-stage regressions.¹⁵ The results reported in Table 1.4 suggest that our preceding baseline empirical findings hold even after accounting for potential endogeneity. Importantly, we observe a significantly negative relation between the cost of equity capital and a firm’s derivatives use. In the case of model 1, which excludes blockholder ownership dummies, the estimated coefficient of -0.0275 on the derivatives use dummy variable is statistically significant at the 1% level. In model 2, which incorporates blockholder ownership dummies as additional control variables, the estimated coefficient of -0.0236 on the derivatives use dummy is also significant at the 1% level.

At first glance of the derivatives use specifications in model 1 and model 2, we find that the industry-adjusted leverage, firm size, and foreign sales to net sales variables, and the `ownership30+` dummy variable are positively related to the derivatives use decision.

¹⁴ We provide results from the simultaneous equations analysis based on the unadjusted cost of equity, derivatives use, and unadjusted leverage in Table 1.13 of the Appendix. These results are qualitatively similar to those reported in this section.

¹⁵ We also incorporate year dummies to control for time effects while estimating the cost of equity equation within the simultaneous equations system.

As expected, the quick ratio is negatively related to a firm’s derivatives use. The estimated coefficients on these variables are also statistically significant at the 1% or 5% level. Consistent with [Géczy, Minton, and Schrand \(1997\)](#) and [Gay, Lin, and Smith \(2011\)](#), we do not find a significant relation between the derivatives hedging decision and the book-to-market ratio. A similar conclusion emerges both for the number of segments variable and the ownership30 dummy variable.

For the leverage specifications considered in model 1 and model 2, we see a significantly positive relation between the industry-adjusted leverage and derivatives use. This empirical finding is consistent with the well-known debt capacity argument raised in [Leland \(1998\)](#). Firm size and property, plant, and equipment are positively correlated with the industry-adjusted leverage. On the other hand, return on assets, and depreciation are negatively correlated with the level of leverage. However, we do not find a significant relation between the industry-adjusted leverage and SGA expenses. A statistically insignificant relation with the industry-adjusted leverage also appears for our blockholder ownership dummy variables.

1.3.5 Effects of firm size

To further deepen our understanding of the preceding empirical findings, we now investigate the effect of firm size on the relation between derivatives use and the cost of equity capital. In each year, we assign our sample of German non-financial firms to size terciles. By construction, tercile 1 (tercile 3) comprises the smallest (largest) one-third of the sample firms. We present the results of the univariate analysis in Table 1.5. In Panel A for the sample of smaller firms (tercile 1), we notice that derivatives users have a 237 (211) basis point lower cost of equity than non-users based on difference in mean (median) values, an estimate statistically significant at the 1% level. For the industry-adjusted estimates, users have a 94 (104) basis point lower cost of equity compared to that of non-users based on mean (median) values. We also observe that user firms have significantly lower risk factor betas than non-users. For example, the mean market, SMB, and HML betas for the user group are 1.0523, 0.5423, and 0.3172, respectively. The corresponding estimates for the non-user group are, respectively, 1.1959, 0.9144, and 0.3968.

Table 1.5: Univariate comparison of derivatives users and non-users: Size terciles

The table reports mean and median values of the cost of equity, industry-adjusted cost of equity, and market, small-minus-big (SMB), and high-minus-low (HML) factor betas for a sample of derivatives user and non-user German non-financial firms breaking down into size terciles. In Panel A, tercile 1 contains 666 firm-year observations of which 203 report using derivatives and 463 report non-use. In Panel B, tercile 2 contains 660 firm-year observations of which 583 report using derivatives and 77 report non-use. In Panel C, tercile 3 contains 658 firm-year observations of which 602 report using derivatives and 56 report non-use. See also notes to Table 1.2.

Variable	All firms		Derivatives users		Derivatives non-users		Difference tests	
	Mean	Median	Mean	Median	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
Panel A: Tercile 1 (the smallest 1/3 of the sample firms)								
Cost of equity	0.1053	0.1049	0.0889	0.0902	0.1126	0.1113	−0.0237***	−0.0211***
Industry-adjusted cost of equity	0.0124	0.0135	0.0059	0.0063	0.0153	0.0167	−0.0094***	−0.0104***
Market beta	1.1521	1.2285	1.0523	1.0989	1.1959	1.2853	−0.1436***	−0.1864***
SMB beta	0.8010	0.7490	0.5423	0.4889	0.9144	0.8631	−0.3721***	−0.3742***
HML beta	0.3725	0.3300	0.3172	0.3278	0.3968	0.3310	−0.0796***	−0.0032*
Panel B: Tercile 2 (the middle 1/3 of the sample firms)								
Cost of equity	0.0829	0.0829	0.0812	0.0811	0.0953	0.0960	−0.0141***	−0.0149**
Industry-adjusted cost of equity	0.0048	0.0043	0.0041	0.0036	0.0102	0.0096	−0.0061**	−0.0060**
Market beta	0.8635	0.8910	0.8551	0.8812	0.9273	0.9650	−0.0722***	−0.0838***
SMB beta	0.5485	0.4919	0.5217	0.4613	0.7513	0.7234	−0.2296***	−0.2621***
HML beta	0.3683	0.3748	0.3619	0.3700	0.4164	0.4109	−0.0545	−0.0409
Panel C: Tercile 3 (the largest 1/3 of the sample firms)								
Cost of equity	0.0685	0.0673	0.0677	0.0665	0.0773	0.0754	−0.0096**	−0.0089*
Industry-adjusted cost of equity	−0.0012	0.0002	−0.0011	0.0002	−0.0018	0.0007	0.0007	−0.0005
Market beta	0.6939	0.6966	0.6911	0.6976	0.7240	0.6861	−0.0329	0.0115
SMB beta	0.4884	0.4576	0.4701	0.4539	0.6851	0.6911	−0.2150	−0.2252
HML beta	0.3027	0.2962	0.3010	0.2942	0.3214	0.3181	−0.0204*	−0.0239*

In Panel B for mid-size firms (tercile 2), we find that derivatives users have a 141 (149) basis point lower cost of equity than non-users based on mean (median) values. Also, firms that use derivatives have a 61 (60) basis point lower industry-adjusted cost of equity than non-users based on mean (median) values. These apparent differences in mean (median) values between user and non-user groups are statistically significant at the 1% or 5% level. Moreover, derivatives user firms have lower market, SMB, and HML factor betas than non-users. But the mean and median differences in HML beta are statistically insignificant at conventional levels. For the sample of larger firms (tercile 3) in Panel C, the estimated cost of equity of user firms is significantly lower than that of non-users by 96 (89) basis points based on mean (median) values. Moreover, derivatives user firms have a significantly lower HML beta than do non-users.

Table 1.6: Derivatives use and the industry-adjusted cost of equity: Pooled OLS regressions for size terciles

The table reports the pooled ordinary least squares (OLS) regression results of the relation between a sample of German non-financial firms' industry-adjusted cost of equity and their use of derivatives, while breaking down firms into size terciles. The dependent variable is the industry-adjusted cost of equity. Numbers in parentheses are standard errors corrected for simultaneous clustering on firm and year. See also notes to Tables 1.2 and 1.3.

	Tercile 1		Tercile 2		Tercile 3	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept	0.0249*** (0.0055)	0.0245*** (0.0057)	0.0034 (0.0083)	0.0031 (0.0086)	-0.0069 (0.0091)	-0.0074 (0.0094)
Derivatives use	-0.0214*** (0.0089)	-0.0215*** (0.0082)	-0.0117 (0.0085)	-0.0111 (0.0084)	-0.0027 (0.0071)	-0.0026 (0.0070)
Industry-adjusted leverage	0.0309*** (0.0083)	0.0311*** (0.0085)	0.0369*** (0.0131)	0.0321*** (0.0120)	0.0177* (0.0107)	0.0167* (0.0101)
Book-to-market	0.0213** (0.0099)	0.0240*** (0.0101)	0.0253*** (0.0108)	0.0250*** (0.0107)	0.0154*** (0.0053)	0.0161*** (0.0052)
Illiquidity	0.0493*** (0.0137)	0.0472*** (0.0160)	0.0139*** (0.0038)	0.0132*** (0.0038)	0.0116* (0.0060)	0.0126** (0.0060)
Number of segments	-0.0040 (0.0053)	-0.0040 (0.0057)	-0.0034 (0.0046)	-0.0033 (0.0046)	-0.0040 (0.0051)	-0.0037 (0.0050)
Ownership30		-0.0054 (0.0127)		-0.0047 (0.0120)		0.0016 (0.0119)
Ownership30 ⁺		-0.0143** (0.0067)		-0.0150** (0.0075)		0.0027 (0.0076)
Number of observations	621		618		616	
Number of derivatives users	178		570		592	
Number of derivatives non-users	443		48		24	
Adjusted R^2	0.0972	0.0985	0.0721	0.0731	0.0604	0.0675

The empirical results in Table 1.5 also offer evidence that both the unadjusted and

industry-adjusted cost of equity estimates are decreasing in firm size. This is consistent with our earlier results, reported in Tables 1.3 and 1.4, which show that a firm's cost of equity capital is negatively correlated with its size. Furthermore, Table 1.5 demonstrates that the mean and median values for the market, SMB, and HML factor betas are decreasing in firm size.

Table 1.7: Type of derivatives use and the industry-adjusted cost of equity

The table reports the pooled ordinary least squares regression results of the relation between a sample of German non-financial firms' industry-adjusted cost of equity and the type of derivatives use. The dependent variable is the industry-adjusted cost of equity. Currency is a dummy variable that takes the value 1 if a firm reports the use of foreign currency derivatives and zero otherwise. Interest is a dummy variable that takes the value 1 if a firm reports the use of interest rate derivatives and zero otherwise. Commodity is a dummy variable that takes the value 1 if a firm reports the use of commodity derivatives and zero otherwise. The ratio of each segment sales to total sales is also incorporated in the pooled OLS regressions. Numbers in parentheses are standard errors corrected for simultaneous clustering on firm and year. See also notes to Tables 1.2 and 1.3.

	Model 1	Model 2
Intercept	0.0211*** (0.0061)	0.0210*** (0.0063)
Currency	-0.0095*** (0.0025)	-0.0094*** (0.0025)
Interest	-0.0033*** (0.0014)	-0.0032** (0.0014)
Commodity	-0.0015 (0.0016)	-0.0016 (0.0016)
Industry-adjusted leverage	0.0318*** (0.0056)	0.0320*** (0.0057)
Book-to-market	0.0644*** (0.0126)	0.0626*** (0.0130)
Illiquidity	0.0418*** (0.0072)	0.0417*** (0.0072)
Size	-0.0373*** (0.0092)	-0.0345*** (0.0097)
Number of segments	-0.0027 (0.0020)	-0.0029 (0.0021)
Ownership30		-0.0072 (0.0135)
Ownership30 ⁺		-0.0195*** (0.0069)
Number of observations	1855	
Number of derivatives users	1331	
Number of derivatives non-users	524	
Adjusted R^2	0.0502	0.0509

Using the multivariate framework, we now examine the relation between firms' industry-adjusted cost of equity and their use of derivatives broken down into size terciles. Table 1.6 presents the results from the pooled OLS regressions. For each size tercile, we consider

two model specifications similar to those used in Section 1.3.2.1. We observe, from model 1 for the sample of smaller firms (tercile 1), that the estimated coefficient of -0.0214 on the derivatives use dummy variable is statistically significant at the 1% level. In case of model 2 which controls for blockholder ownership, the corresponding coefficient of -0.0215 is also significant at the 1% level. These coefficient estimates suggest that user firms in the smaller tercile have a lower cost of equity than non-users.¹⁶ Consistent with [Gay, Lin, and Smith \(2011\)](#), we also do not find a significantly negative association between the cost of equity capital and derivative instruments use for the samples of mid-size (tercile 2) and larger (tercile 3) firms.

1.3.6 Type of derivatives use

In the context of the relation between German firm's hedging activities, through the derivatives use, and the cost of equity capital, it is also interesting to know whether the type of derivatives matters. To shed light on this issue, we repeat our baseline pooled OLS regression analysis by instead including three separate dummy variables for foreign currency, interest rate, and commodity derivatives use. Table 1.8 presents the results based on the industry-adjusted cost of equity. In model 1, which does not control for blockholder ownership in a firm, we see that the estimated coefficients of -0.0095 and -0.0033 , respectively, on the foreign currency and interest rate derivatives use dummies are statistically significant at the 1% level. This in turn implies that the use of both derivatives contributes to the overall reduction in firm's cost of equity. More so, the estimated coefficient on the foreign currency derivatives use is significantly higher in absolute terms than that of the interest rate derivatives use coefficient. The p -value for the test of the null hypothesis that the coefficients are equal is 0.0473. This finding is not surprising considering the fact that listed German firms export a significant fraction of their output outside of the European Union, which exposes them to relatively higher levels of exchange rate risk compared to their exposure to interest rate movements. However, our estimated coefficient of -0.0015 on the commodity derivatives use dummy variable is statistically indistinguishable from

¹⁶ We find qualitatively identical results in an unreported exercise based on the unadjusted cost of equity.

zero. Similar empirical findings emerge from model 2 which incorporates blockholder ownership dummies. The use of both foreign currency and interest rate derivatives are associated with the reduction in the cost of equity capital for user firms. Once again, the estimated coefficient on the commodity derivatives use dummy turns out to be statistically insignificant at conventional levels.¹⁷ In sum, the empirical evidence suggests that the use of foreign currency and, to a lesser extent, interest rate derivatives helps reduce the cost of equity estimates for derivatives user German non-financial firms in our sample. We note that [Gay, Lin, and Smith \(2011\)](#) also report a similar finding in the context of US non-financial firms.

1.3.7 New users of derivatives

In our preceding empirical analysis, one could argue that derivatives non-user group is not an appropriate benchmark for comparing users due to differences in firm-level characteristics. To help mitigate this concern, we also investigate the change in the cost of equity capital experienced by firms that were non-users of derivatives and subsequently initiated derivatives programs. Following [Gay, Lin, and Smith \(2011\)](#), a firm is categorized as a new user of derivative instrument(s) if it reports derivatives use in year t , but does not report a position in derivatives prior to year t during our sample period. This classification gives us a sub-sample of 86 non-financial firms that are identified as new users of derivatives.

Table 1.9 presents mean and median changes in the cost of equity, industry-adjusted cost of equity, and market, SMB, and HML factor betas. Consistent with our baseline empirical results, we find that new users experience a significant mean (median) reduction in the cost of equity of 246 (253) basis points in the first year of adoption. The mean and median reductions in the industry-adjusted cost of equity are, respectively, 286 and 287 basis points. Both of these estimates are statistically significant at the 1% level. New user firms also experience a significant mean (median) reduction in their market, SMB, and HML factor betas.

¹⁷ The results based on the unadjusted cost of equity are qualitatively similar to those reported in this section. To conserve space, these are omitted in this paper.

Table 1.8: Type of derivatives use and the industry-adjusted cost of equity

The table reports the pooled ordinary least squares regression results of the relation between a sample of German non-financial firms' industry-adjusted cost of equity and the type of derivatives use. The dependent variable is the industry-adjusted cost of equity. Currency is a dummy variable that takes the value 1 if a firm reports the use of foreign currency derivatives and zero otherwise. Interest is a dummy variable that takes the value 1 if a firm reports the use of interest rate derivatives and zero otherwise. Commodity is a dummy variable that takes the value 1 if a firm reports the use of commodity derivatives and zero otherwise. The ratio of each segment sales to total sales is also incorporated in the pooled OLS regressions. Numbers in parentheses are standard errors corrected for simultaneous clustering on firm and year. See also notes to Tables 1.2 and 1.3.

	Model 1	Model 2
Intercept	0.0211*** (0.0061)	0.0210*** (0.0063)
Currency	-0.0095*** (0.0025)	-0.0094*** (0.0025)
Interest	-0.0033*** (0.0014)	-0.0032** (0.0014)
Commodity	-0.0015 (0.0016)	-0.0016 (0.0016)
Industry-adjusted leverage	0.0318*** (0.0056)	0.0320*** (0.0057)
Book-to-market	0.0644*** (0.0126)	0.0626*** (0.0130)
Illiquidity	0.0418*** (0.0072)	0.0417*** (0.0072)
Size	-0.0373*** (0.0092)	-0.0345*** (0.0097)
Number of segments	-0.0027 (0.0020)	-0.0029 (0.0021)
Ownership30		-0.0072 (0.0135)
Ownership30 ⁺		-0.0195*** (0.0069)
Number of observations	1855	
Number of derivatives users	1331	
Number of derivatives non-users	524	
Adjusted R^2	0.0502	0.0509

1.4 Conclusion

Despite the widespread use of derivatives for active corporate risk management, there is hardly any empirical evidence available regarding the impact of financial hedging on the cost of equity outside of the US. This paper examines the relation between firms' derivatives use and the cost of equity capital for a sample of German non-financial firms. We use hand-collected data on derivatives hedging and compute firm's cost of equity capital based on the [Fama and French \(1993\)](#) three-factor model. Our univariate analysis shows that user firms experience, on average, 306 basis points lower cost of equity than non-

Table 1.9: Changes in the cost of equity and risk characteristics of new users of derivatives

The table reports changes in the cost of equity, industry-adjusted cost of equity, and market, small-minus-big (SMB), and high-minus-low (HML) factor betas for a sample of 86 German non-financial firms that initiated derivatives programs during the sample period. A firm is categorized as a new user of derivatives if it reports derivatives use in year t , but does not report a position in derivatives prior to year t . See also notes to Table 1.2.

Variable	Mean change	Median change	Std. dev.
Cost of equity	−0.0246***	−0.0253***	0.0175
Industry-adjusted cost of equity	−0.0286***	−0.0287***	0.0151
Market beta	−0.0750***	−0.0778***	0.1248
SMB beta	−0.0192***	−0.0185***	0.0347
HML beta	−0.0209**	−0.0227**	0.0932

users. When considering the industry-adjusted estimate, derivatives users still enjoy, on average, 109 basis points lower cost of equity. We also find that the reduction in the cost of equity of derivatives user firms is attributable to their lower market, SMB, and HML factor betas. This observation is consistent with the notion that firm’s use of derivative instruments is associated with the lowering of financial distress risk and this distress risk has a systematic component, which is priced in the cross-section of stock returns.

Our finding of a negative relation between derivatives use and the cost of equity capital remains robust to multivariate specifications and specifications that accounts for potential endogeneity arising from a firm’s derivatives hedging and capital structure decisions. Our empirical analysis also reveals that the reduction in the cost of equity capital is largest for smaller firms and for firms that use foreign currency and interest rate derivative instruments. We find that new user firms experience a significant reduction in the cost of equity in the first year of adoption. The reduction in the cost of equity stems from lower exposures to the market, SMB, and HML risk factors. In sum, our examination of the impact of derivatives use on the cost of equity provides useful insights for corporations wishing to use derivatives as a means to reduce their cost of financing capital.

Appendix

Table 1.10: Descriptive statistics

The table reports descriptive statistics for firm characteristics of a sample of derivatives user and non-user German non-financial firms used in the empirical analysis. The sample period is from 1999 to 2009. See also notes to Tables 1.2–1.4.

Variable	All firms			Derivatives users			Derivatives non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
Industry-adjusted leverage	1984	0.0395	0.0448	1388	0.0512	0.0564	596	0.0121	0.0178	0.0391***	0.0386***
Book-to-market	1984	0.7024	0.6203	1388	0.6934	0.5882	596	0.7233	0.6952	−0.0299**	−0.1070
Illiquidity	1984	0.0187	0.0159	1388	0.0139	0.0106	596	0.0298	0.0282	−0.0159***	−0.0176***
Size	1984	5.9800	5.6903	1388	6.7050	6.3189	596	4.2915	4.2265	2.4135***	2.0924***
Number of segments	1984	3.3669	3.0000	1388	3.6070	3.0000	596	2.8077	3.0000	0.7993***	0.0000
Quick ratio	1984	0.5215	0.4369	1388	0.3851	0.2668	596	0.8390	0.8331	−0.4359***	−0.5663***
Foreign sales to net sales	1984	0.3660	0.3370	1388	0.4564	0.4817	596	0.1554	0.0000	0.3010***	0.4817***
Depreciation	1984	0.0341	0.0284	1388	0.0366	0.0313	596	0.0284	0.0218	0.0082***	0.0095***
Return on assets	1984	4.5284	4.7956	1388	4.7944	5.1200	596	3.9090	4.0400	0.8854***	1.0800***
SGA expenses	1984	0.2164	0.1629	1388	0.2390	0.1922	596	0.3001	0.2359	−0.0886***	−0.0406***
Property, plant, and equipment	1984	0.2208	0.1813	1388	0.2433	0.2200	596	0.1683	0.0911	0.0750***	0.1289***

Table 1.11: Correlations of firm characteristics

The table reports Pearson product-moment correlation coefficients of firm characteristics. Numbers in italic denote statistical significance at the 1% level. See also notes to Tables 1.2–1.4.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Industry-adjusted cost of equity	(1)	1.0000														
Market beta	(2)	<i>0.4670</i>	1.0000													
SMB beta	(3)	<i>0.4800</i>	<i>0.0874</i>	1.0000												
HML beta	(4)	<i>0.4812</i>	<i>-0.0820</i>	<i>0.0778</i>	1.0000											
Industry-adjusted leverage	(5)	<i>0.0770</i>	<i>0.0424</i>	<i>0.0449</i>	<i>0.0655</i>	1.0000										
Book-to-market	(6)	<i>0.0950</i>	<i>0.0379</i>	<i>-0.2693</i>	0.0598	<i>0.0737</i>	1.0000									
Illiquidity	(7)	<i>0.0410</i>	<i>0.0806</i>	<i>-0.0641</i>	-0.1309	<i>-0.0976</i>	<i>0.2191</i>	1.0000								
Size	(8)	<i>-0.0289</i>	<i>-0.0533</i>	<i>-0.0605</i>	<i>-0.0677</i>	<i>0.1647</i>	<i>-0.0332</i>	<i>0.2829</i>	1.0000							
Number of segments	(9)	-0.0045	-0.0203	<i>-0.0316</i>	-0.0545	-0.0566	0.0291	<i>-0.0752</i>	<i>0.4871</i>	1.0000						
Quick ratio	(10)	<i>0.0128</i>	0.0142	0.0325	<i>-0.0699</i>	<i>-0.2341</i>	-0.0317	-0.0111	<i>-0.1980</i>	<i>-0.1180</i>	1.0000					
Foreign sales to net sales	(11)	-0.0083	-0.0529	<i>0.0501</i>	-0.0289	<i>0.0634</i>	0.0064	<i>-0.1522</i>	<i>0.4264</i>	<i>0.1848</i>	<i>-0.0820</i>	1.0000				
Depreciation	(12)	-0.0179	0.0187	-0.0298	<i>-0.0589</i>	<i>-0.0766</i>	<i>0.0666</i>	0.0377	<i>0.1356</i>	<i>0.1066</i>	<i>-0.1573</i>	-0.0209	1.0000			
Return on assets	(13)	-0.0293	<i>-0.0934</i>	0.0208	-0.0050	0.0110	<i>-0.1712</i>	<i>-0.1362</i>	<i>0.1572</i>	0.0218	<i>-0.0672</i>	<i>0.0998</i>	<i>-0.0679</i>	1.0000		
SGA expenses	(14)	<i>0.0035</i>	<i>0.0274</i>	<i>0.0197</i>	0.0318	<i>-0.1382</i>	<i>-0.1524</i>	<i>-0.0726</i>	<i>-0.2796</i>	<i>-0.1525</i>	<i>0.0209</i>	<i>-0.0568</i>	0.0262	<i>-0.0447</i>	1.0000	
Property, plant, and equipment	(15)	<i>-0.0259</i>	<i>-0.0278</i>	<i>-0.0182</i>	<i>-0.0884</i>	<i>0.2579</i>	<i>0.0972</i>	0.0313	<i>0.2988</i>	<i>0.1709</i>	<i>-0.1647</i>	<i>-0.0258</i>	<i>0.6114</i>	<i>0.0752</i>	<i>-0.2108</i>	1.0000

Table 1.12: Derivatives use and the cost of equity: Pooled OLS regressions

The table reports the pooled ordinary least squares (OLS) regression results of the relation between a sample of German non-financial firms' cost of equity and their use of derivatives. The dependent variable is the cost of equity. See also notes to Table 1.3.

	Model 1	Model 2
Intercept	0.0742*** (0.0135)	0.0774*** (0.0186)
Derivatives use	-0.0440*** (0.0102)	-0.0428*** (0.0109)
Leverage	0.0947*** (0.0197)	0.0986*** (0.0204)
Book-to-market	0.0761*** (0.0093)	0.0752*** (0.0098)
Illiquidity	0.0462*** (0.0076)	0.0466*** (0.0082)
Size	-0.0405*** (0.0093)	-0.0427*** (0.0104)
Number of segments	-0.0020 (0.0023)	-0.0021 (0.0023)
Ownership30		-0.0099 (0.0116)
Ownership30 ⁺		-0.0189*** (0.0053)
Number of observations	1855	
Number of derivatives users	1331	
Number of derivatives non-users	524	
Adjusted R^2	0.0747	0.0766

Table 1.13: Derivatives use and the cost of equity: Simultaneous equations analysis

The table reports results of the relation between firms' cost of equity, derivatives use, and leverage, estimated within a simultaneous equations framework. See also notes to Table 1.4.

Dependent variable: Variable/estimation method	Model 1			Model 2		
	Cost of equity OLS	Derivatives Probit	Leverage OLS	Cost of equity OLS	Derivatives Probit	Leverage OLS
Intercept	0.1036*** (0.0268)	-1.8493*** (0.3566)	0.0313* (0.0166)	0.1047*** (0.0273)	-1.7747*** (0.3628)	0.0378* (0.0198)
<i>Endogenous variables</i>						
Derivatives use	-0.0467*** (0.0103)		0.0536*** (0.0212)	-0.0478*** (0.0111)		0.0535*** (0.0215)
Leverage	0.1701*** (0.0239)	0.3822*** (0.0554)		0.1739*** (0.0232)	0.3879*** (0.0557)	
<i>Exogenous variables</i>						
Book-to-market	0.0860*** (0.0125)	-0.2031 (0.1713)	0.0837*** (0.0159)	0.0787*** (0.0134)	-0.2036 (0.1701)	0.0835*** (0.0160)
Illiquidity	0.0614*** (0.0215)			0.0639*** (0.0227)		
Size	-0.0741*** (0.0175)	0.4595*** (0.0774)	0.0438*** (0.0047)	-0.0737*** (0.0183)	0.4631*** (0.0773)	0.0440*** (0.0049)
Number of segments	-0.0045* (0.0024)	-0.0038 (0.0056)		-0.0061* (0.0035)	-0.0040 (0.0056)	
Quick ratio		-0.0707** (0.0317)			-0.0710** (0.0320)	
Foreign sales to net sales		1.6445*** (0.3145)			1.6520*** (0.3200)	
Property, plant, and equipment			0.2291*** (0.0445)			0.2327*** (0.0457)
Depreciation			-0.3787* (0.2259)			-0.3816* (0.2278)
Return on assets			-0.1630*** (0.0529)			-0.1712*** (0.0530)
SGA expenses			-0.0757 (0.0495)			-0.0760 (0.0501)
Ownership30				-0.0112 (0.0126)	-0.0189 (0.0200)	0.0279 (0.0175)
Ownership30 ⁺				-0.0266** (0.0135)	0.0399** (0.0181)	0.0214 (0.0153)
Number of observations	1855					
Number of derivatives users	1331					
Number of derivatives non-users	524					
Adjusted R^2	0.0870		0.2364	0.0872		0.2431
Log-likelihood		-774.0460			-776.2013	

Chapter 2

Derivatives Use and Financial Distress Risk: Evidence from Germany

2.1 Introduction

Financial distress cost has widely been examined in both asset pricing and corporate finance studies¹. A recent stream of corporate finance studies divulge on firms risk management strategies using derivatives and its impact on financial distress (e.g. cost of equity, cost of debt) and potential value implications (e.g. investment). For instance, [Campello, Lin, Ma, and Zou \(2011\)](#) investigate impact of hedging on the cost of debt for the US non-financial firms and the value implication of hedging via investment. Empirical study by [Gay, Lin, and Smith \(2011\)](#) suggests that the derivatives using firms have lower cost of equity via reduction in financial distress risk. Most recently [Chen and King \(2014\)](#) identifies that the firms using derivatives have lower cost on public debt.

Recent empirical investigations on the impact of hedging² on financial distress risk are focused on the US non-financial firms. Firms in the US belong to the market-oriented financial system³. Therefore, empirical results for the US might not be valid for the

¹Voluminous asset pricing studies examine the relationship between distress risk and cross-section of expected stock returns (see [Campbell, Hilscher, and Szilagyi \(2008\)](#), [Chava and Purnanandam \(2010\)](#), [George and Hwang \(2010\)](#), [Garlappi and Yan \(2011\)](#)). Corporate finance studies look at a wide variety of dimension. For instance, [Kahl \(2002\)](#) provides a theoretical framework whereby creditors with the precise information on firms probability of recovery can decide whether to liquidate the firm or not. Empirical investigation by [Almeida and Philippon \(2007\)](#) suggests that the firms use less leverage due to its potential distress risk which could potentially be larger than the marginal tax benefits of debt.

²We use derivatives use and hedging interchangeably throughout this paper, which indicates financial hedging.

³Financial market where tradeable securities are the dominant form of financial asset is referred

firms that belong to bank-based financial system⁴. For instance, a study by [Antoniou, Guney, and Paudyal \(2008\)](#) on the capital structure for the capital-market oriented versus bank-oriented institutions suggests that the capital structure of the firm is dependent on the country specific factors (e.g. corporate governance, tax system, investor protection). [Fauver and Naranjo \(2010\)](#) identify that the firm value implication of the hedging decision is dependent on the country-specific and firm-level corporate governance. Therefore, this study makes an attempt to investigate the impact of derivatives use on the financial distress risk of the German non-financial firms.

The financial distress risk and its associated cost is dependent on the bankruptcy code. Recently, [Bolton and Oehmke \(2015\)](#) suggest that the priority claims order can be violated via hedging. In the US, the absolute priority violation is a predominant phenomenon. Bankruptcy code in the US and Germany is far different which has been thoroughly discussed by [Franks, Nyborg, and Torous \(1996\)](#). Considering the difference in corporate governance, financial system and bankruptcy code between the US and Germany this study attempts to identify the impact of derivatives use on the German non-financial firms' distress risk. This study explicitly considers financial distress risk due to the potential cost of financial distress. [Glover \(2016\)](#) suggests that the cost of financial distress at the time of default is on average 45% of firm value which is higher than the existing empirical estimates⁵.

Prior empirical studies on hedging have paid very little attention on the bank-based economies. There are no studies that have used hand collected data entirely dedicated to analyze the impact of derivatives use on the bank-based financial system following firms⁶. Prior survey-based cross-country study by [Bodnar and Gebhardt \(1999\)](#) compare and contrast the risk management practices in the US and Germany. They suggest that

to as market-oriented financial system. This system channel funds quickly to the new firms and market tends to be highly volatile ([Vitols, Casper, Soskice, and Woolcock \(1997\)](#)).

⁴The bank-based financial system is referred to as the financial system where bank deposits and direct loans are key financial assets. Firms in the bank-based financial system widely rely on bank loan for financing ([Beck and Levine \(2002\)](#)).

⁵Extant prior studies predicts 5.3% and 21.7% by [Warner \(1977\)](#) and [Davydenko, Strebulaev, and Zhao \(2012\)](#) respectively.

⁶[Bodnar and Gebhardt \(1999\)](#) and [Bodnar, Consolandi, Gabbi, and Jaiswal-Dale \(2013\)](#) take an attempt using the survey data. Further, [Bartram, Brown, and Fehle \(2009\)](#) and [Allayannis, Lel, and Miller \(2012\)](#) conduct a cross-country analysis using the hand-collected data, but there are no studies focused on country-specific analysis for bank-oriented institutions.

both of the countries have some similarities and dissimilarities⁷. Therefore, presuming the derivatives use impact for German firms to be similar to the US firms, would be simply an error without empirical validation. Following this, we make an attempt to verify some stylized facts which have been verified for the US firms.

To investigate the impact of hedging on distress risk for German non-financial firms, this study uses hand-collected data from the annual reports of publicly listed firms over the period of 1999-2010. The sample consists of 2112 firm-year observations. Distress risk is measured by the 1- and 5-year probability of default. We collect this data from Moody's Analytics. We initially use univariate and multivariate pooled OLS to identify the relationship between derivatives use and financial distress risk of the firm. However, the results obtained from pooled OLS regression cannot be interpreted conclusive evidence of causal relationship due to omitted variable bias⁸. We use treatment effect model to verify our results obtained using the pooled OLS. Considering the prior studies, this study identifies that derivatives use has significant negative impact on the firm distress risk. Our results complement the study of [Purnanandam \(2008\)](#)⁹.

This study contributes to the literature in three ways. First, this study first makes an attempt to analyze the impact of derivatives use on the bank-oriented German non-financial firms using hand collected hedging data. Therefore, this study provides an empirical validation how the use of derivatives can benefit the bank-based German non-financial firms or the firms incorporated in the countries alike. This supports the argument made by [Smith and Stulz \(1985\)](#) and [Froot, Scharfstein, and Stein \(1993\)](#). Secondly, this study shows the impact of foreign currency and interest rate derivatives use on distress risk borne by the firms. Finally, results of this study contribute to the understanding of which type of derivatives instrument(s) use can mitigate the financial distress risk of the firm.

⁷For instance, both of the countries use derivatives to mitigate the risk exposure of the firm. However, the primary motive for the US firms is to reduce the cash flow volatility, whereas for German firms primary motive is to accounting earnings management.

⁸This is thoroughly discussed in Section 3.3.

⁹Our results are not exactly comparable to those found for the US due to the differences exist between sample selection, time period differences and proxy of distress risk. For instance, [Purnanandam \(2008\)](#) uses sample firms from 1996-1998, whereas our sample comprises of 1999-2010. Our sample covers the financial crisis period. Most importantly, [Purnanandam \(2008\)](#) uses leverage as a proxy for financial distress. In our study we use market based 1- and 5-year EDF as a proxy for financial distress.

Remainder of this paper is organized in the following way. We discuss related literature in Section 2.2. The empirical model specification is discussed in Section 2.3. Data requirement and collection is discussed in Section 2.4. Empirical results are discussed in Section 2.5. Finally, this study concludes in Section 2.6.

2.2 Related Literature

Modigliani and Miller (1958) paradigm of perfect capital market suggests that corporate risk management is not valuable. However, in the existence of capital market imperfection in the Modigliani and Miller (1958) paradigm allows the firm to reduce the risk (e.g. distress risk (see Smith and Stulz (1985) and Purnanandam (2008)), increase debt capacity (Leland (1998)), and reduce underinvestment (see Bessembinder (1991) and Froot, Scharfstein, and Stein (1993))) and increase firm value by employing corporate risk management techniques. However, risk management studies are widely concentrated on the market-oriented US firms.

Indeed the empirical investigations that investigate the impact of derivatives use on the firm value, distress risk, investment, cash flow volatility or the cost of capital for the US firms contribute to the risk management literature. The US firms belong to market based financial system where the shareholders are disburse and the banks act as an external source of financing for the non-financial firms. Hence, they may not experience a similar impact as firms in the bank based economies (e.g. Germany, France, Italy, Japan). To illustrate we consider Germany¹⁰, where unlike the US market oriented financial system the country follows bank based financial system. Banks shareholding to the non-financial firms are not restricted, whereby the banks can have voting power on the company. Moreover, due to the proxy voting many banks can vote for the corporate decision making.

In addition to this, blockholding is a common phenomenon in Germany. This indicates that only a handful of shareholders own a higher percentage of the company shares. The implication of the blockholding on the firm value implication is also ambiguous. For

¹⁰We do not consider other bank based countries. The focus of our study is Germany. The painstaking process of hedging data collection from the annual report restrict us from doing multiple country analysis.

instance, [Jensen and Meckling \(1976\)](#) argue the blockholding will reduce the agency costs between management and shareholders due to blockholders participation in the board. However, [Fama and Jensen \(1983\)](#) argue that the blockholders can benefit from this extra blockholding via tunneling the cash flows. Therefore, the risk management of the German firms and its outcome from risk management could be different to that of market based countries such as the US and the UK.

The cross-country differences in bankruptcy have potential impact on the financial distress (see [Franks, Nyborg, and Torous \(1996\)](#)). For instance, the US Chapter 11 bankruptcy code allows large firms to survive through restructuring. However, the probability for liquidation of the small firms is high. Even though the German bankruptcy procedure (named as *Insolvenzordnung*) has some resemblance of the US Chapter 11, it restricts firms to be restructured within three-months. Therefore, probability of liquidation for German firms is likely to be higher than the US firms ¹¹.

In relation to this, a recent argument made by [Bolton and Oehmke \(2015\)](#) portrays that during bankruptcy firms using derivatives in the US enjoy special status. At the time of default, derivative counterparties can collect payment from defaulted counterparty through netting, closeout and collateralization provisions (see [Bolton and Oehmke \(2015\)](#)). However, for the UK and Germany this might not be applicable by taking into consideration the argument made by [Hellwig and Kenadjian \(2012\)](#)¹². Hence, the extant empirical findings on the impact of derivatives use on financial distress risk for the US firms might not hold for German firms.

The benefit from the reduction of the financial distress is multifaceted. For instance, [Stulz \(1996\)](#) argue that the value of the firm is appreciable if the firm can implement costless risk management program which reduces the bankruptcy costs. The theoretical evidence of [Leland \(1998\)](#) shows that the derivatives use increases the debt capacity of the firm, whereby the firms with higher level of debt increases its value through incremental

¹¹This study does not claim that the probability of the financial distress for the US firms is lower than German firms. Prior empirical investigations are insufficient to draw such conclusion. However, considering only the restructuring time limitation, this is plausible that German firms have higher distress risk than the US firms. For more comprehensive details see [Franks, Nyborg, and Torous \(1996\)](#).

¹²An empirical analysis by [Davydenko and Franks \(2008\)](#) provides further explanation.

tax shield benefit from extra debt use. This possible firm value implication of derivatives use motivates this study to examine the impact of derivatives on the distress risk of the firm.

The extant literature examining the impact of derivatives use on the distress risk of the firm use leverage as a proxy for financial distress. We do not argue that the leverage is not an appropriate proxy for financial distress. However, we suggest based on the prior studies (see [Garlappi, Shu, and Yan \(2008\)](#) and [Garlappi and Yan \(2011\)](#)) this study considers to use the financial distress risk proxy measure based on the market-based data. Therefore, we use 1- and 5-year EDF data, collected from Moody’s Analytics to measure the probability that the firm will default within 1 and 5 year, respectively.

While earlier studies on hedging concentrate on the US market-oriented firms, very little is emphasized on the firms operating in the bank-oriented system. In this study, we extend the literature by focusing on the impact of derivatives use on the distress risk for the German firms. German firms are considered as traditional bank-oriented firms ([Gorton and Schmid \(2000\)](#)).

2.3 Description of Data Collection

We consider publicly listed German non-financial firms irrespective of the firm size to avoid the predominant sample selection bias that has been widely observed in the prior empirical studies. For instance, extant studies consider Fortune 500 firms with revenue greater than \$500 million or assets greater than \$500 million (e.g. [Géczy, Minton, and Schrand \(1997\)](#), [Gay, Lin, and Smith \(2011\)](#))¹³.

Like, some of the hedging studies (e.g. [Gay, Lin, and Smith \(2011\)](#) collect hedging data for the period 1992-1996 from Swaps Monitor Publications, Inc.) we do not collect hedging data from any data provider. Similar to [Géczy, Minton, and Schrand \(1997\)](#), [Purnanandam \(2008\)](#) and [Campello, Lin, Ma, and Zou \(2011\)](#) we hand collect derivatives use

¹³This study does not consider all listed non-financial firms. Because, many firm discloses the annual report in German language. Recent year annual reports are available in portable document format (PDF) which can be translated using Google translator. However, the earlier reports cannot be translated due to picture format PDF file. Moreover, some of the recent annual reports cannot be translated or partially translated when we use the Google document translation tool.

information from the annual reports. This study searches for the following keywords to locate information on derivatives use and hedging strategies “hedge”, “derivatives”, “market risk”, “exposure”, “foreign exchange”, “interest rate”, “commodity”, “futures”, “options”, “swap”, “risk management”, “forward”, and “financial instrument” in the annual reports of German non-financial firms. After locating the keyword(s), we read the surrounding texts to verify if the firm is a derivatives user or not for that particular firm-year. We hand-code as “1”, if the surrounding text provide any information that the firm is using derivatives, otherwise hand-code “0”. Therefore, “0” indicates that the firm is a non-user of derivatives for the corresponding year of the annual report. The following examples provide a glimpse of how we hand-code the derivatives use indicator —

1. “As an enterprise with worldwide operations, business is conducted in a variety of currencies, from which currency risks arise. Since a significant portion of Group revenues are generated outside the euro currency region and the procurement of production material and funding is also organised on a worldwide basis, currency risk is an extremely important factor for Group earnings. At 31 December 2007, derivative financial instruments were in place to hedge exchange rate risks, in particular for the currencies US dollar, British pound, Canadian dollar and Japanese yen. The hedging contracts comprise mainly option and forward currency contracts”—BMW Group Annual Report 2007 (p. 125)
2. “Derivative financial instruments do not exist. The MEDICLIN Group is engaged in domestic activities only. Foreign currency transactions were not carried out, nor do other currency risks exist.....there exists an interest rate risk due to the potential changes in market interest rates. This risk is counteracted by purchasing appropriate maturities.”—Mediclin AG Annual Report 2008 (p. 57 & 118)
3. “....the Group is in general only exposed to interest rate and other market risks arising in the normal course of business. The group does not hold or issue derivative financial instruments for trading purposes or to hedge against fluctuations in interest

rates and foreign exchange rates as there is no real requirement to do so from today's point of view....." Vtion Wireless Technology AG Annual Report 2009 (p. 88)

4. "... Celesio is exposed among other things— to risks resulting changes in exchange rate and interest rates. Based on a risk appraisal, selected hedging instruments are use to limit these risks.....Interest caps, collars, and swaps were used in the fiscal year to hedge interest rate risk." Celesio AG Annual Report 2006 (p. 165)

In the BMW Group 2007 annual report (*example 1*), it is explicitly mentioned that the firm is exposed to foreign currency risk. Therefore, the firm uses foreign currency options and forward contracts. Hereby, we hand code firm-year observation as "1" in "derivatives use" indicator and "foreign currency derivatives" indicator respectively. However, Mediclin AG (*example 2*) and Vtion Wireless Technology AG (*example 3*) annual report of 2008 and 2009 respectively provide enough information that these firms did not use any derivatives instruments for the corresponding year of the annual report. Therefore, we hand-code "0" for all hedging dummies (e.g. derivatives use indicator, foreign currency derivatives indicator, interest rate derivatives indicator, commodity price derivatives indicator) for the year corresponding to the annual report.

In the final example of Celecio AG (*example 4*), we hand-code "1" in derivatives use indicator and interest rate derivatives indicator. Because, the firm provides enough information about the use of derivatives. More specifically, it is explicitly stated in the annual report of the firm that it uses interest rate derivatives to reduce its interest rate risk exposure. Therefore, we hand-code interest rate derivatives as "1". In addition to this, we also hand-code "0" for foreign currency derivatives and commodity price derivatives indicator for the corresponding firm-year observation.

To proceed for the empirical examination of this we require also firm specific daily and annual data. To construct the variable excess return and equity volatility we collect daily return index data for all listed stocks from Datastream. We also the annual data from Datastream. The sample of this study spans from 1999 to 2010 and has 2112 firm-year observations.

2.4 Empirical Model Specification

The extant hedging theories propose a straightforward connection between hedging and distress risk. [Smith and Stulz \(1985\)](#) and [Purnanandam \(2008\)](#) argue that hedging reduces financial distress risk. Using leverage as a proxy for financial distress [Purnanandam \(2008\)](#) suggests that the use of derivatives reduces financial distress for the US non-financial firms. Instead of using leverage as a proxy for financial distress, we consider 1- and 5-year EDF as a proxy for financial distress which is widely been used to forecast corporate default (see [Garlappi, Shu, and Yan \(2008\)](#), [Garlappi and Yan \(2011\)](#)). To examine the relationship between hedging and EDF, this study considers the following model:

$$\begin{aligned} \text{EDF}_{i,t} = f(\text{Derivatives}_{i,t}, \text{Leverage}, \text{Firm size}_{i,t}, \text{Profitability}_{i,t}, \\ \text{Equity volatility}_{i,t}, \text{Excess return}_{i,t}, \text{Cash ratio}_{i,t}, \text{Year dummies}) \end{aligned} \quad (2.1)$$

EDF is a market-based measure of distress risk, sourced from Moody's Analytics. 1- and 5-year EDF measures the probability that the firm will default within 1 and 5 year(s) time respectively. EDF is calculated using the Vasicek-Kealhofer model following the framework of [Merton \(1974\)](#) and calibrated through a comprehensive historical default database. In the empirical studies conducted by [Garlappi, Shu, and Yan \(2008\)](#) and [Garlappi and Yan \(2011\)](#) use EDF as a proxy for financial distress. These studies suggest that EDF is suitable for practical analysis ¹⁴.

This study sources data on the use of derivatives from the annual report of German non-financial firms over the period of 1999-2010. Similar to other studies we do not consider financial firms. The risk management practices and motives for financial and non-financial firms are different. Most importantly, financial firms might hold derivatives for the purpose of trading. The extant literature argues that the risk management practices of financial and non-financial firms are not comparable due to statutory capital requirements, capital structure, and government regulations. Prior studies on hedging (e.g. [Géczy, Minton, and](#)

¹⁴Earlier studies (e.g. [Bharath and Shumway \(2008\)](#), [Campbell, Hilscher, and Szilagyi \(2008\)](#)) argue that Merton's DD model can easily be improved upon conditioning on other variables. [Campbell, Hilscher, and Szilagyi \(2008\)](#) and [Bharath and Shumway \(2008\)](#) provide hazard and naïve model respectively. They argue that their model predictability is higher than the DD model. We do not take a stance on which model has higher forecasting power, rather following the prior empirical studies this study uses Moody's Analytics EDF measure as a proxy for distress risk.

Schrand (1997), Campello, Lin, Ma, and Zou (2011), Gay, Lin, and Smith (2011), Chen and King (2014)) use either dichotomous (dummy variable) or continuous (aggregate notional amount) or both measures as proxy for derivatives use.

The empirical studies (e.g. Graham and Rogers (2002), Campello, Lin, Ma, and Zou (2011), Gay, Lin, and Smith (2011)) that consider both binary and continuous measure of hedging find qualitatively similar results. Haushalter, Klasa, and Maxwell (2007) argue that all of the measurement approaches that are followed by the prior research are inexact¹⁵. Moreover, the firms in Germany are less reliant on stock market and have reluctant accounting disclosure requirements (Gorton and Schmid (2000)). Therefore, the firms rarely disclose the notional amount of derivatives use and position. Given the difficulty of obtaining continuous measure of derivatives use from the annual reports and profound qualitatively similar results using both measure by prior studies, we consider the binary approach.

Along the lines of Purnanandam (2008), Froot, Scharfstein, and Stein (1993) and Smith and Stulz (1985), we expect derivatives using firms to have a lower EDF compared to non-users. Firms with a higher level of leverage are exposed to a higher level of financial distress risk. Following Purnanandam (2008), we use leverage as proxy for the source of distress risk of the firm. Leverage is measured as the sum of current portion of long-term debt and long-term debt scaled by total assets. Bartram, Brown, and Conrad (2011) suggest that the firms with higher leverage are exposed to higher systematic risk. Prior empirical studies by Chava and Jarrow (2004) and Campbell, Hilscher, and Szilagyi (2008) identify positive association between leverage and bankruptcy. Therefore, we expect positive relationship between leverage and EDF.

The firm size has disproportional effect on financial distress as argued by Warner (1977). The author suggests that size is negatively related to EDF. Following the empirical support from several studies (e.g. Warner (1977), Shumway (2001), Chava and Jarrow (2004)) that size is negatively related with distress risk, this study considers firm size. This study computes firm size as natural logarithm of total assets. The empirical evidence

¹⁵Dummy variable does not measure the intensity of derivatives use by the firm. Whereas, continuous measure of derivatives use without knowing the direction of the position is insufficient to verify the hedging strategy of the firm.

by [Campbell, Hilscher, and Szilagyi \(2008\)](#) suggests that, profitability of the firm reduces financial distress. Firms with higher profitability intuitively will have higher cash inflows whereby the increased liquidity and debt servicing ability of the firm will lower the default risk. In addition to this, highly profitable firms can use internally generated funds to fulfill the investment requirement. This reduces the demand for costly external funds (e.g. new equity issue or debt financing), which could potentially reduce the probability of default. Therefore, we consider profitability of the firm which is computed as the ratio of income before extraordinary items to total assets.

Liquidity of the firm is referred to widely recognized factor for firms' default predictability (see [Altman \(1968\)](#) and [Ohlson \(1980\)](#))¹⁶. These existing studies consider funding liquidity of the firm. Funding liquidity can be defined as the firms financial ability to repay the corporate debt. Higher funding liquidity reduces distress risk of the firm due to firms' internally available cash or cash equivalent assets which can be used to repay its debt. Whereas, less liquid firms will be facing severe discount in selling their assets in an illiquid market to repay its debt during unfavorable time therefore firms should be more prone to default. Moreover, a recent study by [Bartram, Brown, and Conrad \(2011\)](#) identifies that liquidity reduces interest rate risk. [Chod, Rudi, and Mieghem \(2010\)](#) suggest that the firm can operationally mitigate its risk by increasing cash and cash-equivalent assets. [Haushalter, Klasa, and Maxwell \(2007\)](#) find that firms with limited liquid assets are more likely to have a higher probability of default. Therefore, we expect the firm liquidity and EDF to exhibit negative relationship. To proxy for funding liquidity we consider cash ratio which is calculated as the sum of cash and short-term assets scaled by total assets.

Further, we include excess return measured as firm's annual equity return minus the value weighted return from all shares listed in Germany. This study constructs the value weighted return index for all listed common shares in Germany. [Brückner, Lehmann, Schmidt, and Stehle \(2014\)](#) provide value weighted market index freely, however do not consider bottom 20% size stocks, which could potentially lead to measurement error¹⁷. In

¹⁶Recent empirical studies focus on firms market liquidity and default risk (see [Brogaard, Li, and Xia \(2017\)](#)). Measuring market liquidity risk requires high-frequency data. This data is expensive. Therefore, we consider only funding liquidity.

¹⁷Quantifying the market return without considering the small size stocks which are expected to have higher return due to higher risk will lead to measurement error. This error is reduced by

an attempt to reduce the measurement error, we construct the value weighted market factor for Germany¹⁸. The empirical studies by [Bharath and Shumway \(2008\)](#) and [Brogaard, Li, and Xia \(2017\)](#) suggest that there is a positive association between distress risk and excess return¹⁹. Therefore, we also expect similar relationship.

We include equity volatility which is computed as one year daily returns standard deviation and annualized by multiplying by square root of 252. [Hail and Leuz \(2006\)](#) suggest that the equity volatility represents firms market risk. Empirical studies by [Shumway \(2001\)](#), [Chava and Jarrow \(2004\)](#), and [Campbell, Hilscher, and Szilagyi \(2008\)](#) identify that equity return volatility is strongly positively associated with the expected default probability. Therefore, this study expects equity volatility to exhibit positive relationship with EDF.

Our empirical analysis using the pooled OLS framework may generate spurious inferences. Because, a significant difference in the risk measure of the firms that use, or restrain from using derivatives could be due to omitted variables that determine the risk exposure and consequent risk management practice. Most importantly, failing to incorporate such variables may camouflage the distinctive differences among firms risk management practices implemented. In addition to this, risk management decision implemented by the firm is only observable. However, the manager of the firm identifies the risk exposure of the firm and evaluates the available risk management opportunities and implements that which is cost effective and reduces risk. In reality, only in the controlled experiment this is observable where the subjects (e.g. firm) can be randomly assigned to treatment. This is a tedious task for the researchers to observe the ex-ante and ex-post corporate choices and decisions; however, we can observe the ex-post corporate decisions.

Following the guideline discussed by [Roberts and Whited \(2011\)](#), we use the treatment

constructing value weighted market return index.

¹⁸We collect the return index (RI) and numbers of shares outstanding data from Datastream to calculate the value weighted return index. This study only excludes the firm if the return index data is missing for any firm, which is due to data unavailability. Details on the construction of the value-weighted return index is discussed in the appendix.

¹⁹A number of studies suggest that even the firms have higher distress risk earns lower return. For instance [Dichev \(1998\)](#) and [Campbell, Hilscher, and Szilagyi \(2008\)](#) identifies that the firms with higher risk have lower return. However, the study by [Chava and Purnanandam \(2010\)](#) suggest that there is a positive association between risk and return. They suggest that the prior studies those identifies a negative relationship are due to consideration of noisy ex post realized return by the prior studies.

effect model. There are several other techniques to tackle the the problem of selection bias due to unobservables. Each of the techniques have some limitations. For instance, instrumental variable approach is one of the ways to deal with such problem. To find a valid instrument and thereafter encountering the issue of weak instrument often lead researcher to avoid this technique. In this study, finding the right instrument is challenging. In addition to this, derivatives use decision is a dummy variable which takes the value of “1” if the firm is using any derivatives (e.g. foreign currency, interest rate, or commodity derivatives), otherwise “0”, where our interest is to identify the causal effect of derivatives use on the EDF.

The firm choice to use derivatives is not random. Therefore, we consider the treatment effect model to validate that our statistical inferences are not spurious. We do not take a stance regarding superiority of any of the techniques²⁰. Due to the interest of the study and data availability issue, we use treatment effect model. More specifically, this study uses two-stage treatment effect model where the treatment choices are binary and the program outcomes (in our case derivatives use) depend on a linear combination of observable and unobservable factors. Thereby, in the first stage we estimate the choice model. Thereafter, in the second stage a bias correction term is added. This two-stage treatment effect model is referred to as Heckman’s two-step treatment effect model.

In the context of our study, we consider probability of default of the firm is a function of derivatives use, leverage, firm size, profitability, equity volatility, excess return, and cash ratio. This is expressed in equation 2.1. However, this study considers probability of derivatives use as a function of leverage, firm size, profitability, equity volatility, book-to-market, foreign sales, research and development expenses, and foreign sales. At first, we estimate the selection model using the following equation—

²⁰For instance, propensity score matching can be used to deal with the selection bias. However, propensity score matching requires that the selection or self-selection of the treated vs. untreated firms can be explained by the observable factors. However, this is a strong assumption as the industry related or country specific risk factors or firm specific or any combination of these could affect the firm decision to be treated (decision to use derivatives or not). Therefore, we consider Heckman two-stage model to evaluate that the statistical inferences found using the pooled OLS model is not biased due to selection bias.

$$\text{Derivatives use}_{it}^* = \pi_0 + \pi_1 \text{Instrumental variables}_{it} + \pi_2 \text{Control variables}_{it} + \mu_{it} \quad (2.2)$$

In equation (2.2) we consider that the *derivatives use*_{it}^{*} is latent variable and μ_{it} is the error term. We use the predicted value from equation (2.2) in the equation (2.1), where if the predicted value of *derivatives use*_{it}^{*} is greater than “0” then it is considered as “1” otherwise “0”.

Hereby, this study uses the Heckman’s proposed two-stage approach to evaluate the effect firm choice to use derivatives for which the treatment choices are binary and the outcome of derivatives use depend on a linear combination of observable and unobservable factors. Using this approach we attempt to resolve the problem of estimation bias²¹. To evaluate the effectiveness of this bias correction Heckman derives inverse Mills ratio. We test whether it is significant to verify the significance of our model.

2.5 Empirical Results

2.5.1 Univariate Analysis Results

Table 2.1 presents mean and median values of the 1- and 5-year EDF, book-to-market value of equity, cash ratio, excess return, firm size, foreign sales to net sales, leverage, profitability, research and development expenses (R&D expenses) and equity volatility for all firm, derivatives user, and non-user groups. We also report differences in mean and median values between users and non-users in relation to the aforementioned variables. Our univariate comparison provides strong evidence that the derivatives using German non-financial firms have on average a lower 1-year EDF. A similar empirical finding emerges when we consider 5-year EDF. Specifically, derivatives users markedly have 99(139) basis point lower 1-year EDF than non-users on mean(median) values. Looking at the long horizon default probability of 5-year we find that user firms have 97(107) basis point lower

²¹Estimation bias arises as there are unobservable factors those affect both treatment selection and treatment outcome. For example, in our case firms those exposed to higher distress risk will use derivatives to reduce the risk.

Table 2.1: Univariate Comparison of Derivatives Users vs. Non-users

The table reports mean and median values of 1- and 5-year expected default frequency (EDF), book-to-market value of equity, cash ratio, excess return, firm size, foreign sales to net sales, profitability, R&D expenses, and stock volatility for a sample of German non-financial firms. The sample period is from 1999 to 2010. 1- and 5-year EDF values, computed using the KMV-Merton framework due to [Merton \(1974\)](#), are sourced from Moody's Analytics. Book-to-market value of equity is the ratio of book value of equity and market value of equity. Cash ratio is computed as the ratio of cash to current liabilities. Excess return is calculated as annual return on the firm minus the value weighted return on all stocks listed in Germany. Firm size is computed as natural logarithm of total assets. Foreign sales to net sales is computed as ratio of net foreign sales to total sales. Leverage is computed as the ratio of long-term debt plus the current portion of long-term debt to total assets. Profitability is computed as the ratio of net income before extraordinary items to total assets. R&D expenses is computed as the ratio of research and development expenditure to total assets. Equity volatility of a firm is first computed as the standard deviation over one year of daily (i.e., trading day) returns and later annualized by multiplying by $\sqrt{252}$. N is the number of firm-year observations. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. The sample period is from 1999 to 2010.

Variable	All firms			Derivatives users			Derivatives non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
1-year EDF	2112	0.0099	0.0091	1548	0.0073	0.0054	564	0.0172	0.0193	−0.0099***	−0.0139***
5-year EDF	2112	0.0098	0.0097	1548	0.0072	0.0068	564	0.0169	0.0175	−0.0097***	−0.0107***
Book-to-market	2112	0.6349	0.5358	1548	0.6189	0.5366	564	0.6786	0.5318	−0.0597***	0.0047
Cash Ratio	2112	0.4957	0.1703	1548	0.4094	0.1684	564	0.7323	0.1836	−0.3229***	−0.0152**
Excess Return	2112	0.1215	0.1272	1548	0.1011	0.1124	564	0.1775	0.1677	−0.0764***	−0.0553***
Firm Size	2112	6.0632	5.5460	1548	6.7009	6.3108	564	4.3130	4.2451	2.3879***	2.0657***
Foreign sales to net sales	2112	0.3751	0.3800	1548	0.4469	0.4702	564	0.1781	0.0000	0.2688***	0.4702***
Leverage	2112	0.2245	0.1812	1548	0.2456	0.2237	564	0.1663	0.0501	0.0793***	0.1736***
Profitability	2112	0.0286	0.0485	1548	0.0512	0.0527	564	−0.0336	0.0217	0.0848***	0.0310***
R&D Expenses	2112	0.0295	0.0026	1548	0.0284	0.0071	564	0.0324	0.0000	−0.0040	0.0071***
Equity Volatility	2112	0.1729	0.1669	1548	0.1641	0.1592	564	0.1970	0.1931	−0.0329***	−0.0339***

than non-users on mean(median) values. The mean and median difference tests for the 1- and 5-year EDF are statistically significant at 1% level.

Further, the mean difference test for book-to-market, cash ratio, and equity volatility suggest that the derivatives using firms have lower book-to-market, cash ratio, and equity volatility than non-users. This is significant at 1% level. Derivatives using firms have higher excess return, firm size, foreign sales to net sales, leverage, and profitability than the non-users. The mean difference is significant at 1% level. Our univariate test

results exhibit the expected sign that we discussed in Section 2.4.

Table 2.2: Derivatives Use Impact on EDF

The table reports pooled OLS regression results for a sample of German non-financial firms' derivatives use impact on 1- and 5-year EDF. Derivatives use is a dummy variable that takes the value 1 if a firm reports the use of any type of derivatives (i.e., foreign currency, interest rate, or commodity derivatives) and zero otherwise. All models include year dummies. Numbers in the parentheses are standard errors. Standard errors are adjusted for firm level clustering. See also notes to Table 2.1. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	1-year EDF	5-year EDF
Derivatives Use	−0.0107*** (0.0032)	−0.0102*** (0.0034)
Leverage	0.0491 *** (0.0066)	0.0434*** (0.0054)
Firm Size	−0.0076*** (0.0018)	−0.0070*** (0.0015)
Profitability	−0.0132* (0.0072)	−0.0152** (0.0066)
Equity Volatility	0.2090*** (0.0275)	0.1850*** (0.0216)
Excess Return	−0.0075*** (0.0010)	−0.0073*** (0.0009)
Cash Ratio	−0.0004 (0.0004)	−0.0004 (0.0004)
Constant	0.0352*** (0.0112)	0.0299*** (0.0093)
Observations	2,103	2,103
R-squared	0.495	0.521

2.5.2 Multivariate Analysis Results

The preliminary results based on univariate test on Table 2.1 suggest that derivatives users have lower 1- and 5-year EDF. To gauge further, we use multivariate regression analysis. This study uses pooled ordinary least square (OLS) to examine the impact of derivatives use on 1- and 5-year EDF. We present the results of the estimated relation between firms' 1- and 5-year EDF and derivatives in table 2.2. The column two represents estimated results for 1-year EDF, while column three represents for 5-year EDF. Starting with estimated coefficient for derivatives use indicator in column three suggest that relationship between derivatives use and 1-year EDF is negative and significant at 1% level. The coefficient −0.0107 suggests that derivatives using firms have a 107 basis point lower 1-year EDF than non-users. In other words, firms those use derivatives instrument(s) indeed

experience a sizable reduction in the 1-year EDF. It is worthy to mention that our result aligned with the conjecture in the literature as argued by [Stulz \(1986\)](#) and empirically suggested by [Purnanandam \(2008\)](#) that hedging reduces financial distress risk of the firm.

One of the key question that emerges that whether impact of derivatives use only reduces the distress risk for the short horizon or it is also persistent in long horizon. To answer this question, we consider 5-year EDF. We find that the firm using derivatives have lower 5-year EDF, suggesting that our result is valid for both short and long horizon. We also notice that the estimated coefficient for the control variables have expected sign as we discussed in Section 2.4. For instance, firm size and profitability exhibit negative relationship. Whereas, firms with higher equity volatility and higher excess return have higher EDF. This is similar to what found by [Bharath and Shumway \(2008\)](#)²².

2.5.3 Treatment Effect Results

The univariate and pooled OLS results demonstrate a significant negative effect of derivatives use on EDF. However, as we pointed earlier that the empirical findings based on the pooled OLS can be criticized due to the fact that firm choice of using derivatives may be driven by some unobservable factors. To illustrate, for a given firm we can only identify if the firm is using derivatives or not from the publicly available annual reports, but we are unable to incorporate the outcomes of choices that the firm did not make. If the firm decision were made random or else if we could run a controlled experiment then the notion of bias in the estimation presented in table 2.2 would not arise. It arises due to the fact that the firms are heterogeneous and we can only observe the firms ex post decisions made. Therefore, we consider treatment effect model.

We consider the two-stage framework suggested by Heckman to estimate the unbiased parameters. The first stage proceeds by separately running probit regression for the derivatives use decision. The second stage involves estimating the structural equations where the relevant explanatory variables are replaced with the corresponding predicted values obtained from the first stage probit model. As discussed in Section 2.4, if the

²²We note that these baseline empirical findings also hold when we repeat our entire analysis using lagged firm-level control variables. We do not report the results to conserve space.

Table 2.3: Derivatives Use Impact on EDF: Treatment Effect Model

The table reports treatment effect results for a sample of German non-financial firms' derivatives use impact on 1- and 5-year EDF. See also notes to Table 2.1–2.2. χ^2 is the value for correlation between treatment errors and the outcome errors. Inverse-Mills ratio is the instrument that incorporates the censoring latent variables in the second stage estimation. SE Inverse-Mills is the standard error term of the Inverse-Mills ratio. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	Derivatives use Selection	1-year EDF Outcome	5-year EDF Outcome
Derivatives Use		–0.0127*** (0.0035)	–0.0121*** (0.0035)
Leverage	0.2196 (0.2472)	0.0296*** (0.0054)	0.0273*** (0.0041)
Firm Size	0.3869*** (0.0337)	–0.0339*** (0.0028)	–0.0349*** (0.0024)
Profitability	1.0664*** (0.3229)	–0.0122** (0.0061)	–0.0138** (0.0055)
Equity Volatility	–8.4730*** (1.2098)	0.3002*** (0.0241)	0.2644*** (0.0188)
Excess Return		–0.4910*** (0.0812)	–0.4642*** (0.0827)
Cash Ratio		–0.0026*** (0.0005)	–0.0023*** (0.0005)
Book–to–market	–0.3388*** (0.0836)		
R&D	2.3018*** (0.7497)		
Quick Ratio	–0.0478** (0.0196)		
Foreign sales to net sales	1.1861*** (0.1420)		
Constant	0.4734 (0.3554)	0.0400*** (0.0059)	0.0330*** (0.0047)
Observations	2102	2102	2102
χ^2	3.5821	3.8521	3.8521
Inverse-Mills	0.1190	0.1190	0.1190
SE Inverse-Mills	0.0195	0.0195	0.0195

predicted value for derivatives use is greater than “0” then we consider the firm to be user of derivatives otherwise we consider the firm-year as non-user. The results reported in table 2.3 suggest that our preceding baseline empirical findings hold even after accounting the potential unobservable factors that could influence the firm choice of using derivatives. Notably, we identify that there is a significant negative relationship between derivatives use and the 1-year EDF. The coefficient for derivatives use is –0.0127 and statistically significant at 5%. Similarly, we also run similar model for the 5-year EDF and qualitatively similar results are found. The coefficient for derivatives use is –0.0121 and statistically significant at 5%. Therefore, we suggest that our result obtained in the pooled OLS are

Table 2.4: Univariate Comparison of FX Users (FX only) and FX Non-users (Derivatives Non-Users)

The table reports mean and median difference test results for 1- and 5-year expected default frequency (EDF), book-to-market value of equity, cash ratio, excess return, firm size, foreign sales to net sales, profitability, R&D expenses, and stock volatility for a sample of foreign currency derivatives user and derivatives non-user German non-financial firms. Panel A reports for foreign currency derivatives users and non-foreign currency derivatives users. Panel B reports for foreign currency derivatives users only and derivatives non-users. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. See also notes to Tables 2.1.

Panel A: FX Users and FX non-users comparison								
Variable	FX users			FX non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
1-year EDF	1310	0.0067	0.0042	802	0.0121	0.0133	−0.0054***	−0.0091***
5-year EDF	1310	0.0065	0.0040	802	0.0114	0.0128	−0.0049***	−0.0088***
Book-to-market	1310	0.6099	0.5286	802	0.6755	0.5468	−0.0655***	−0.0182
Cash Ratio	1310	0.3564	0.1674	802	0.7229	0.1823	−0.3664***	−0.1488
Excess Return	1310	0.1256	0.1263	802	0.1429	0.1436	−0.0173***	−0.0173***
Firm Size	1310	6.8861	6.5290	802	4.7190	4.6120	2.1671***	1.9170***
Foreign sales to net sales	1310	0.4849	0.51845	802	0.1957	0.0190	0.2891***	0.4994***
Leverage	1310	0.2408	0.2204	802	0.1977	0.0999	0.0431***	0.1205***
Profitability	1310	0.0512	0.0526	802	−0.0083	0.0367	0.0595***	0.0158***
R&D Expenses	1310	0.0306	0.0113	802	0.0277	0.0000	0.0028	0.0113***
Equity Volatility	1310	0.1627	0.1580	802	0.1895	0.1853	−0.0267***	−0.0273***
Panel B: FX only users and derivatives non-users comparison								
Variable	FX only users			Derivatives non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
1-year EDF	368	0.0068	0.0062	564	0.0172	0.0193	−0.0104***	−0.0131***
5-year EDF	368	0.0066	0.0058	564	0.0169	0.0175	−0.0103***	−0.0117***
Book-to-market	368	0.5845	0.4873	564	0.6787	0.5319	−0.0941***	−0.0446
Cash Ratio	368	0.5365	0.3249	564	0.7324	0.1836	−0.1959**	0.1413***
Excess Return	368	0.1307	0.1300	564	0.1775	0.1677	−0.0468***	−0.0377***
Firm Size	368	5.6170	5.2761	564	4.3130	4.2451	1.3039***	1.0310***
Foreign sales to net sales	368	0.4335	0.4578	564	0.1781	0.0000	0.2554***	0.4578***
Leverage	368	0.1125	0.0404	564	0.1664	0.0502	−0.0539***	−0.0098
Profitability	368	0.0475	0.0654	564	−0.0336	0.0217	0.0811***	0.0437***
R&D Expenses	368	0.0486	0.0291	564	0.0324	0.0000	0.0162***	0.0291***
Equity Volatility	368	0.1714	0.1650	564	0.1971	0.1932	−0.0257***	−0.0281***

not spurious due to unobservable factors affecting firm decision to use derivatives.

Our result is similar to the expectation of the theories provided by (Purnanandam, 2008; Froot, Scharfstein, and Stein, 1993; Smith and Stulz, 1985). In addition to this our result support the empirical findings of Magee (2013). It is worth mentioning that Magee (2013) Magee examines the impact of foreign currency derivatives use and default probabilities for the US firms. We address similar question in the following section.

2.5.4 Effects of Foreign Currency and Interest Rate Derivatives on Financial Distress

In an attempt to deepen our understanding of the proceeding empirical findings, we further investigate the effect of using foreign currency and interest rate derivatives use on the 1- and 5-year EDF. In doing so, we identify if the firms are using foreign currency and interest rate derivatives to reduce the distress risk of the firm. Similar to derivatives use dummy variable construction we construct the dummy for the foreign currency and interest rate derivatives. However, categorizing the firms into the user of foreign currency and interest rate derivatives could lead to under/over estimation of the actual effect on EDF. For instance, a firm could use foreign currency derivatives and comparing with non foreign currency derivatives user could be misleading due to the fact that the non-user of foreign currency derivatives could use interest rate or commodity price derivatives or both to mitigate the risk. Similarly, a firm could use both currency and interest rate derivatives whereby the effect of foreign currency or interest rate derivatives on EDF will be exacerbated. To minimize such distortion in our results we generate a more restrictive dummy variable for the user of foreign currency and interest rate derivatives. We generate a dummy variable for foreign currency only users by considering a firm only use foreign currency derivatives not any other derivatives then we denote it as “1”, and “0” if the firm does not use any derivatives. We construct similar dummy variable for interest rate derivatives use and name it IR only.

Initially, we conduct mean and median difference test to identify the impact of foreign currency derivatives use on the 1- and 5-year EDF and other firm characteristics. We

Table 2.5: Foreign Currency Derivatives Use Impact on EDF

The table reports pooled OLS regression results for a sample of German non-financial firms' foreign currency derivatives use impact on 1- and 5-year EDF. FX only is a dummy variable that takes the value 1 if a firm reports the use only foreign currency derivatives and zero if the firm is not using any derivatives. See also notes to Table 2.1–2.4. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	1-year EDF	5-year EDF
FX only	– 0.0102*** (0.0013)	–0.0094*** (0.0015)
Leverage	0.0590*** (0.0128)	0.0557*** (0.0120)
Firm Size	–0.0098*** (0.0022)	–0.0096*** (0.0021)
Profitability	–0.0154* (0.0080)	–0.0166** (0.0075)
Equity Volatility	0.1990*** (0.0353)	0.1870*** (0.0320)
Excess Return	–0.0084*** (0.0015)	–0.0083*** (0.0014)
Cash Ratio	–0.0008 (0.0005)	–0.0007 (0.0005)
Constant	0.0254** (0.0120)	0.0236** (0.0113)
Observations	926	926
R-squared	0.444	0.478

report the univariate test results in table 2.4. In panel A, we conduct the mean and median difference test for non-restricted dummy of FX users vs FX non-users. Again our result is similar to what we found for the simple derivatives use dummy. Our univariate results affirm that the foreign currency derivatives user enjoys significant reduction in the 1- and 5-year EDF. This mean(median) difference is 54(91) basis points and statistically significant at 1% (1%) level for 1-year EDF.

Further, we conduct similar univariate test for the restricted dummy for foreign currency derivatives users (FX only) vs derivatives no-users and report in panel B of table 2.4. Our results are qualitatively similar to what we found in panel A. Our result for other firm specific characteristics also similar to what we found in table 2.1.

Later, we conduct the univariate analysis to identify the impact of interest rate derivatives use on the 1- and 5-year EDF and other firm characteristics. We report the univariate test results in table 2.5. At first we conduct the mean and median difference test for non-restricted dummy of IR users vs IR non-users and results are reported in panel A. Again,

Table 2.6: Foreign Currency Derivatives Use Impact on EDF: Treatment Effect Model

The table reports treatment effect results for a sample of German non-financial firms' foreign currency derivatives use impact on 1- and 5-year EDF. See also notes to Table 2.1–2.5. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	FX Only Selection	1-year EDF Outcome	5-year EDF Outcome
FX Only		−0.0121*** (0.0019)	−0.0109*** (0.0016)
Leverage	2.4726*** (0.3720)	0.0876*** (0.0138)	0.0747*** (0.0105)
Firm Size	0.2757*** (0.0401)	−0.0023** (0.0010)	−0.0025*** (0.0008)
Profitability	0.6842* (0.3957)	−0.0158* (0.0092)	−0.0171** (0.0082)
Equity Volatility	−9.9867*** (1.6545)	0.4679*** (0.0478)	0.3978*** (0.0363)
Excess Return		−0.8144 (0.0791)	−0.8961*** (0.0789)
Cash Ratio		−0.0015** (0.0006)	−0.0012** (0.0005)
Book-to-market	−0.3957*** (0.1057)		
R&D	3.7618*** (0.8800)		
Quick Ratio	−0.1883*** (0.0431)		
Foreign sales to net sales	1.3201*** (0.1815)		
Constant	1.0705** (0.4532)	0.0946*** (0.0120)	0.0359*** (0.0078)
Observations	925	925	925
χ^2	4.2310	4.2310	4.2310
Inverse Mills	0.1351	0.1351	0.1351
SE Inverse Mills	0.0182	0.0182	0.0182

our results are similar to what we found previously using simple derivatives use dummy. Our univariate results suggest that the interest rate derivatives user enjoys significant reduction in the 1- and 5-year EDF. This mean(median) difference is 104(131) basis points and statistically significant at 1% level for 1-year EDF.

We also conduct similar univariate test for the restricted dummy for interest rate derivatives users (IR only) vs derivatives no-users and report in panel B of table 2.5. Our results are qualitatively similar to what we found in panel A. Our result for other firm specific characteristics also similar to what we found in table 2.1 and 2.4.

Hence, we suggest that the empirical results presented in table 2.4 and 2.5 both confirm that the 1- and 5-year EDF is reduced via use of foreign currency and interest rate

Table 2.7: Univariate Comparison of IR Users (IR only) and IR Non-users (Derivatives Non-Users)

The table reports mean and median difference test results for 1- and 5-year expected default frequency (EDF), book-to-market value of equity, cash ratio, excess return, firm size, foreign sales to net sales, profitability, R&D expenses, and stock volatility for a sample of interest rate derivatives user and derivatives non-user German non-financial firms. Panel A reports for interest rate derivatives users and non-interest rate derivatives users. Panel B reports for interest rate derivatives users only and derivatives non-users. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. See also notes to Tables 2.1–2.6.

Panel A: IR Users and IR non-users comparison								
Variable	IR users			IR non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
1-year EDF	1137	0.0054	0.0062	975	0.0128	0.0159	−0.0074***	−0.0097***
5-year EDF	1137	0.0056	0.0057	975	0.0121	0.0154	−0.0065***	−0.0097***
Book-to-market	1137	0.6339	0.5568	975	0.6359	0.5003	−0.0019	0.0565***
Cash Ratio	1137	0.3301	0.1440	975	0.6886	0.2403	−0.3585***	−0.0963***
Excess Return	1137	0.1354	0.1362	975	0.1651	0.1642	−0.0297***	−0.0280***
Firm Size	1137	7.0716	6.7090	975	4.8872	4.6864	2.1843***	2.0225***
Foreign sales to net sales	1137	0.4521	0.4712	975	0.2853	0.1929	0.1667***	0.2783***
Leverage	1137	0.2941	0.2824	975	0.1432	0.0456	0.1509***	0.2367***
Profitability	1137	0.0513	0.0505	975	0.0020	0.0430	0.0493***	0.0075***
R&D Expenses	1137	0.0218	0.0032	975	0.0384	0.0017	−0.0166***	0.0014
Equity Volatility	1137	0.1614	0.1563	975	0.1862	0.1823	−0.0247***	−0.0260***
Panel A: IR only users and derivatives non-users comparison								
Variable	IR only users			Derivatives non-users			Difference tests	
	N	Mean	Median	N	Mean	Median	Mean <i>t</i> -test	Median Wilcoxon test
1-year EDF	205	0.0079	0.0070	564	0.0172	0.0193	−0.0093***	−0.0123***
5-year EDF	205	0.0075	0.0079	564	0.0169	0.0175	−0.0094***	−0.0096***
Book-to-market	205	0.6989	0.5909	564	0.6787	0.5319	0.0203	0.0591*
Cash Ratio	205	0.6518	0.2197	564	0.7324	0.1836	−0.0806	−0.0360***
Excess Return	205	0.1396	0.1387	564	0.1775	0.1677	−0.0379***	−0.0290***
Firm Size	205	5.5705	5.3424	564	4.3130	4.2451	1.2574***	1.0973***
Foreign sales to net sales	205	0.2422	0.1709	564	0.1781	0.0000	0.0641***	0.1709***
Leverage	205	0.2862	0.2537	564	0.1664	0.0502	0.1198***	0.2036***
Profitability	205	0.0467	0.0518	564	−0.0336	0.0217	0.0804***	0.0301***
R&D Expenses	205	0.0172	0.0000	564	0.0324	0.0000	−0.0152***	0.0000
Equity Volatility	205	0.1738	0.1706	564	0.1971	0.1932	−0.0233***	−0.0226***

derivatives use. However, our univariate test results do not control for firm-specific variables. Therefore, we also run the pooled OLS regression using the framework stated in equation 2.1, by replacing the derivatives use dummy by FX only and IR only dummy²³.

Initially, the foreign currency only (FX only) derivatives use impact on the 1- and 5-year EDF using the pooled OLS regression reported in table 2.6. For 1- and 5-year EDF model the estimated coefficient for FX only are -0.0102 and -0.0094 respectively. The coefficients are significant at 1% level. This suggest that the firms using only foreign currency derivatives can reduce their financial distress cost. This is consistent with the findings of (Magee, 2013; Purnanandam, 2008).

Table 2.8: Interest Rate Derivatives Use Impact on EDF

The table reports fixed effects regression results for a sample of German non-financial firms' interest rate derivatives use impact on 1- and 5-year EDF. IR only is a dummy variable that takes the value 1 if a firm reports the use of interest rate derivatives and zero if the firm is not using any derivatives (i.e., foreign currency, interest rate, or commodity derivatives). Numbers in the parentheses are standard errors. See also notes to Table 2.1–2.7. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	1-year EDF	5-year EDF
IR only	-0.0117^{**} (0.0027)	-0.0115^{***} (0.0028)
Leverage	0.0520^{***} (0.0114)	0.0500^{***} (0.0110)
Firm Size	-0.0127^{***} (0.0030)	-0.0107^{***} (0.0024)
Profitability	-0.0153^{*} (0.0088)	-0.0150^{*} (0.0078)
Equity Volatility	0.2370^{***} (0.0425)	0.2230^{***} (0.0358)
Excess Return	-0.0090^{***} (0.0016)	-0.0088^{***} (0.0015)
Cash Ratio	-0.0007 (0.0007)	-0.0006 (0.0006)
Constant	0.0204 (0.0143)	0.0121 (0.0126)
R-squared	0.4442	0.4898
Observations	765	765

In an attempt to verify that our result obtained in the pooled OLS are not biased due to unobservable factors we also estimate the same relationship using the two-stage

²³We also estimate using the non-restricted dummy of foreign currency and interest rate derivative use. Our results are qualitatively similar. For the purpose of brevity we do not report the results.

Heckman model. These results are reported in table 2.7 and qualitatively similar to the results reported in table 2.6. Hence, our results are robust.

Table 2.9: Interest Rate Derivatives Use Impact on EDF: Treatment Effect Model

The table reports treatment effect results for a sample of German non-financial firms' interest rate derivatives use impact on 1- and 5-year EDF. Quick ratio is computed as the ratio of net current assets to current liabilities. Numbers in the parentheses are standard errors. See also notes to Table 2.1–2.8. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	IR Only Selection	1-year EDF Outcome	5-year EDF Outcome
IR Only		−0.0165*** (0.0026)	−0.0143*** (0.0020)
Leverage	1.5928*** (0.3324)	0.0374** (0.0146)	0.0329*** (0.0109)
Firm Size	0.3643*** (0.0494)	−0.0032* (0.0017)	−0.0034** (0.0013)
Profitability	1.3144*** (0.4774)	−0.0178 (0.0090)	−0.0183** (0.0076)
Equity Volatility	−6.3039*** (1.7092)	0.4732*** (0.0503)	0.4080*** (0.0388)
Excess Return		−0.4023*** (0.0449)	−0.4361*** (0.0405)
Cash Ratio		−0.0019*** (0.0007)	−0.0019*** (0.0006)
Book-to-market	−0.0862 (0.1129)	−0.0862 (0.1129)	
R&D	0.5012 (0.9988)	0.5012 (0.9988)	
Quick Ratio	0.0298 (0.0238)	0.0298 (0.0238)	
Foreign sales to net sales	0.4375** (0.2159)	0.4375** (0.2159)	
Constant	−1.2573** (0.4937)	0.0856*** (0.0138)	0.0856*** (0.0138)
Observations	764	764	
χ^2	5.4598	4.4598	
Inverse Mills	0.1976	0.1976	0.1976
SE Inverse Mills	0.0213	0.0213	0.0213

Now, we focus on the users of interest rate derivatives. At first, this study uses the pooled OLS multivariate analysis to identify if there is any causal relationship between the IR only users and 1- and 5- year EDF. The results are reported in table 2.8. We find that there is a negative relationship between IR only derivatives use and 1-year EDF. This is significant at 5% level. Similarly, for the 5-year EDF it is also negative and significant at 1% level. Though, the results suggest that there is a causal relationship but we cannot interpret these results as conclusive evidence between IR only users and 1- and 5-year EDF. Therefore, we estimate this relationship with two-stage Heckman procedure.

The estimated parameters are reported in table 2.9. Our results are qualitatively similar to what we found in table 2.8. Therefore, we conclude that the users of interest rate derivatives can benefit via reduction in financial distress risk.

Table 2.10: Type of Derivatives Use Impact on EDF

The table reports pooled OLS results for a sample of German non-financial firms' different derivatives instrument (e.g. FX, IR, CP, both FX and IR, both FX and CP, both IR and CP or FX, IR and CP) impact on 1- and 5-year EDF. Numbers in the parentheses are standard errors. See also notes to Table 2.1–2.9. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	1-year EDF		5-year EDF	
	(1)	(2)	(3)	(4)
One Type	−0.0402*** (0.0055)		−0.0304*** (0.0038)	
FX Derivatives		−0.0447*** (0.0068)		−0.0336*** (0.0048)
IR Derivatives		−0.0358*** (0.0068)		−0.0272*** (0.0047)
CP Derivatives		−0.0277*** (0.0066)		−0.0181*** (0.0049)
Two Type	−0.0505*** (0.0063)		−0.0362*** (0.0038)	
FX & IR		−0.0292*** (0.0079)		−0.0243*** (0.0055)
FX & CP		−0.0300*** (0.0078)		−0.0206*** (0.0066)
IR & CP		−0.0025 (0.0098)		−0.0060 (0.0099)
Three Type	−0.0047 (0.0094)	−0.0052 (0.0110)	−0.0025 (0.0064)	−0.0077 (0.0100)
Leverage	0.0383*** (0.0090)	0.0372*** (0.0090)	0.0352*** (0.0078)	0.0344*** (0.0078)
Firm Size	−0.0058*** (0.0017)	−0.0059*** (0.0017)	−0.0056*** (0.0014)	−0.0057*** (0.0014)
Profitability	−0.0167** (0.0072)	−0.0165*** (0.0071)	−0.0180*** (0.0067)	−0.0178*** (0.0066)
Equity Volatility	0.1940*** (0.0266)	0.1950*** (0.0264)	0.1740*** (0.0212)	0.1750*** (0.0211)
Excess Return	−0.0073*** (0.0009)	−0.0073*** (0.0010)	−0.0071*** (0.0008)	−0.0071*** (0.0008)
Cash Ratio	−0.0005 (0.0004)	−0.0005 (0.0004)	−0.0005 (0.0004)	−0.0005 (0.0004)
Constant	0.0334*** (0.0109)	0.0347*** (0.0108)	0.0279*** (0.0089)	0.0287*** (0.0088)
R-squared	0.480	0.483	0.497	0.500
Observations	2102	2102	2102	2102

2.5.5 Type of Derivatives

To our best knowledge, Gay, Lin, and Smith (2011) were the first attempt to identify the impact of different combination of derivatives use on the cost of equity. They suggest

that the cost of equity incorporates distress risk and the foreign currency and interest rate derivatives reduces the cost of equity plausibly via reduction in distress risk. In spirit of that we further investigate which type of derivatives matters when considering the relation between combination of different types of derivatives use and the EDF by conducting pooled OLS regression analysis.

In doing so, we use the dummy variable for foreign currency, interest rate, and commodity price derivatives users as discussed in section 5.3²⁴. We use the non-restricted dummy variables. For example, for foreign currency derivatives use dummy we hand-code “1” if the firm is using foreign currency derivatives, otherwise “0”. In addition to this we also generate dummies named “One type”, “Two type” and “Three type”. If the firm uses only one type of derivatives then the dummy variable takes the value “1”, otherwise “0”. Similarly, we construct the “Two type” and “Three type” dummies. The regression results are reported in table 2.10. In model (1) and model (3) we examine the extent to which the firm uses different type of derivatives and its impact on 1- and 5-year EDF, respectively. However, in model (2) and model (4) we examine the impact of specific derivatives use and combination of derivatives use impact on the 1- and 5-year EDF, respectively.

The results reported in column (1) suggest that the firm using one and two type of derivatives instrument benefit via reduction in cost of equity, whereas the three type of derivatives user have negative but insignificant impact on the EDF. Quantitatively similar results are obtained for 5-year EDF in model (3). Further, the results presented in model (2) suggest that the FX and IR derivatives reduce the 1-year the EDF significantly. This support the result presented in table 2.6–2.9. However, the commodity price derivatives user have negative but insignificant impact on 1-year EDF. It also suggest that the firm using foreign currency and interest rate derivatives, and foreign currency and commodity price derivatives significantly benefit via reduction in 1-year EDF. The results are qualitatively similar for the 5-year EDF reported in column (4). This suggest that the firm using different combination or only one type of derivatives (except commodity price derivatives or combination of interest rate and commodity price derivatives or combination of all

²⁴In prior analysis we do not consider commodity price derivatives use as the number of firms using commodity price derivatives but not using any other derivatives instrument is only 19 firm-year observations.

derivatives instruments) can reduce financial distress risk. Our findings are similar to the findings of [Gay, Lin, and Smith \(2011\)](#).

2.6 Conclusion

This paper investigates the impact of derivatives use on default probability for German non-financial firms. Prior research on hedging widely focused on market-oriented capital market countries more specifically for the US and the UK. However, bank-oriented capital market countries are less explored. The bankruptcy code (see [Bolton and Oehmke \(2015\)](#)) and corporate governance system (see [Fauver and Naranjo \(2010\)](#)) difference could also have an impact the risk management.

Prior literature find some similarities and dissimilarities between market-oriented and bank-based financial system countries capital structure and hedging decision (see [Rajan and Zingales \(1995\)](#), [Bodnar and Gebhardt \(1999\)](#), and [Edwards and Nibler \(1999\)](#)). Therefore, entirely focusing on the bank-oriented capital market enhances the understanding how the firms belonging to bank-based financial system could benefit from the risk management activities through hedging. This paper contributes by focusing on risk management activities by German non-financial firms that operate in bank-oriented financial system.

Following the difference between the bank- and market based economies, this study uses hand collected hedging data from the annual reports of German non-financial firms over the period of 1999–2010 to examine the impact of derivatives use on the financial distress risk. This study identifies that the hedging reduces financial distress risk of the firm measured by 1- and 5-year EDF. This supports the theoretical argument made by [Smith and Stulz \(1985\)](#) and empirical results by [Purnanandam \(2008\)](#). We also find that the foreign currency and interest rate derivatives are the main derivatives instrument those help in the reduction of 1- and 5-year EDF. Overall, results of this study suggest that the firms using derivatives benefit from reduction in distress risk. In summary, hedging helps to mitigate the distress risk of the firm.

Our paper adds to the extant literature by quantifying the tangible benefit of deriva-

tives use on the financial distress risk. This reduction in risk is ultimately attributable to firm value and investment which has been empirically examined in many studies (e.g. (Allayannis and Weston, 2001; Carter, Rogers, and Simkins, 2006; Campello, Lin, Ma, and Zou, 2011)). Hence, this study complements and extends this line of literature by empirically identifying the impact of financial hedging on the financial distress risk for the firms outside the US.

Appendix

A1: EDF Measure

Moody's KMV measures firm's Expected Default Frequency (EDF) following the model provided by Vasicek-Kealhofer (VK) model. The VK model was developed following the option pricing framework of Black-Scholes-Merton. The equity of the firm is assumed as perpetual option in this model where default point²⁵ acting as the absorbing barrier for the firm's asset value. The measure of EDF indicates the probability of default of the firm during the forthcoming year, or years. In our case, we consider 1- and 5-year EDF which indicates the probability that the firm will default within 1 and 5 year respectively.

The model requires equity prices and financial statements data to calculate the firm's EDF. It can be calculated in three steps. The first step is to estimate the asset value and volatility using the share price data and book value of liabilities. Thereafter, distance-to-default (DD) is calculated from the asset value and asset volatility and book value of liabilities. At last, default probability is determined from DD. Moody's KMV uses a default database to derive an empirical distribution relating the DD to a default probability. So, the default probability or EDF is assigned for a given level of DD following the distribution.

Briefly, the following equational framework is used to measure the value of equity:

$$V_E = V_A N(d1) - e^{-rT} X N(d2) \quad (2.3)$$

Here, X denotes book value of the debt which is due at time T . Now, $d1$ and $d2$ can be calculated using the following equations:

$$d1 = \frac{\frac{\ln(V_A)}{X} + (r + \frac{\sigma_A^2}{2})}{\sigma \sqrt{T}} \quad (2.4)$$

$$d2 = d1 - \sigma_A \sqrt{T} \quad (2.5)$$

Here, r denotes risk-free rate. Now, we can calculate the DD following the expression used in Black-Scholes option pricing model as expressed in (2.6) and thereafter using the

²⁵The asset value at which the firm will default, generally lies somewhere between total liabilities and current or short-term liabilities is referred to as default point.

normal distribution $\varepsilon \sim N(0,1)$ default probability in terms of the cumulative normal distribution can be identified.

$$DD = \frac{\ln(\frac{V_A}{X_t}) + (\mu - \frac{\sigma_A^2}{2})t}{\sigma_A \sqrt{t}} \quad (2.6)$$

$$p_t = N \left[- \frac{\ln(\frac{V_A}{X_t}) + (\mu - \frac{\sigma_A^2}{2})t}{\sigma_A \sqrt{t}} \right] = N(-DD) \quad (2.7)$$

It is worth noting that, Black-Scholes model allows only two types of liabilities (single class debt and single class equity). However, in reality firm have different types of liabilities (e.g., short-term liabilities, long-term liabilities, convertible debt, preferred and common equity). Therefore, the VK model considers multiple classes of liabilities (e.g., short-term liabilities, long-term liabilities, convertible debt, preferred and common equity). The default distribution is measured using the publicly listed defaults in the US. However, the model performs well is estimating default probabilities for other countries.

Non market-based measures of distress risk are z- and o-score. These measures are sensitive to the accounting information. Most importantly, coefficient of z- and o-score are identified based on the simulation of the US companies. Therefore, using the coefficient of the US firms to calculate the financial distress of German firms would cause measurement error. Though, EDF is also calibrated following the US default data, the existing studies suggest that the probability of default predicted based on such calibration provides good approximation.

A2: Construction of Market Index

To construct the market risk factor mimicking portfolio, we first collect daily total return indexes (adjusted for stock splits and dividend payments) of all listed common stocks in Germany irrespective of the Exchanges for the period between January 1998 to December 2010 from Datastream.^{26,27} Thereafter, we calculate market capitalization

²⁶ For Germany, the default search option for “total return index” in Datastream only retrieves the stocks listed in the Frankfurt Stock Exchange (FSE). To obtain return information for a stock that is not listed in the FSE, we first identify the Exchange in which the firm is listed and then use the Exchange code to collect the total return index data for that firm’s stock. If the firm is cross-listed in the FSE and other Exchanges then we consider the FSE data only.

²⁷ The Fama and French (1993) three factors for Germany are publicly available in the Humboldt University of Berlin website (<https://www.wiwi.hu-berlin.de/de/professuren/bwl/bb/data/>)

and book-to-market ratio of a firm's common stock by following the methods suggested in [Fama and French \(1993\)](#). Market capitalization is therefore computed as the number of equity shares outstanding times the price of one share at the end of June in each year t . In June of year $t + 1$, we recalculate market capitalization.

We compute the daily return for the market risk factor mimicking portfolio as the value-weighted portfolio return of all aforementioned common stocks. The market capitalization defined above is used as the weight variable.

fama-french-factors-germany/fama-french-factors-for-germany). However, these factors are constructed using both common and preferred stocks, and abandon bottom 20% market capitalization firms. This could potentially lead to measurement error. To overcome this issue, we construct the factors using all publicly listed common stocks. In an unreported exercise, we find that our empirical results hold even with the market factor available in the aforementioned source.

Chapter 3

Debt Specialization Around the World

3.1 Introduction

A voluminous literature in finance has documented the relationship between leverage, investment, and how a country's legal system can affect the external finance. However, these prior studies presume that the debt structure of the firm is uniform. In other words, the fact that the firm uses different types of debt which is initially documented in the theoretical literature (see [Bolton and Scharfstein \(1990\)](#), [Chemmanur and Fulghieri \(1994\)](#), [Bolton and Scharfstein \(1996\)](#)) and most recently empirically examined in few studies (see ([Rauh and Sufi, 2010](#); [Colla, Ippolito, and Li, 2013](#)), is widely ignored. As suggested by [Rauh and Sufi \(2010\)](#) ignorance of the debt heterogeneity miss substantial part of capital structure variation. Although, the recent studies by [Rauh and Sufi \(2010\)](#), and [Colla, Ippolito, and Li \(2013\)](#) consider the debt heterogeneity but these studies consider the US firms and leave other countries as ignorance is bliss perhaps due to unavailable data. Still, for other, more pragmatic reasons, an attempt to revisit the debt specialization in other countries is important as external financing is related to legal rules and quality of enforcement as suggested by [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1997\)](#) and [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1998\)](#). Therefore, this study also examines the debt structure of the firms and how it affect the investment of the firm in different countries where the country specific debt enforcement varies.

[Fan, Titman, and Twite \(2012\)](#) suggest that the choice of firm financing is determined by a combination of factors that is not only related to the characteristics of the firm but

also related to the institutional environment it operates in. Therefore, these recent studies by [Rauh and Sufi \(2010\)](#), and [Colla, Ippolito, and Li \(2013\)](#) explain how the institutional characteristics affect the choice of different debt types and fail to explain the variation in the institutional environment. They also do not consider how the choice of debt can affect corporate investment.

Most importantly, in recent days much attention has been directed to the country debt enforcement which affect the renegotiations among the contractual parties during the financial distress. The spotlight turned to this question for two reasons. First, during financial crisis many firms experiencing financial distress were either liquidated or restructured if renegotiation were possible. Renegotiation of the debt contract can effectively benefit the stakeholders and thereby the prolonged adverse effect of firms default on the economywide crisis can be reduced or avoidable. Secondly, countries where there is little scope of debt renegotiation exhibit higher cost of capital (see [Favara, Schroth, and Valta \(2012\)](#) and [Gopalan, Mukherjee, and Singh \(2016\)](#)). Recent study by [Favara, Morellec, Schroth, and Valta \(2017\)](#) suggests that the firm with higher default probability in higher debt enforcement countries exhibit negative relationship with investment. Therefore, during the financial crisis when economywide recession is experienced despite the fact that central bank lowered interest rates the investment activities were very slow. Henceforth, it is an important question to answer if the debt enforcement which affect the firm ability to renegotiate the debt contract and inefficient liquidation can affect the choice of debt and investment activities?

To avoid inefficient liquidation due to liquidity crisis the firm can issue bank debt whereby the renegotiation is much easier compared to the public debt as suggested by [Bolton and Scharfstein \(1996\)](#). In such case, similar to the theories we are assuming that public debt such as corporate bonds and notes and commercial papers have dispersed creditors, while bank loans such as term loans and drawn credit line have one or few creditors. Though, it is possible that the public debt is held by limited number of creditors and bank debt is dispersed due to syndicated loan activities. Due to data unavailability we have made similar assumptions to the other theoretical studies. Therefore, firms in the

higher debt enforcement country are likely to substitute public debt by bank debt whereby the inefficient liquidation of the firm is avoidable. However, if the firms have access to both public and bank debt then the less financially constrained firm would choose public debt which is a cheaper source of financing. Firms can also reduce the abrasive effect of underinvestment due to access in public debt market. Public debt reduces the chance of debt renegotiation due to dispersed debt holders and higher debt enforcement in the country where the firms have little or no scope for renegotiation. Hence, they would prefer to underinvest to avoid liquidation. This suggest that the debt structure of the firm and its investment is conditional on the debt enforcement of the country.

In an attempt to shed new light in the literature we present comprehensive dataset on firms use of debt types for 46 countries around the world over almost 14 years to examine both firm specific and institutional determinants of the choice of debt types in different countries. We also examine, how the debt diversification affects firm investment. This study builds on this recent literature in three ways. Firstly, this study examines the variation of the debt types across countries that cannot be explained by a single country analysis. Secondly, we provide evidence that how the debt heterogeneity across different countries can affect the investment. This explains the plausible channel through which debt diversification can affect the firm value. We do not claim increase in investment essentially leads to increase in firm value; rather we say due to canonical view that the firm invests in the positive NPV projects. Finally, this study also shows how firms with financial distress decide to use bank or public debt conditional on the debt enforcement of the country.

To examine how the debt specialization which is conditioned on debt enforcement of the country affect the investment, this study conducts pooled OLS regression analysis. In this empirical analysis, firms are assigned to particular debt enforcement based on the country it is registered in. This raises the concern that the firms' ability to invest might be affected through the correlated observable and unobservable country characteristics other than debt contracts enforceability. Therefore, we consider time-varying firm and country specific controls to control for such confounding effects. We also examine the

choice of public or bank debt during financial distress conditioned on debt enforcement of the country using tobit model. In the tobit model, our lower bound is zero and upper bound is 1 as the firm can choose 0% to 100% of its debt as public or bank debt.

To allay the concern that the unobserved country characteristics may disproportionately influence our results, we employ differences-in-differences technique around the financial crisis period. [Schularick and Taylor \(2012\)](#) suggest that the financial crisis amplify, propagate and generate shocks both in normal times and also in times of financial distress. Moreover, during the financial crisis the economywide financial distress increases firms' financial distress, causes liquidity crisis and might require firms to renegotiate the debt contract. Therefore, implementing differences-in-differences considering financial crisis strengthen the interpretation of our results. We similarly, apply difference-in-difference to identify the firm choice of public and bank debt. The result suggests that during the normal times firms in the higher debt enforcement countries with higher debt specialization have positive impact on investment, whereas during the crisis period it is negative. This is consistent with the fact that during crisis period firms suffer from liquidity crisis in terms of both bank and public debt, which consequently reduces investment of the firm. We suggest that the imperfect enforcement of debt contracts can affect the aggregate financing and investment activities by reducing the cost incurred by the creditors to recover debt and the risk of inefficient liquidation faced by both shareholders and creditors in high debt enforcement countries.

To our knowledge, the dynamics of debt specialization around the world have not been studied for a broad sample of countries. More importantly, how debt specialization in imperfect debt enforcement affect the firm investment decision. Also, examine whether the enforcement of debt contracts at default affects the firm decision to choose bank and public debt. However there are few studies that are comparable to ours in spirit. For instance, [Colla, Ippolito, and Li \(2013\)](#) examines how the US firms employ different debt types. An empirical study by [Fan, Titman, and Twite \(2012\)](#) suggests that the firms in the weak enforcement countries use more short-term debt while strong enforcement countries use long-term debt. Most recently, a paper by [Favara, Morellec, Schroth, and Valta \(2017\)](#)

suggests the investment is negatively correlated with the firms' default probability in higher debt enforcement countries.

The plan of this paper is as follows. Section 3.2 lays out the theoretical motivation on the interplay between corporate debt specialization, investment decision and debt enforcement of the country. Also, it shows how the imperfect debt enforcement of debt contracts in default can affect the choice of public and bank debt. Section 3.3 describes the data collection process and construction of the debt diversification variable, and debt enforcement measure. Overview on debt specialization is described in Section 3.4. The analysis on the impact of debt heterogeneity on investment and the choice of bank or public debt is described in Section 3.5. Difference-in-difference results are discussed in Section 3.6. Finally, Section 3.7 concludes. Variable construction and the factors affecting the firms' choice of each debt types are delegated to the Appendix at the end of this paper.

3.2 Related literature

A large body of literature devoted to the capital structure decision and how the firm adjust its target capital structure. For instance, [Rajan and Zingales \(1995\)](#) empirically investigate the determinants of capital structure choice for the G-7 countries. They suggest that the choice of leverage across the G-7 countries is similar. More recently, the empirical study by [Fan, Titman, and Twite \(2012\)](#) suggests that the country-specific factors (e.g. legal system, tax code, corruption, preferences on capital suppliers) can explain a significant portion of variation in the leverage and debt maturity choice.

Later, the scholars divulged their interest on capital structure adjustment speeds rather than the choice of capital structure which focused on the debt and equity component of the capital structure. Examining capital structure adjustment in an international context helps to verify how the costs and benefits of adjusting to the target depends on the firm's institutional, legal and financial environment. [Öztekin and Flannery \(2012\)](#) and [Öztekin \(2015\)](#) provides empirical evidence in an international context that adjustment speed of the firm is correlated with the legal and financial traditions.

In the back drop of such studies, [Colla, Ippolito, and Li \(2013\)](#) provide an insight how

the variation of the capital structure and financing process can be explained by studying the debt specialization of the firm. Though this inevitable attempt contributed to the literature extensively, but no attempt so far has been made to explain the cross-country differences and how it affects the choice of debt components. Moreover, a current strand of literature suggests that cost of debt and maturity of debt can be affected by debt enforcement (see [Gopalan, Mukherjee, and Singh \(2016\)](#) and debt contract can resolve the financial distress of the firm (see [Gennaioli and Rossi \(2012\)](#)). Therefore, it is important to identify how the firm decides to use different debt types given its financial distress and debt enforcement of the country.

Firm's financing and investment decision would be irrelevant under the proposition of [Modigliani and Miller \(1958\)](#). However, the frictions that exist in the capital market link financing and investment. According to pecking order theory debt is the second best source of financing after retained earnings. Due to interest of this study we focus on external debt financing.

The neoclassical model of q and investment considers constant investment opportunities, and constant external financing cost. Following this, many empirical studies examine the impact of external financing, more specifically leverage on investment. [Denis and Denis \(1993\)](#) and [Lang, Ofek, and Stulz \(1996\)](#) suggest that there is negative relationship between leverage and investment. Their evidence supports the argument made by [Myers \(1977\)](#). The negative effect of leverage on investment causes the firm to forgo valuable growth opportunities. Therefore, firm should choose lower leverage at the time of higher growth opportunities, while the firms with lower growth opportunities should have higher leverage. In relation to this an empirical study by [McConnell and Servaes \(1995\)](#) suggests that the relationship between Tobin's q and leverage is positive for low-growth firms and negative for high-growth firms.

Despite the fact that scholars have extensively focused on the equity or debt financing and investment, only a few studies focus on the debt structure, financing and investment. An early research paper by [Stulz and Johnson \(1985\)](#) argued that firms' underinvestment problem can be alleviated by the secured debt. More recently, in an attempt to mitigate

the equityholders underinvestment problem argued by [Myers \(1977\)](#) and later overinvestment problem by [Jensen and Meckling \(1976\)](#), [Hackbarth and Mauer \(2012\)](#) develop a model. Their model show how the investment policy of the firm is intertwined with capital structure and debt priority. They argue that financially unconstrained firms prefer to have senior debt if the firm have few growth opportunities. Whereas, junior debt is preferred by the financially constrained firms with or without growth opportunities.

Undoubtedly, the theoretical works provided some empirically testable predictions. There are very few empirical studies that have empirically tested the predictions. Recently, [Giambona and Golec \(2013\)](#) take such step and empirically examine why high growth firms use relatively more unsecured debt? Results of their study suggest that there is strong positive relationship between firms' growth opportunities and secured debt. Leveraging through unsecured debt provides equity like flexibility and most importantly the firm does not need to forgo the tax or monitoring benefit of debt, in case similar flexibility is obtained through equity financing.

In this debate of impact of debt financing on investment the key factor that plays an important role is the financial distress (see [Bolton, Chen, and Wang \(2011\)](#)). Financial distress of the firm which is often caused by higher leverage (usually referred as “debt overhang”) reduces the investment. This choice of external finance (leverage) is dependent on the financial distress of the firm¹. The financial crises have witnessed the fluctuations in the macroeconomy which depicted a large decline in corporate investment as suggested by [Campello, Giambona, Graham, and Harvey \(2011\)](#). Also an empirical study by [Chava and Roberts \(2008\)](#) suggest that the firm reduces investment at the time of violation of loan covenant. This effect is large if there is severe information asymmetry between borrowers and lenders. This violation of covenants increases restriction on further debt issuance which imposes capital expenditure restriction which reduces investment. The probability of debt covenant violation during a economywide financial distress is very common.

Financial distress is costly and often leads to either reorganization or liquidation of the firm. Henceforth, many theoretical studies on bankruptcy have focused on the state-

¹There are many other factors could influence the choice external finance of the firm (e.g. firm size, age, country-specific factors).

provided process of reorganization or liquidation procedure (see [Schiantarelli, Stacchini, and Strahan \(2016\)](#)). [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#) survey study suggest that during financial distress only 36% of the cases the firm could be operating as going concern otherwise it is inefficiently liquidated. At the process of debt enforcement typically a firm lose around 50% of its value (worldwide average). However, the cost of insolvency, time and efficiency varies across the countries. Their study suggest that the inefficient debt enforcement leads to underdeveloped debt markets. However, we know from a very early study by [Rajan and Zingales \(1998\)](#) that the financial market development substantially support the economic growth and imperfections would have an impact on investment and growth.

The growth of the credit markets and firms' investment activities is dependent on the bankruptcy and debt collection laws. A pioneering study by [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1998\)](#) suggests that the a well-functioning credit market is dependent on the effective enforcement of debt contracts. [Drozd and Serrano-Padial \(2016\)](#) argue that the data can hardly explain such an effect at the time of economywide distress. Therefore, they develop a model by linking default rates, enforcement and credit supply. Their model suggest that during the financial crises there are high number of default applications. This causes the constrained enforcement agents² to become inefficient. The consequence of this is the disproportionate jumps in default rates. Ultimately, this leads to significant credit tightening by the credit suppliers.

Initially this economywide distress will increase the financial distress of the firm as a consequence of economywide distress risk spillover. Further, the increase in distress risk will lead to reduction in investment due to contraction of credit supply. More specifically, the traditional financing channel (e.g. banks) will reduce loanable funds. Only the firms with credit rating who have access to public bond market will be able to issue bonds and mitigate the problem of underinvestment if the firm have lower distress risk otherwise firms will be exposed to liquidity default. According to theories, bank finance is costly as banks incur cost on acquiring information about the firm, whereas the bond financing relies on

²Constrained enforcement agent indicates that during the time of higher number of bankruptcy filings there are delays by bankruptcy courts due to limited resource (e.g. experienced judges) available to the bankruptcy court. For further details see [Drozd and Serrano-Padial \(2016\)](#).

publicly available information. The cheap financing cost comes at an expense of higher probability of liquidation during financial distress. As argued by [Bolton and Scharfstein \(1990\)](#) bond financing reduces strategic default due to given rights to creditors to liquidate the firm, but it leads to inefficiencies if the firm exposed to liquidity default.

Henceforth, the firm with increased financial distress during the financial crises will also reduce the investment activities to avoid financial distress or potential bankruptcy. However, the firms with access to the public bond market can mitigate it partially. Now, if we incorporate the debt enforcement, which could potentially affect the market functioning, then firms' decision to choose lower cost bonds relative to expensive bank debt will depend on the possibility of renegotiation of the debt contract at the time of financial distress. This decision is also conditional on the country-specific debt enforcement as the weak enforcement in countries leads to increase in cost of borrowing due to firm choice of strategic default and higher cost of debt recovery.

In lieu to this, a study by [Favara, Morellec, Schroth, and Valta \(2017\)](#) suggest that debt enforcement exhibit negative relationship with investment and is dependent on the financial distress of the firm. Though this study sheds new light, but does not consider the source of financing or more specifically debt specialization.

[Gennaioli and Rossi \(2012\)](#) argue that the debt structure of the firm can resolve the financial distress. The impact of enforcement on the credit market suggested by [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1997\)](#) and [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#) motivate us to study the relationship between debt specialization³ and investment. By studying such relationship we can explain how the debt specialization can affect investment in the presence of different debt enforcement across countries. As we know that the flexible debt enforcement will allow reorganization process during financial bankruptcy and reduce financial distress costs and also improve external financing conditions. Therefore, we expect that during normal time firms in higher debt enforcement countries will have higher debt specialization to lower the financial distress risk and increase investment. However, in the countries with higher debt enforcement leaving less scope for renegotiation

³This study measures debt specialization by computing HHI. Construction and meaning of HHI is discussed in Section 3.3.2.

will lead to lower investment during the time of economywide shock. We test this using difference-in-difference technique considering 2007–2009 financial crisis as an economy-wide shock⁴.

3.3 Data and empirical framework

3.3.1 *Sample*

We collect all the firms listed in the major stock exchanges in the countries Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, China, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary India, Indonesia, Ireland, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, the United Kingdom, and the United States and covered by S&P Capital IQ⁵. We collect the firm-specific data in US Dollar denomination. Time period of the study spans from 2002 to 2015.

To build a reliable sample, this study considers the following screening procedure. We consider all non-financial and non-utility firms. Therefore, firms with the SIC codes between 4900-4949 and 6000-6999 are dropped from the sample⁶. We also remove (a) firm-years with missing or zero values of debt, (b) firm-years with missing or zero total assets, (3) remove all the firm-years with market or book-leverage outside the interval (we follow the approach of [Lemmon, Roberts, and Zender \(2008\)](#)).

Following [Colla, Ippolito, and Li \(2013\)](#) this study considers that a firm’s debt can be sourced from seven types of debt. These are namely commercial papers (CP), drawn credit lines (DC), term loans (TL), senior bonds and notes (SEBN), subordinated bonds and notes (SUBN), capital leases (CL), and other debt (OTH). Our study requires information on the debt components therefore, we replace all the missing values as zero and sum all types of debt for each firm in a given year and if that is not exactly same with the

⁴This is discussed in section 3.6.

⁵All the countries considered in this study usually have one major exchange, except for the US (NYSE, AMEX, NASDAQ) and China (Shanghai and Schenzen).

⁶This study drops out financial and utility firms due to divergent capital structure from the non-financial firms, which is primarily caused by the government regulation and ownership.

total debt then we drop the firm-year observation⁷. The final sample comprises of 19,504 unique firms across 46 countries.

Table 3.1: Country Characteristics

This table reports within-country summary for country specific and aggregate firm characteristics. The mean value for GDP growth, GDP per capita, Domestic credit, and Domestic credit by FIs are for the period 2002–2015. For the variable definition see notes in table 3.16.

Country	Legal origin	Civil law	Debt enforcement	Distress risk	Investment	Bank debt	Public debt	GDP growth	GDP per capita	Domestic credit	Domestic credit by FIs
Argentina	French	1	0.308	0.121	0.064	0.822	0.148	3.691	9.172	13.04	33.059
Australia	English	0	1.000	0.048	0.094	0.720	0.143	2.947	10.839	118.236	141.054
Austria	German	1	0.667	0.032	0.083	0.672	0.180	1.379	10.742	93.074	127.613
Bangladesh	English	0	0.313	0.068	0.073	0.932	0.007	6.08	6.714	40.787	57.650
Belgium	French	1	0.615	0.042	0.061	0.689	0.064	1.410	10.684	60.587	114.293
Brazil	French	1	0.417	0.057	0.063	0.741	0.155	2.874	9.250	47.539	89.446
Canada	English	0	0.667	0.050	0.099	0.567	0.323	1.97	10.779	157.275	185.321
Chile	French	1	0.000	0.023	0.074	0.522	0.414	4.150	9.418	90.885	97.124
China	German	1	0.000	0.042	0.079	0.883	0.092	9.396	8.402	126.728	149.365
Cyprus	English	0	0.313	0.080	0.044	0.902	0.040	0.890	10.297	208.379	255.863
Denmark	Nordic	1	0.500	0.034	0.059	0.785	0.103	0.665	10.971	172.565	207.763
Finland	Nordic	1	0.692	0.033	0.051	0.753	0.159	1.233	10.732	79.603	123.067
France	French	1	0.231	0.041	0.048	0.644	0.106	1.062	10.613	88.192	129.994
Germany	German	1	0.455	0.046	0.050	0.731	0.126	1.106	10.628	95.556	137.434
Greece	French	1	0.417	0.086	0.045	0.642	0.294	-0.412	10.179	91.562	121.126
Hong Kong	English	0	1.000	0.045	0.052	0.802	0.129	3.908	10.338	172.336	171.455
Hungary	German	1	0.667	0.052	0.092	0.821	0.001	1.740	9.484	48.210	67.848
India	English	0	0.500	0.045	0.083	0.743	0.036	7.474	7.191	47.337	69.635
Indonesia	French	1	0.375	0.104	0.065	0.842	0.091	5.480	7.996	29.049	42.398
Ireland	English	0	0.615	0.027	0.047	0.589	0.267	2.898	10.827	118.758	180.516
Israel	English	0	0.556	0.045	0.046	0.765	0.215	3.669	10.313	69.825	87.108
Italy	French	1	0.231	0.056	0.046	0.781	0.060	-0.121	10.494	81.775	136.963
Japan	English	0	0.538	0.025	0.042	0.825	0.125	0.582	10.664	185.998	326.060
Malaysia	English	0	0.583	0.048	0.053	0.838	0.071	5.076	9.096	111.533	127.58
Mexico	French	1	0.273	0.026	0.056	0.557	0.378	2.391	9.100	22.917	40.699
Netherlands	French	1	0.250	0.031	0.055	0.695	0.176	1.111	10.807	114.387	187.520
New Zealand	English	0	1.000	0.042	0.067	0.764	0.116	2.482	10.441	127.458	133.171
Norway	Nordic	1	0.385	0.041	0.076	0.686	0.186	1.465	11.390	78.473	81.375
Pakistan	English	0	0.313	0.121	0.081	0.899	0.038	4.074	6.946	21.685	45.883
Peru	French	1	0.538	0.041	0.078	0.652	0.185	5.650	8.431	25.034	20.026
Philippines	English	0	0.538	0.091	0.062	0.789	0.079	5.273	7.621	32.585	51.590
Poland	German	1	0.417	0.050	0.068	0.776	0.071	3.676	9.419	44.444	60.076
Portugal	French	1	0.538	0.066	0.038	0.690	0.200	0.245	9.999	135.263	165.223
Romania	French	1	0.438	0.083	0.045	0.903	0.027	1.518	9.053	34.737	42.182
Russia	French	1	0.250	0.054	0.080	0.756	0.153	1.875	9.303	45.884	40.019
Singapore	English	0	1.000	0.043	0.060	0.847	0.060	5.588	10.701	106.052	87.959
South Africa	English	0	0.455	0.038	0.077	0.668	0.090	2.824	8.886	142.486	177.678
South Korea	English	0	0.538	0.036	0.067	0.754	0.109	9.089	9.950	146.597	131.065
Spain	French	1	0.462	0.031	0.043	0.785	0.051	1.537	10.33	141.416	190.518
Sweden	Nordic	1	0.667	0.042	0.042	0.771	0.123	2.031	10.849	116.705	138.466
Switzerland	French	1	0.538	0.021	0.048	0.594	0.286	1.802	11.195	157.79	169.543
Taiwan	German	1	0.538	0.051	0.057	0.810	0.123	NA	NA	NA	NA
Thailand	English	0	0.692	0.045	0.073	0.813	0.094	3.871	8.488	116.273	135.333
Turkey	French	1	0.692	0.060	0.062	0.904	0.022	4.644	9.236	49.116	68.073
United Kingdom	English	0	1.000	0.040	0.052	0.748	0.149	1.640	10.573	163.507	175.893
United States	English	0	0.538	0.036	0.059	0.433	0.487	1.903	10.792	186.776	224.733

⁷This is very important for the purpose of construction of debt specialization index (HHI). This is explained in the following subsection 3.3.2.

In table 3.1 we present the country characteristics ⁸. We provide information about the legal origin of country. Legal origin could be English, French, German, or Nordic ⁹. Civil law is a dummy variable which takes value of “1” if the firm belongs to civil law country otherwise it is “0”. Legal origin and civil law data sourced from Djankov, Hart, McLiesh, and Shleifer (2008). Debt enforcement of the country is measured using Djankov, Hart, McLiesh, and Shleifer (2008) survey data. We discuss the construction of this variable in section 3.3.3. The mean value of default, investment, bank debt, public debt are also tabulated in column 5–8. *Default* indicates the probability that the firm will default within one year. Investment is measured by firms’ capital expenditure lagged to total assets. Bank debt represents the sum of term loans and drawn credit line to total assets. Public debt indicates the sum of senior bonds and notes, subordinated bonds and notes and commercial papers to total debt. GDP growth indicates the annual growth of gross domestic product. GDP per capital indicates the natural logarithm of gross national income per capita. Domestic credit indicates the financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. Domestic credit by financial sector (Domestic credit FIs) indicates the domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net.

Table 3.2 reports the summary of debt specialization for the 46 countries. The top three countries with highest number of firms in the sample are the United States, India, and Japan. Whereas, top three countries with lowest number of firms in the sample are from Hungary, Argentina, and Peru. A low proportion of debt consists of commercial papers. Among the sample countries, firms in Portugal use higher proportion of its debt as commercial papers. Proportion of debt used by the firms’ as drawn credit line to total debt varies across different countries. However, firms in Poland heavily rely on drawn credit line. This indicates that firms in Poland rely on arm-length financing from the pre-committed supplier of credit. Many countries firms heavily rely on the term loans.

⁸For Taiwan country specific macroeconomic data is not available from World Bank. We insert “NA” which indicates that the data is not available.

⁹Nordic is often referred to as Scandinavia.

Table 3.2: Debt Specialization Across the World

This table reports summary statistics on ratios of different debt types to total debt. Column (2) represents number of firms in the respective country. Column (3)-(9) represents mean value for the corresponding debt types namely commercial papers (CP), drawn credit lines (DC), term loans (TL), senior bonds and notes (SEBN), subordinated bonds and notes (SUBN), capital leases (CL), and other loans (OTH). Column (10) reports the mean debt diversification for the country. For the variable definition see notes in table 3.16.

	N	CP	DC	TL	SEBN	SUBN	CL	OTH	HHI
Argentina	36	0.000	0.070	0.752	0.138	0.010	0.006	0.024	0.834
Australia	837	0.001	0.376	0.343	0.137	0.005	0.074	0.063	0.763
Austria	54	0.000	0.106	0.565	0.177	0.002	0.046	0.102	0.666
Bangladesh	99	0.000	0.293	0.640	0.005	0.002	0.019	0.042	0.660
Belgium	71	0.007	0.102	0.587	0.050	0.007	0.089	0.158	0.687
Brazil	177	0.001	0.131	0.610	0.142	0.012	0.016	0.088	0.712
Canada	938	0.002	0.222	0.345	0.274	0.047	0.044	0.065	0.689
Chile	45	0.003	0.007	0.514	0.411	0.001	0.046	0.017	0.604
China	1081	0.001	0.072	0.811	0.090	0.002	0.008	0.016	0.819
Cyprus	66	0.000	0.315	0.587	0.039	0.001	0.023	0.035	0.592
Denmark	84	0.000	0.092	0.693	0.097	0.006	0.047	0.064	0.775
Finland	96	0.042	0.046	0.707	0.115	0.001	0.053	0.034	0.690
France	367	0.010	0.136	0.508	0.094	0.002	0.068	0.181	0.647
Germany	409	0.002	0.091	0.641	0.118	0.006	0.058	0.084	0.762
Greece	132	0.000	0.068	0.574	0.294	0.000	0.035	0.028	0.666
Hong Kong	724	0.001	0.116	0.686	0.128	0.000	0.020	0.049	0.781
Hungary	16	0.000	0.171	0.650	0.001	0.000	0.062	0.117	0.782
India	2734	0.003	0.272	0.470	0.034	0.000	0.004	0.216	0.592
Indonesia	236	0.001	0.352	0.491	0.090	0.000	0.035	0.031	0.668
Ireland	62	0.005	0.165	0.425	0.262	0.000	0.037	0.106	0.766
Israel	212	0.000	0.075	0.690	0.214	0.001	0.004	0.016	0.757
Italy	145	0.001	0.131	0.650	0.059	0.000	0.062	0.096	0.670
Japan	1630	0.005	0.046	0.779	0.119	0.000	0.026	0.025	0.761
Malaysia	619	0.010	0.348	0.490	0.062	0.000	0.046	0.044	0.581
Mexico	59	0.002	0.075	0.481	0.361	0.015	0.020	0.044	0.679
Netherlands	115	0.005	0.197	0.498	0.152	0.020	0.052	0.076	0.664
New Zealand	86	0.016	0.322	0.442	0.096	0.004	0.030	0.089	0.800
Norway	138	0.001	0.117	0.569	0.181	0.004	0.056	0.071	0.715
Pakistan	286	0.000	0.317	0.583	0.037	0.000	0.031	0.032	0.575
Peru	39	0.007	0.109	0.542	0.178	0.000	0.073	0.091	0.689
Philippines	113	0.004	0.133	0.657	0.071	0.003	0.020	0.112	0.773
Poland	215	0.001	0.451	0.326	0.070	0.000	0.095	0.057	0.700
Portugal	32	0.102	0.096	0.594	0.098	0.000	0.043	0.066	0.609
Romania	159	0.019	0.210	0.693	0.008	0.000	0.036	0.034	0.809
Russia	84	0.002	0.121	0.635	0.151	0.000	0.031	0.059	0.695
Singapore	470	0.000	0.179	0.669	0.059	0.001	0.057	0.035	0.681
South Africa	216	0.003	0.195	0.473	0.082	0.004	0.091	0.151	0.629
South Korea	714	0.005	0.263	0.491	0.104	0.000	0.009	0.127	0.668
Spain	61	0.001	0.105	0.680	0.049	0.001	0.027	0.136	0.694
Sweden	243	0.005	0.216	0.555	0.104	0.013	0.050	0.056	0.718
Switzerland	146	0.006	0.137	0.458	0.269	0.011	0.031	0.089	0.703
Taiwan	1042	0.011	0.123	0.687	0.112	0.000	0.004	0.063	0.749
Thailand	329	0.000	0.109	0.703	0.091	0.003	0.040	0.053	0.697
Turkey	215	0.000	0.031	0.873	0.022	0.000	0.031	0.043	0.884
United Kingdom	967	0.002	0.220	0.528	0.146	0.000	0.057	0.046	0.722
United States	2905	0.008	0.207	0.226	0.414	0.065	0.038	0.042	0.712

Turkish and Chinese listed firms have 87% and 81% of debt comprising term loans, respectively. Whereas, firms in the US have only 23% of debt in term loans.

Firms use public debt market to issue senior bonds and notes and subordinated bonds and notes. Firms in the US source 41% of debt as senior bonds and notes where the public debt market for the corporate bonds is well functioning. However, the Bangladeshi and Romanian firms source only 0.5% and 0.8% respectively of their debt through senior bonds and notes where the debt market is not well functioning compared to the common law countries. Firms from different countries source a very small portion of their debt as subordinated bonds and notes, capital leases, and other debt.

3.3.2 *Measure of Debt Specialization*

We follow the approach of [Colla, Ippolito, and Li \(2013\)](#) to construct the debt specialization of the firm. Initially we calculate sum of squared debt types $SS_{i,t}$ for the firm i at year t using the following equation –

$$SS_{i,t} = \left(\frac{CP_{i,t}}{TD_{i,t}}\right)^2 + \left(\frac{DC_{i,t}}{TD_{i,t}}\right)^2 + \left(\frac{TL_{i,t}}{TD_{i,t}}\right)^2 + \left(\frac{SEBN_{i,t}}{TD_{i,t}}\right)^2 + \left(\frac{SUBN_{i,t}}{TD_{i,t}}\right)^2 + \left(\frac{CL_{i,t}}{TD_{i,t}}\right)^2 + \left(\frac{OTH_{i,t}}{TD_{i,t}}\right)^2 \quad (3.1)$$

where CP, DC, TL, SEBN, SUBN, CL, OTH, and TD denote commercial papers, drawn credit lines, term loans, senior bonds and notes, subordinated bonds and notes, capital lease, other debt, and total debt respectively. Later, we calculate normalized Herfindahl–Hirschman Index (HHI) for the firm i at year t using the equation (3.2).

$$HHI_{i,t} = \frac{SS_{i,t} - \frac{1}{7}}{1 - \frac{1}{7}} \quad (3.2)$$

HHI measures the firm intensity of employing a particular debt instrument. It takes a value between “0” and “1”. Higher value of HHI indicates that the firms uses fewer debt types, whereas lower value indicates that the firm uses many debt types. Alternatively, we can say if the firm uses only one type of debt then HHI takes the value “1”. However, if it is equals to “0” this indicates that the firm employs all seven types of debt in equal proportion.

Further, we construct an alternative measure of debt specialization similar to [Colla, Ippolito, and Li \(2013\)](#). For firm i at year t we construct a dummy variable “One_debt_90” equal to “1” if a firm obtains at least 90% of its debt from one debt type, otherwise “0”.

3.3.3 *Measure of Debt Enforcement*

A contemporaneous study by [Favara, Morellec, Schroth, and Valta \(2017\)](#) suggests that the debt enforcement of the country affects the default probability of the firm due to opportunity of debt renegotiation at the time of financial distress which consequently distorts the investment of the firm. Higher debt diversification reduces strategic default of the firm, however, it increases the probability of the default at the time of liquidity crisis. Further, an earlier study by [Esty and Megginson \(2003\)](#) suggest that the legal enforcement affect the ownership of debt. Therefore, this study tries to examine whether debt specialization by the firm in imperfect debt enforcement countries affect the investment decision by the firm. In an attempt to investigate this relationship, this study measures the debt enforcement using the survey data from [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#).

To measure the debt enforcement, this study follow the approach of [Favara, Schroth, and Valta \(2012\)](#) which is also similarly used by [Favara, Morellec, Schroth, and Valta \(2017\)](#). *Debt enforcement* is measured as the average of 16 binary indicators that are likely to strengthen the enforcement of debt contracts at default. This is due to the frictions against renegotiations. This index ranges from “0” to “1” and for each country this value is fixed over the time. Higher value of debt enforcement indicates that there is little scope of debt renegotiations at the time of default. Variables those are included from the study of [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#) to calculate the debt enforcement are – creditors right to sale or seize collateral without approval from the court; creditors right to enforce their security in or out-of court; firms ability to pledge all its assets as collateral, firm or stakeholders cannot appeal at all against the insolvency order; firm or stakeholders cannot appeal at all against liquidation order; firms’ ability to liquidate without the attempt of reorganization; insolvency can be initiated through an automatic trigger; after the commencement of the insolvency proceedings the creditors may enforce

their security; during lawsuits creditors may enforce their security; after the commencement of insolvency the defaulting firm must cease operations; during the insolvency the management of the company does not remain in control; at the time of insolvency the creditors have the right to approve the appoint of the insolvency administrator; appointed insolvency administrator may be dismissed by creditors; reorganization plan is approved directly by the creditors vote; and prior to commencement of reorganization proceedings the firm must submit proof of reorganization prospects.

The computation of the debt enforcement index is from 2005 survey data sourced from from [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#); however, we consider the same value for all the period of our study 2002 to 2015. Similar to [Favara, Morellec, Schroth, and Valta \(2017\)](#) we assume that the insolvency practice by the country is captured by this index. This country-specific practice is persistent over the years due to historical root of economical, political and social values.

3.3.4 Empirical Method

To identify the impact of debt specialization on the investment of the firm, this study estimates the following regression model:

$$\begin{aligned} Investment_{i,j,c,t} = & \beta_0 + \beta_D \times HHI_{i,j,c,t-1} + \beta_\epsilon \times Debt\ enforcement_c \\ & + \beta_{D\epsilon} \times (HHI_{i,j,c,t-1} \times Debt\ enforcement_c) + \beta_\lambda \times Z_{i,j,c,t-1} + u_{i,j,c,t} \end{aligned} \quad (3.3)$$

The dependent variable in equation (3.3) is investment for firm i , industry j and country c at year t . $HHI_{i,j,c,t-1}$ denotes lagged debt specialization index, and the country-specific measure of debt enforcement is denoted by $Debt\ enforcement_c$. We also control for firm- and country-specific factors that are likely to affect the investment of the firm. This study controls for financial distress risk of the firm ($Default_{t-1}$), which is measured as firms' probability of default within one year. We also control for firm age ($\ln(age_{t-1})$), size ($\ln(it\ Total\ assets_{t-1})$), firm's growth opportunities (Market-to-book value of assets), asset liquidity, leverage of the firm and if the firm is rated or not. Further, we also control

for some country-specific factors e.g. GDP growth rate, GDP per capita, domestic credit as % of GDP, and domestic credit provided by financial institutions as % of GDP. To account for the time-varying factors that are common to all firms or industry, we consider year and Fama-French 12 industry¹⁰ fixed effects. Standard errors are clustered at firm level.

Investment and financing is inseparable. Therefore, studying the impact of debt specialization on investment without scrutinizing how the firm chooses private and public debt will miss a substantial part of capital structure. Thus we use the following regression model to identify how the firm chooses debt (public or private):

$$\begin{aligned} \text{Dependent variable}_{i,j,c,t} = & \beta_0 + \beta_D \times \text{Distress risk}_{i,j,c,t-1} + \beta_\epsilon \times \text{Debt enforcement}_c \\ & + \beta_{D\epsilon} \times (\text{Distress risk}_{i,j,c,t-1} \times \text{Debt enforcement}_c) + \beta_\lambda \times Z_{i,j,c,t-1} + u_{i,j,c,t} \end{aligned} \quad (3.4)$$

The dependent variable in equation (3.4) is either public or private debt. Earlier theories on debt structure (see Bolton and Scharfstein (1996), Chemmanur and Fulghieri (1994)) suggest that the public debt is cheaper than private debt. Therefore, firm will choose public debt over the private debt. During financial distress when the firm fails to generate enough cash flow to pay its creditors, it requires debt renegotiation. If the firm has a higher level of private debt which is presumed to be held by one or few creditors it will enjoy the flexibility of renegotiation at the time of financial distress. However, public debt does not provide such flexibility due to disbursed creditors as suggested by Bolton and Scharfstein (1996). Hence, the firm will choose its debt composition by considering such a trade-off. Therefore, the variable of interest in this model is the distress risk.

The debt renegotiation is important for all the stakeholders compared to liquidation at default¹¹. However, the renegotiation is dependent on the country's legal system. There-

¹⁰Fama-French 12 industry classification details information is available in https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_12_ind_port.html

¹¹Debt renegotiation allows the firm to operate in the long-run whereby the shareholders wealth is not diluted or wiped out due to liquidation. Moreover, the creditor can recover its principal and interest income and in the future they can extend the arm-length whereby the future income can be generated. Similarly, the customers need not forgo the warranty benefit and the suppliers could still have long-term relationship.

fore, we consider the debt enforcement which indicates the ability of the firm to make a successful renegotiation in or out-of-court following the liquidity default. Higher debt enforcement will hinder the successful renegotiation.

Firms with higher financial default probability have higher risk of liquidity default. Therefore, we consider the interaction between distress risk and debt enforcement which will measure how the relationship between firm's choice of debt and its default risk vary with the country-specific measure of debt enforcement. Additionally, the firms- and country-specific factors can affect the choice of public or private debt. This study controls for firm size, age, market-to-book, if the firm pays dividend or not, research and development expenditure, if the firm is rated or not, leverage, cash ratio, tangibility, and profitability. The country-specific variables we consider are GDP growth rate, GDP per capita, domestic credit as % of GDP, and domestic credit provided by financial institutions as % of GDP. Similar to investment model we consider year fixed effects to account the time-varying factors those are common to all firms. Standard errors are clustered at firm level.

3.4 An overview on Debt Specialization

3.4.1 Use of Different Types of Debt

To provide an overview of the debt choices of the firms across various countries this study summarizes the debt usage of the firm in table 3.3. Panel A in table 3.3 tabulates the summary statistics for all sample firms, Panel B summarizes the sample of firms listed in Civil Law origin countries, Panel C summarizes the non-Civil law countries firms. Finally, Panel D summarizes for the non-US countries firms, we do so due to the fact that the number of firms in the sample is higher from the US which could potentially affect the aggregate outlook.

Panel A indicates that the 83% firms employ term loans with the mean value of 53.5%. Also, more than 50% of the firms use credit line with a mean value of 19%. This suggests that the drawn credit line and term loans comprise of 73% ($19.1 + 53.5$) of debt for the world firms on average. A very small number of firms use commercial paper and

Table 3.3: Distribution of Debt Types

The table reports summary statistics on ratios of different debt types to total debt. Column (2) represents mean. Column (3)-(9) represents 1st, 5th, 25th, median, 75th, 95th, and 99th percentiles respectively. Column (10) reports number of positive observations. Panel A represents summary for all sample firms. Panel B and C represents summary for same of firms listed in the civil law and non-civil law countries respectively. Panel D presents firm-year observations of non-US publicly listed firms. For the variable definition see notes in table 3.16.

	Mean	P1	P5	P25	Median	P75	P95	P99	Positive observations
Panel A: All firms									
Capital leases	0.032	0.000	0.000	0.000	0.000	0.006	0.183	0.629	32.939
Commercial paper	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.157	3.088
Drawn credit line	0.191	0.000	0.000	0.000	0.000	0.306	0.909	1.000	50.333
Other debt	0.083	0.000	0.000	0.000	0.000	0.013	0.680	1.000	31.117
Sen. bonds & notes	0.143	0.000	0.000	0.000	0.000	0.107	0.924	1.000	32.448
Sub. bonds & notes	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.494	2.640
Term loans	0.535	0.000	0.000	0.107	0.584	0.948	1.000	1.000	83.022
Panel B: Sample firms listed in Civil Law Countries									
Capital leases	0.035	0.000	0.000	0.000	0.000	0.008	0.209	0.624	33.819
Commercial paper	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.201	4.431
Drawn credit line	0.130	0.000	0.000	0.000	0.000	0.114	0.816	1.000	38.226
Other debt	0.067	0.000	0.000	0.000	0.000	0.000	0.589	1.000	24.005
Sen. bonds & notes	0.119	0.000	0.000	0.000	0.000	0.068	0.773	1.000	30.344
Sub. bonds & notes	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.999
Term loans	0.639	0.000	0.000	0.300	0.780	0.999	1.000	1.000	89.439
Panel C: Sample firms listed in Non-Civil Law Countries									
Capital leases	0.040	0.000	0.000	0.000	0.000	0.014	0.229	0.744	40.019
Commercial paper	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.157	2.782
Drawn credit line	0.190	0.000	0.000	0.000	0.000	0.281	0.959	1.000	47.874
Other debt	0.050	0.000	0.000	0.000	0.000	0.000	0.379	1.000	21.261
Sen. bonds & notes	0.197	0.000	0.000	0.000	0.000	0.286	0.993	1.000	40.622
Sub. bonds & notes	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.770	4.476
Term loans	0.498	0.000	0.000	0.012	0.523	0.940	1.000	1.000	76.816
Panel D: Non-US firms									
Capital leases	0.031	0.000	0.000	0.000	0.000	0.006	0.178	0.600	32.924
Commercial paper	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.139	2.889
Drawn credit line	0.189	0.000	0.000	0.000	0.000	0.305	0.889	1.000	50.609
Other debt	0.089	0.000	0.000	0.000	0.000	0.019	0.719	1.000	31.595
Sen. bonds & notes	0.103	0.000	0.000	0.000	0.000	0.021	0.735	1.000	27.469
Sub. bonds & notes	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.993
Term loans	0.580	0.000	0.000	0.220	0.657	0.967	1.000	1.000	88.359

subordinated bonds and notes.

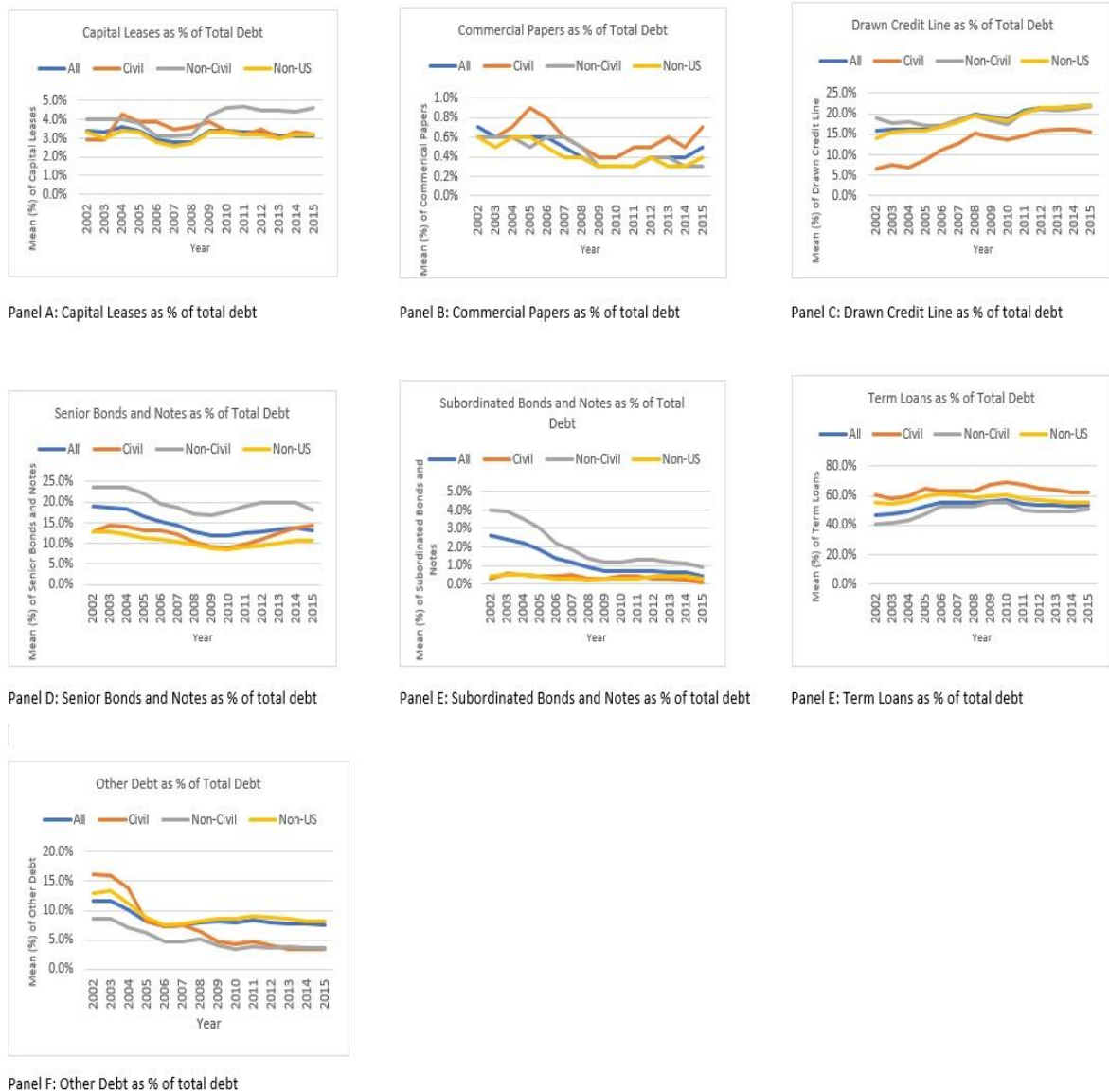
Legal origin of the country affect the external finance of the firm (La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998)). La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) suggest that in the civil law countries capital markets are least developed and have

the weakest investor protection compared to the common law countries. Therefore, we divide our sample into civil and non-civil law countries to identify if any differences exist between these countries. By comparing and contrasting Panel B and Panel C in table 3.3, we find that for firms in civil law countries 64% of the debt comprises of term loans on average, whereas for the non-civil law countries it is 50% on average. This indicates that the firms in the civil law countries are highly dependent on the traditional bank-based financing. On the other way the senior bonds and notes in the non-civil law countries are higher than the civil law countries. One of the plausible reason for such variation in the term loans and senior bonds and notes could be the lesser developed financial markets in the civil law countries, whereby firms have to rely more on the banks. One of the prominent way of managing short-term financing needs of the firm is by using credit line. Both the civil-law and non-civil law countries firm use credit lines. However, firms in the civil-law countries using drawn credit line is 38% and for non-civil law countries it is 48%.

Interestingly, the similarity between the civil-law and non-civil law countries firms is that both group firms use very small fraction of debt as capital leases, commercial papers and other debt. The average proportion of debt used as capital leases and commercial paper for civil and non-civil countries is 4%. The US firms consist of around 15% of the sample, therefore, we also report the summary statistics of debt instruments for the non-US countries in Panel D. The sample is qualitatively similar to Panel A.

We further proceed to the pattern of debt specialization over the sample period of 2002 to 2015. Figure 3.1 shows the trend over the time for each debt types. In the Panel A of figure 3.1 plots average use of capital leases as percentage of total debt for the sample period. For civil law countries and the non-US countries it is declining over the period. However, non-civil law countries experience increase in capital lease. More interestingly, after the financial crises firm used more of capital leases. Capital lease allows the credit supplier to own the capital asset and generate rent income for a fixed period. Hence, during the time of firm incapacity to pay the rent, the renter can confiscate the asset and sale or rent to other parties, whereby the renter can recover its investment. During the financial crisis the constrained firm can reduce underinvestment by mitigating the capital

Figure 3.1: Distribution of Debt Types Across Years



This figure plots averages of seven debt types used as percentage of total debt by firms across the sample year (2002–2015) for all firms, firms in the civil, non-civil law and non-US countries.

needs through capital leases and the creditor can mitigate risk of loan losses via capital lease. This could be a plausible reason owing to which the firm use of capital lease increased after the financial crisis.

Panel B in figure 3.1 plots the average use of commercial paper as percentage of total debt for the firms in all countries, civil, non-civil law and the non-US countries. An overall comparison across different groups suggest that the use of commercial papers over the period has declined. However, civil law countries experienced peak use of commercial

papers before the financial crises, and declined drastically till 2010 and later experiencing a slow upward trend. Firms could minimize the use of commercial papers to avoid the debt rollover risk during the crisis period, when the credit market is tight.

Figure portrayed in Panel C of figure 3.1 suggests that over the time firms have increased the use of drawn credit line as percentage of total debt. It suggest that there is convergence in the use of drawn credit line for the non-civil and the non-US countries. Despite the fact that civil law countries also experienced increase in drawn credit line, still the difference among these group of countries is wide. In 2002 it was 12.2% (18.9 – 6.7) and in 2015 it is 6.1 (21.7 – 15.6). This suggests that the steady and flat increase in the use of drawn credit line in non-civil and the non-US countries is converging with the civil law countries due to higher incremental use of drawn credit line in the civil law countries.

The use of senior bonds and notes experience a sharp decline for all the groups before the financial crises as depicted in Panel D of figure 3.1. However, after the financial crisis it shows a flatter upward trend. [Becker and Ivashina \(2014\)](#) suggest that, when the credit market condition is tight then firm substitute bank loan financing by issuing bond debt. This suggests that the firms that have access to the bond market do not need to shrink the investment activities due to tighter credit market condition where bank-dependent firms experience a larger decline (see [Adrian, Colla, and Song Shin \(2013\)](#) and [Kashyap, Lamont, and Stein \(1994\)](#)).

Interestingly, there is a sharp decline for subordinated bonds and notes for the non-civil law countries which can be noted from Panel E of figure 3.1. Though the slope for the civil and the non-US countries is downward but flat. One of the plausible reason for little use of subordinated bonds and notes is the higher cost compared to senior bonds and notes due to the priority structure.

Term loan is a traditional way of financing and this is sourced from bank or syndicated banks. Panel F shows that all the groups exhibit an increasing trend over time. The conceivable reason for such observed trend could be that the credit constrained firms do not have access to bond markets therefore, they must rely on bank financing. Also, in many countries corporate debt market is not well functioning. For example, the civil law

Table 3.4: Distribution of Debt Types Across Years

This table reports summary statistics on ratios of different debt types to total debt for every sample years. For the variable definition see notes in table 3.16.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Panel A: All firms														
Capital leases	0.034	0.033	0.036	0.034	0.029	0.028	0.028	0.034	0.034	0.033	0.033	0.031	0.031	0.031
Commerical paper	0.007	0.006	0.006	0.006	0.006	0.005	0.004	0.003	0.003	0.003	0.004	0.004	0.004	0.005
Drawn credit line	0.158	0.161	0.162	0.162	0.172	0.184	0.200	0.193	0.186	0.207	0.215	0.213	0.227	0.220
Other debt	0.116	0.117	0.101	0.082	0.072	0.075	0.079	0.081	0.080	0.084	0.080	0.078	0.077	0.076
Sen. bonds & notes	0.189	0.186	0.183	0.166	0.152	0.144	0.129	0.120	0.120	0.125	0.129	0.135	0.138	0.130
Sub. bonds & notes	0.026	0.024	0.022	0.019	0.014	0.012	0.009	0.007	0.007	0.007	0.007	0.006	0.006	0.004
Term loans	0.469	0.473	0.489	0.531	0.556	0.552	0.551	0.562	0.569	0.541	0.532	0.532	0.528	0.534
HHI	0.693	0.697	0.694	0.694	0.697	0.697	0.693	0.700	0.704	0.692	0.694	0.698	0.695	0.695
Excl90	0.445	0.448	0.437	0.438	0.439	0.441	0.432	0.446	0.455	0.436	0.440	0.441	0.439	0.432
Panel B: Sample firms listed in Civil Law Countries														
Capital leases	0.029	0.029	0.043	0.039	0.039	0.035	0.036	0.039	0.034	0.032	0.035	0.030	0.033	0.032
Commerical paper	0.006	0.006	0.007	0.009	0.008	0.006	0.005	0.004	0.004	0.005	0.005	0.006	0.005	0.007
Drawn credit line	0.067	0.076	0.070	0.088	0.111	0.128	0.151	0.142	0.138	0.145	0.157	0.161	0.162	0.156
Other debt	0.162	0.159	0.138	0.081	0.073	0.076	0.065	0.048	0.043	0.046	0.041	0.033	0.034	0.033
Sen. bonds & notes	0.127	0.145	0.141	0.131	0.131	0.122	0.103	0.092	0.088	0.097	0.109	0.125	0.137	0.145
Sub. bonds & notes	0.003	0.006	0.005	0.004	0.004	0.005	0.003	0.003	0.004	0.004	0.003	0.003	0.002	0.001
Term loans	0.605	0.579	0.596	0.649	0.633	0.627	0.635	0.671	0.688	0.671	0.650	0.642	0.626	0.626
HHI	0.763	0.752	0.728	0.716	0.707	0.717	0.728	0.755	0.756	0.748	0.736	0.741	0.735	0.725
Excl90	0.553	0.536	0.493	0.474	0.462	0.478	0.493	0.543	0.555	0.533	0.510	0.514	0.502	0.491
Panel C: Sample firms listed in Non-Civil Law Countries														
Capital leases	0.040	0.040	0.040	0.038	0.031	0.031	0.032	0.042	0.046	0.047	0.045	0.045	0.044	0.046
Commerical paper	0.006	0.006	0.006	0.005	0.006	0.006	0.005	0.003	0.003	0.003	0.004	0.004	0.003	0.003
Drawn credit line	0.189	0.177	0.179	0.172	0.171	0.185	0.197	0.183	0.173	0.206	0.212	0.207	0.211	0.217
Other debt	0.086	0.085	0.071	0.063	0.048	0.046	0.051	0.041	0.035	0.039	0.037	0.038	0.036	0.036
Sen. bonds & notes	0.236	0.237	0.236	0.219	0.196	0.187	0.171	0.168	0.176	0.191	0.198	0.200	0.200	0.179
Sub. bonds & notes	0.040	0.039	0.035	0.030	0.022	0.019	0.014	0.012	0.012	0.013	0.013	0.012	0.011	0.009
Term loans	0.402	0.417	0.433	0.472	0.527	0.526	0.531	0.549	0.555	0.500	0.490	0.494	0.494	0.509
HHI	0.682	0.701	0.705	0.709	0.723	0.718	0.712	0.717	0.726	0.717	0.726	0.723	0.720	0.729
Excl90	0.421	0.450	0.452	0.462	0.478	0.475	0.462	0.474	0.486	0.476	0.491	0.485	0.487	0.503
Panel D: Non-US firms														
Capital leases	0.033	0.030	0.034	0.033	0.028	0.026	0.027	0.033	0.033	0.032	0.032	0.030	0.032	0.032
Commerical paper	0.006	0.005	0.006	0.006	0.005	0.004	0.004	0.003	0.003	0.003	0.004	0.003	0.003	0.004
Drawn credit line	0.141	0.154	0.158	0.158	0.168	0.180	0.196	0.190	0.184	0.203	0.213	0.214	0.218	0.220
Other debt	0.130	0.133	0.113	0.089	0.076	0.078	0.082	0.085	0.086	0.090	0.088	0.085	0.082	0.081
Sen. bonds & notes	0.129	0.128	0.122	0.114	0.110	0.104	0.097	0.089	0.084	0.090	0.094	0.099	0.105	0.106
Sub. bonds & notes	0.004	0.005	0.005	0.004	0.003	0.003	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.003
Term loans	0.557	0.546	0.562	0.596	0.610	0.604	0.591	0.596	0.606	0.578	0.566	0.564	0.556	0.554
HHI	0.701	0.697	0.693	0.692	0.697	0.696	0.694	0.697	0.699	0.687	0.689	0.694	0.692	0.691
Excl90	0.456	0.448	0.434	0.434	0.438	0.437	0.432	0.440	0.444	0.425	0.431	0.434	0.433	0.436

countries debt market is less well functioning compared to the non-civil law countries or more specifically the common law countries as suggested by [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1997\)](#), therefore the slope for the civil law countries exhibits more steepness than the non-civil law countries. Finally, Panel F depicts the other debt as percentage of total debt. There is downward trend in this category of debt over the period. Noticeably, the civil law countries experience a significant decrease in other debt. However, for the non-civil law and non-US countries it is very flat after the financial crisis.

3.4.2 Debt Specialization and Ratings

Prior theoretical studies (see [Diamond \(1991\)](#) and [Chemmanur and Fulghieri \(1994\)](#)) argue that the firms will move from bank debt to public debt as the credit quality of the firm improves. [Diamond \(1991\)](#) suggests that, higher credit quality firms borrow from arm's-length lenders to avoid the monitoring cost associated with bank debt¹² which increases the cost of bank debt. Prior work by [Faulkender and Petersen \(2006\)](#) suggests that the firms with credit ratings have higher leverage due to credit ratings and conclude that this is due to access to public bond market. In relation to this, the empirical study by [Colla, Ippolito, and Li \(2013\)](#) suggests that the higher credit rating leads to higher public debt for the US firms. Therefore, we examine the impact of credit rating on the firms' choice of debt types.

In table 3.5, we present the summary of all debt types at different thresholds for the rated firms. Similar to [Colla, Ippolito, and Li \(2013\)](#) this study employs a wide spectrum of thresholds ranging from 10% to 99% to identify the significant usage of debt type by the firms. In this analysis, 10% threshold indicates that the firm-year observations those employ more than 10% of debt from the corresponding source of debt. More specifically, in Panel A, 0.044 for capital leases indicates that higher than 10% of debt sourced as capital leases by more than 4% of the firm-years. The sum of all debt types at each threshold is reported in row titled "Total". A value of "1" in total row across all the thresholds would indicate that all the firms were specialized in one debt type. Whereas, an equal division

¹²Trade-off between bank debt and commercial papers is considered in the model developed by [Diamond \(1991\)](#).

Table 3.5: Concentration on One Debt Type: Rated Firms

This table reports summary of debt types for different thresholds for rated firms. For example, “10%” denotes the share of firm-year observations that employ more than 10% of debt from one debt type. The remaining columns are similarly defined. The sum of all share values in a given threshold is represented as “Total”. This indicates the share of firm-year observations that employ more than a given threshold level of debt from at least one debt type. Panel A represents summary for all rated sample firms. Panel B and C represents summary for sample of rated firms listed in the civil law and non-civil law countries respectively. Panel D presents firm-year observations of non-US listed rated firms. For the variable definition see notes in table 3.16.

	Thresholds								
	10%	30%	50%	60%	70%	80%	90%	95%	99%
Panel A: All firms									
Capital leases	0.044	0.009	0.004	0.003	0.002	0.002	0.001	0.001	0.000
Commercial paper	0.076	0.017	0.006	0.003	0.002	0.002	0.001	0.001	0.001
Drawn credit line	0.211	0.094	0.045	0.032	0.021	0.015	0.011	0.009	0.006
Other debt	0.093	0.037	0.026	0.022	0.018	0.014	0.012	0.011	0.010
Sen. bonds & notes	0.804	0.715	0.590	0.522	0.436	0.344	0.232	0.165	0.090
Sub. bonds & notes	0.119	0.081	0.05	0.041	0.032	0.025	0.019	0.016	0.010
Term loans	0.435	0.292	0.197	0.152	0.115	0.082	0.060	0.047	0.032
Total	1.781	1.246	0.918	0.775	0.627	0.484	0.336	0.250	0.149
Panel B: Sample firms listed in Civil Law Countries									
Capital leases	0.040	0.006	0.004	0.002	0.001	0.000	0.000	0.000	0.000
Commercial paper	0.083	0.011	0.003	0.002	0.002	0.001	0.001	0.000	0.000
Drawn credit line	0.149	0.059	0.024	0.012	0.009	0.006	0.005	0.002	0.002
Other debt	0.161	0.077	0.057	0.051	0.042	0.036	0.032	0.029	0.026
Sen. bonds & notes	0.810	0.679	0.497	0.418	0.307	0.206	0.094	0.049	0.019
Sub. bonds & notes	0.039	0.009	0.008	0.008	0.006	0.002	0.000	0.000	0.000
Term loans	0.680	0.437	0.301	0.228	0.172	0.119	0.087	0.066	0.047
Total	1.961	1.277	0.895	0.722	0.540	0.370	0.218	0.146	0.094
Panel C: Sample firms listed in Non-Civil Law Countries									
Capital leases	0.044	0.009	0.003	0.002	0.002	0.002	0.002	0.001	0.001
Commercial paper	0.075	0.019	0.007	0.003	0.002	0.002	0.001	0.001	0.001
Drawn credit line	0.223	0.102	0.049	0.036	0.024	0.017	0.012	0.011	0.007
Other debt	0.074	0.027	0.018	0.015	0.013	0.009	0.008	0.007	0.006
Sen. bonds & notes	0.804	0.729	0.617	0.551	0.470	0.380	0.266	0.194	0.107
Sub. bonds & notes	0.138	0.099	0.060	0.049	0.039	0.031	0.023	0.019	0.013
Term loans	0.374	0.254	0.169	0.131	0.099	0.073	0.054	0.043	0.029
Total	1.734	1.238	0.924	0.787	0.650	0.513	0.366	0.277	0.164
Panel D: Non-US firms									
Capital leases	0.044	0.013	0.007	0.005	0.004	0.003	0.003	0.001	0.001
Commercial paper	0.075	0.013	0.004	0.003	0.003	0.002	0.002	0.002	0.001
Drawn credit line	0.160	0.072	0.034	0.020	0.013	0.009	0.006	0.004	0.003
Other debt	0.134	0.069	0.050	0.043	0.034	0.026	0.021	0.019	0.017
Sen. bonds & notes	0.808	0.662	0.482	0.412	0.318	0.230	0.125	0.080	0.040
Sub. bonds & notes	0.045	0.021	0.012	0.011	0.010	0.006	0.005	0.003	0.003
Term loans	0.640	0.442	0.314	0.237	0.176	0.118	0.080	0.063	0.047
Total	1.906	1.291	0.904	0.731	0.558	0.394	0.241	0.173	0.111

of debt types across all seven sources by the firms would indicate “7” in row total for

column of 10%; correspondingly, it will be “0” for 30% and above thresholds. If total ranges between “0” to “7”, this will indicate that there is tendency toward specialization. In our case, for all the panels presented in table 3.5, it is between the aforementioned range indicating that the firm specialize in the debt type(s).

We have found from the previous analysis that two types of debt are widely used by the firms namely term loans and senior bonds and notes. Interestingly, for all panels of table 3.5 we find that, at 10% threshold more firm-years use senior bonds and notes compared to term loans and this is persistent over the other thresholds. This indicates that the rated firms prefer to use more public debt compared to the term loan which is bank debt. Further dissection of the sample suggests that, the percentage of the rated firms that use more than 90% of debt from only source of debt in panel A, B, C, and D are 34%, 22%, 37%, and 24% respectively. This suggests that the firms in non-civil law countries use more concentrated debt and among which nearly 27% of firm-year observations use senior bonds and notes. The difference between use of term loan and senior bonds and notes for non-civil law countries at 90% threshold is 21%, whereas for the civil law countries it is below 1%. This suggests that the non-civil law countries specialize more on the market debt.

Now, in table 3.6 we present the summary of different debt types at different thresholds for the unrated firms. Looking at both 10% and 90% threshold for panel A, this is affirmed that unrated firms source debt from two main categories namely term loans and drawn credit line. This suggests that bank finance is the main source of financing for the unrated firms, which is similarly found in the literature. Further comparison among the panels suggest that, the percentage of the unrated firms that use more than 90% of debt from only source of debt in panel A, B, C, and D are 45%, 52%, 48%, and 44% respectively. This suggests that the civil law countries unrated firms rely more on concentrated debt and among which 42% of firm-year observations use term loans.

Further, we examine the firms’ choice of debt type by imposing the condition that the firm usage of a particular debt type must exceed by 30% of total debt. Thereafter, we calculate the mean and median for the subset of observations that satisfy this condition

Table 3.6: Concentration on One Debt Type: Unrated Firms

This table reports summary of debt types for different thresholds for unrated firms. For the variable definition see notes in table 3.16. See also notes in table 3.5.

	Thresholds								
	10%	30%	50%	60%	70%	80%	90%	95%	99%
Panel A: All firms									
Capital leases	0.083	0.031	0.016	0.012	0.008	0.006	0.004	0.003	0.002
Commerical paper	0.011	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Drawn credit line	0.384	0.264	0.174	0.138	0.106	0.079	0.055	0.041	0.027
Other debt	0.167	0.098	0.070	0.059	0.050	0.042	0.034	0.030	0.025
Sen. bonds & notes	0.217	0.146	0.100	0.083	0.069	0.056	0.043	0.036	0.028
Sub. bonds & notes	0.015	0.010	0.007	0.006	0.005	0.004	0.003	0.003	0.002
Term loans	0.775	0.678	0.570	0.513	0.451	0.384	0.309	0.261	0.204
Total	1.652	1.230	0.938	0.812	0.689	0.572	0.448	0.374	0.289
Panel B: Sample firms listed in Civil Law Countries									
Capital leases	0.094	0.035	0.017	0.011	0.007	0.004	0.002	0.002	0.001
Commerical paper	0.017	0.005	0.002	0.001	0.000	0.000	0.000	0.000	0.000
Drawn credit line	0.264	0.171	0.114	0.091	0.072	0.055	0.039	0.029	0.019
Other debt	0.118	0.076	0.057	0.049	0.042	0.036	0.029	0.025	0.019
Sen. bonds & notes	0.211	0.137	0.087	0.068	0.053	0.039	0.028	0.022	0.016
Sub. bonds & notes	0.006	0.004	0.003	0.002	0.002	0.002	0.001	0.001	0.001
Term loans	0.841	0.763	0.676	0.625	0.568	0.502	0.422	0.368	0.303
Total	1.551	1.192	0.954	0.848	0.744	0.638	0.521	0.447	0.359
Panel C: Sample firms listed in Non-Civil Law Countries									
Capital leases	0.105	0.040	0.022	0.016	0.012	0.009	0.006	0.004	0.003
Commerical paper	0.008	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Drawn credit line	0.361	0.257	0.182	0.152	0.123	0.098	0.073	0.057	0.040
Other debt	0.094	0.060	0.044	0.038	0.032	0.027	0.021	0.019	0.016
Sen. bonds & notes	0.276	0.195	0.142	0.121	0.103	0.086	0.068	0.058	0.047
Sub. bonds & notes	0.026	0.018	0.013	0.010	0.009	0.007	0.006	0.005	0.004
Term loans	0.724	0.636	0.546	0.497	0.443	0.383	0.309	0.261	0.198
Total	1.595	1.209	0.949	0.835	0.722	0.611	0.483	0.404	0.307
Panel D: Non-US firms									
Capital leases	0.081	0.030	0.014	0.010	0.007	0.005	0.003	0.002	0.001
Commerical paper	0.011	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Drawn credit line	0.381	0.258	0.167	0.131	0.099	0.073	0.049	0.036	0.022
Other debt	0.176	0.103	0.073	0.062	0.052	0.044	0.035	0.031	0.025
Sen. bonds & notes	0.188	0.117	0.074	0.059	0.047	0.036	0.026	0.021	0.016
Sub. bonds & notes	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001
Term loans	0.816	0.717	0.605	0.545	0.479	0.409	0.328	0.277	0.216
Total	1.659	1.233	0.937	0.810	0.686	0.567	0.442	0.368	0.281

for each debt types. These statistics provide an indication if the firms are significant users of a particular debt type. Results are presented in table 3.7 for the rated firms. The panel A for all firms suggests that if the firms use more than 30% of debt as commercial paper or drawn credit line then on average the firms will be significant users of senior bonds and

Table 3.7: Conditional Debt Structure: Rated Firms

This table reports evidence on conditional debt structure for the rated firms. At first, we impose the condition of use of a particular debt type which exceeds 30% of total debt. Thereafter, we compute mean and median (in square brackets) ratios of each debt type to total debt for the subset of observations satisfy this condition. For the variable definition see notes in table 3.16.

	CP	CL	TL	SBN	SUB	CL	OTH
Panel A: All firms							
CL > 30%	0.013 [0.000]	0.044 [0.000]	0.163 [0.049]	0.188 [0.084]	0.022 [0.000]	0.545 [0.467]	0.043 [0.000]
CP > 30%	0.491 [0.442]	0.081 [0.000]	0.222 [0.046]	0.554 [0.629]	0.060 [0.000]	0.018 [0.000]	0.043 [0.000]
DC > 30%	0.005 [0.000]	0.552 [0.490]	0.222 [0.046]	0.554 [0.629]	0.060 [0.000]	0.018 [0.000]	0.043 [0.000]
OTH > 30%	0.025 [0.000]	0.039 [0.000]	0.059 [0.000]	0.152 [0.004]	0.011 [0.000]	0.024 [0.000]	0.690 [0.688]
SBN > 30%	0.024 [0.000]	0.058 [0.000]	0.118 [0.007]	0.746 [0.787]	0.060 [0.000]	0.018 [0.000]	0.043 [0.000]
SUB > 30%	0.000 [0.000]	0.091 [0.000]	0.136 [0.000]	0.104 [0.001]	0.641 [0.601]	0.018 [0.000]	0.043 [0.000]
TL > 30%	0.009 [0.000]	0.035 [0.000]	0.645 [0.617]	0.554 [0.629]	0.060 [0.000]	0.018 [0.000]	0.043 [0.000]
Panel B: Sample firms listed in Civil Law Countries							
CL > 30%	0.000 [0.000]	0.077 [0.000]	0.065 [0.068]	0.266 [0.300]	0.000 [0.000]	0.588 [0.583]	0.080 [0.000]
CP > 30%	0.454 [0.364]	0.053 [0.000]	0.334 [0.224]	0.480 [0.495]	0.013 [0.000]	0.019 [0.001]	0.080 [0.000]
DC > 30%	0.011 [0.000]	0.503 [0.452]	0.334 [0.224]	0.480 [0.495]	0.013 [0.000]	0.019 [0.001]	0.080 [0.000]
OTH > 30%	0.012 [0.000]	0.018 [0.000]	0.052 [0.000]	0.146 [0.000]	0.005 [0.000]	0.028 [0.000]	0.737 [0.768]
SBN > 30%	0.022 [0.000]	0.041 [0.000]	0.210 [0.153]	0.661 [0.669]	0.013 [0.000]	0.019 [0.001]	0.080 [0.000]
SUB > 30%	0.000 [0.000]	0.062 [0.074]	0.175 [0.155]	0.019 [0.000]	0.723 [0.746]	0.019 [0.001]	0.080 [0.000]
TL > 30%	0.011 [0.000]	0.034 [0.000]	0.643 [0.615]	0.480 [0.495]	0.013 [0.000]	0.019 [0.001]	0.080 [0.000]
Panel C: Sample firms listed in Non-Civil Law Countries							
CL > 30%	0.016 [0.000]	0.033 [0.000]	0.163 [0.008]	0.200 [0.001]	0.027 [0.000]	0.535 [0.430]	0.034 [0.000]
CP > 30%	0.496 [0.451]	0.087 [0.000]	0.193 [0.006]	0.575 [0.665]	0.072 [0.000]	0.017 [0.000]	0.034 [0.000]
DC > 30%	0.004 [0.000]	0.557 [0.491]	0.193 [0.006]	0.575 [0.665]	0.072 [0.000]	0.017 [0.000]	0.034 [0.000]
OTH > 30%	0.034 [0.000]	0.037 [0.000]	0.056 [0.000]	0.158 [0.011]	0.016 [0.000]	0.022 [0.000]	0.677 [0.683]
SBN > 30%	0.024 [0.000]	0.061 [0.000]	0.097 [0.000]	0.765 [0.817]	0.072 [0.000]	0.017 [0.000]	0.034 [0.000]
SUB > 30%	0.000 [0.000]	0.091 [0.000]	0.136 [0.000]	0.105 [0.001]	0.640 [0.596]	0.017 [0.000]	0.034 [0.000]
TL > 30%	0.009 [0.000]	0.035 [0.000]	0.646 [0.614]	0.575 [0.665]	0.072 [0.000]	0.017 [0.000]	0.034 [0.000]
Panel D: Non-US firms							
CL > 30%	0.000 [0.000]	0.030 [0.000]	0.181 [0.096]	0.172 [0.001]	0.000 [0.000]	0.580 [0.502]	0.066 [0.000]
CP > 30%	0.500 [0.364]	0.060 [0.000]	0.331 [0.226]	0.481 [0.482]	0.018 [0.000]	0.021 [0.000]	0.066 [0.000]
DC > 30%	0.012 [0.000]	0.530 [0.487]	0.331 [0.226]	0.481 [0.482]	0.018 [0.000]	0.021 [0.000]	0.066 [0.000]
OTH > 30%	0.017 [0.000]	0.035 [0.000]	0.075 [0.000]	0.146 [0.023]	0.005 [0.000]	0.025 [0.000]	0.697 [0.695]
SBN > 30%	0.020 [0.000]	0.048 [0.000]	0.201 [0.131]	0.676 [0.682]	0.018 [0.000]	0.021 [0.000]	0.066 [0.000]
SUB > 30%	0.000 [0.000]	0.076 [0.000]	0.142 [0.002]	0.098 [0.000]	0.644 [0.687]	0.021 [0.000]	0.066 [0.000]
TL > 30%	0.013 [0.000]	0.027 [0.000]	0.649 [0.629]	0.481 [0.482]	0.018 [0.000]	0.021 [0.000]	0.066 [0.000]

notes. This suggests that the firms that raise more short-term debt such as drawn credit line or commercial papers source their higher portion of debt from senior bonds and notes plausibly to mitigate the risk of debt rollover. Further, firms those use more than 30% of term loans also significantly use senior bonds and notes on average (56%). Such findings suggest that the rated firms in need for long-term financing significantly use both term loans and senior bonds and notes.

We also examine if there exists any difference for the civil and non-civil law countries. In civil law countries, significant users of commercial paper and drawn credit line also use on average higher proportion of debt as senior bonds and loans (48%). Similarly non-civil law countries significant users of commercial paper and drawn credit line uses on average higher proportion of debt as senior bonds and loans (58%). However, the average is 10% higher for non-civil law countries. Plausible reasons for such difference between the civil and non-civil law countries could be due to difference in the capital market functioning and being more prone to bank-based financial system. Similarly, though civil and non-civil law countries firms those significantly use senior bonds and notes also use term loans on average 21% and 9.7% which is significantly different¹³.

Later, we examine the conditional debt structure for the non-rated firms and report the results in table 3.8. The values along the main diagonal in panel A suggest that the conditional mean use for the debt type after our imposed condition ranges between 0.1% to 56%. Firms that use significantly senior bonds and notes are also a significant user of term loans on average (19%). Similarly, significant users of term loans on average are also a significant user of senior bonds and notes (12%). The panel A for all firms suggest that if the firms use more than 30% of debt as commercial paper or drawn credit line then firms are also significant user of senior bonds and notes. This is similar to rated firms, which suggests that the firm that raises more short-term debt such as drawn credit line or commercial papers source their higher portion of debt from senior bonds and notes plausibly to mitigate potential risk of debt rollover.

¹³We conduct non-parametric mean and median difference t- and Wilcoxon test and p-value for both test is 0.000. This suggest that there is a difference exist between civil and non-civil law countries.

Table 3.8: Conditional Debt Structure: Unrated Firms

This table reports evidence on conditional debt structure for the unrated firms. For the variable definition see notes in table 3.16. See also notes in table 3.7.

	CP	CL	TL	SBN	SUB	CL	OTH
Panel A: All firms							
CL > 30%	0.001 [0.000]	0.091 [0.000]	0.257 [0.217]	0.053 [0.000]	0.003 [0.000]	0.566 [0.507]	0.086 [0.000]
CP > 30%	0.478 [0.438]	0.198 [0.001]	0.555 [0.621]	0.116 [0.000]	0.008 [0.000]	0.033 [0.000]	0.086 [0.000]
DC > 30%	0.002 [0.000]	0.645 [0.618]	0.555 [0.621]	0.116 [0.000]	0.008 [0.000]	0.033 [0.000]	0.086 [0.000]
OTH > 30%	0.001 [0.000]	0.088 [0.000]	0.154 [0.028]	0.035 [0.000]	0.001 [0.000]	0.014 [0.000]	0.706 [0.715]
SBN > 30%	0.004 [0.000]	0.072 [0.000]	0.187 [0.068]	0.683 [0.670]	0.008 [0.000]	0.033 [0.000]	0.086 [0.000]
SUB > 30%	0.001 [0.000]	0.106 [0.000]	0.107 [0.000]	0.066 [0.000]	0.692 [0.679]	0.033 [0.000]	0.086 [0.000]
TL > 30%	0.003 [0.000]	0.105 [0.000]	0.786 [0.863]	0.116 [0.000]	0.008 [0.000]	0.033 [0.000]	0.086 [0.000]
Panel B: Sample firms listed in Civil Law Countries							
CL > 30%	0.002 [0.000]	0.087 [0.000]	0.310 [0.323]	0.033 [0.000]	0.001 [0.000]	0.536 [0.483]	0.066 [0.000]
CP > 30%	0.463 [0.441]	0.134 [0.000]	0.652 [0.803]	0.104 [0.000]	0.003 [0.000]	0.035 [0.000]	0.066 [0.000]
DC > 30%	0.004 [0.000]	0.654 [0.634]	0.652 [0.803]	0.104 [0.000]	0.003 [0.000]	0.035 [0.000]	0.066 [0.000]
OTH > 30%	0.003 [0.000]	0.040 [0.000]	0.139 [0.000]	0.065 [0.000]	0.001 [0.000]	0.025 [0.000]	0.727 [0.762]
SBN > 30%	0.005 [0.000]	0.054 [0.000]	0.248 [0.209]	0.635 [0.598]	0.003 [0.000]	0.035 [0.000]	0.066 [0.000]
SUB > 30%	0.000 [0.000]	0.044 [0.000]	0.191 [0.084]	0.036 [0.000]	0.691 [0.640]	0.035 [0.000]	0.066 [0.000]
TL > 30%	0.005 [0.000]	0.065 [0.000]	0.831 [0.940]	0.104 [0.000]	0.003 [0.000]	0.035 [0.000]	0.066 [0.000]
Panel C: Sample firms listed in Non-Civil Law Countries							
CL > 30%	0.000 [0.000]	0.091 [0.000]	0.232 [0.157]	0.066 [0.000]	0.005 [0.000]	0.583 [0.523]	0.052 [0.000]
CP > 30%	0.497 [0.437]	0.201 [0.000]	0.530 [0.594]	0.158 [0.000]	0.014 [0.000]	0.042 [0.000]	0.052 [0.000]
DC > 30%	0.001 [0.000]	0.686 [0.680]	0.530 [0.594]	0.158 [0.000]	0.014 [0.000]	0.042 [0.000]	0.052 [0.000]
OTH > 30%	0.000 [0.000]	0.063 [0.000]	0.139 [0.000]	0.055 [0.000]	0.001 [0.000]	0.023 [0.000]	0.719 [0.741]
SBN > 30%	0.003 [0.000]	0.075 [0.000]	0.157 [0.010]	0.713 [0.730]	0.014 [0.000]	0.042 [0.000]	0.052 [0.000]
SUB > 30%	0.001 [0.000]	0.114 [0.000]	0.095 [0.000]	0.070 [0.000]	0.694 [0.690]	0.042 [0.000]	0.052 [0.000]
TL > 30%	0.002 [0.000]	0.090 [0.000]	0.802 [0.889]	0.158 [0.000]	0.014 [0.000]	0.042 [0.000]	0.052 [0.000]
Panel D: Non-US firms							
CL > 30%	0.001 [0.000]	0.091 [0.000]	0.287 [0.275]	0.039 [0.000]	0.001 [0.000]	0.552 [0.493]	0.090 [0.000]
CP > 30%	0.472 [0.436]	0.193 [0.001]	0.588 [0.670]	0.091 [0.000]	0.003 [0.000]	0.031 [0.000]	0.090 [0.000]
DC > 30%	0.002 [0.000]	0.635 [0.605]	0.588 [0.670]	0.091 [0.000]	0.003 [0.000]	0.031 [0.000]	0.090 [0.000]
OTH > 30%	0.001 [0.000]	0.090 [0.000]	0.160 [0.040]	0.033 [0.000]	0.000 [0.000]	0.013 [0.000]	0.702 [0.708]
SBN > 30%	0.004 [0.000]	0.066 [0.000]	0.235 [0.175]	0.641 [0.602]	0.003 [0.000]	0.031 [0.000]	0.090 [0.000]
SUB > 30%	0.001 [0.000]	0.132 [0.000]	0.148 [0.001]	0.053 [0.000]	0.632 [0.566]	0.031 [0.000]	0.090 [0.000]
TL > 30%	0.003 [0.000]	0.104 [0.000]	0.788 [0.865]	0.091 [0.000]	0.003 [0.000]	0.031 [0.000]	0.090 [0.000]

In essence to identify if there is any difference between civil and non-civil law countries, we also tabulate the mean and median values for the conditional use of debt types in panel B and C respectively. The civil law countries which are significant users of senior bonds and notes on average also use significant amount of term loans (25%). Similarly, non-civil law countries which are significant users of senior bonds and notes on average also use significant amount of term loans (16%). Also for the civil law countries significant users of term loans on average also use significant amount of senior bonds and notes (10%), whereas in the non-civil law countries significant users of term loans on average also use significant amount of senior bonds and notes (16%). This difference in use of conditional debt type is significantly different¹⁴.

By comparing and contrasting the results reported in table 3.7 and 3.8, this can be argued that there is similarity in the use of conditional debt structure of both rated and unrated firms. More specifically, firms using significant senior bonds and notes on average also use term loans and vice versa¹⁵. This suggests that the firms which have access to more public debt also have access to private debt and vice versa. However, the difference in the average amount on the conditional debt value suggest that there is heterogeneity exist between rated and non-rated firms and also across the groups. For instance, unrated firms use more private debt such as term loans and drawn credit line, whereas the rated firms use more public debt such as senior bonds and notes and commercial paper.

Results presented in table 3.5–3.8 provide the evidence of impact of credit ratings on the debt type concentration by considering whether the firms are rated or unrated. However, this does not portray the impact of the different spectrum of credit rating on the choice of debt types. Therefore, we also examine the impact of different category of credit rating and on the choice of debt type. The results are reported in table 3.9. In panel A, firms in higher spectrum of credit rating e.g. AAA to BBB are significant user of senior bonds and notes (ranges between 59% and 67%) and debt diversification HHI

¹⁴We conduct non-parametric mean and median difference t- and Wilcoxon test and p-value for both test is 0.000. This suggest that there is a difference exist between civil and non-civil law countries.

¹⁵The mean and median value for rated and unrated or different group of firms based on the group (e.g. All firms, civil law, non-civil law, and non-US firms) are qualitatively same but not quantitatively similar.

Table 3.9: Credit Ratings and Debt Structure

This table reports mean and median (in square brackets) values of different debt types to total debt across different rating classes. For the variable definition see notes in table 3.16.

	AAA	AA	A	BBB	BB	B	<= CCC+	Unrated Unrated
Panel A: All firms								
CL	0.022 [0.015]	0.048 [0.000]	0.013 [0.000]	0.016 [0.000]	0.016 [0.000]	0.021 [0.000]	0.017 [0.000]	0.033 [0.000]
CP	0.135 [0.021]	0.080 [0.000]	0.054 [0.000]	0.022 [0.000]	0.003 [0.000]	0.001 [0.000]	0.003 [0.000]	0.003 [0.000]
DC	0.001 [0.000]	0.016 [0.000]	0.031 [0.000]	0.082 [0.000]	0.116 [0.003]	0.091 [0.000]	0.086 [0.000]	0.198 [0.001]
HHI	0.524 [0.450]	0.596 [0.560]	0.643 [0.624]	0.646 [0.629]	0.613 [0.549]	0.649 [0.621]	0.643 [0.619]	0.700 [0.716]
OTH	0.099 [0.022]	0.087 [0.001]	0.065 [0.004]	0.039 [0.000]	0.040 [0.000]	0.019 [0.000]	0.017 [0.000]	0.086 [0.710]
SBN	0.588 [0.607]	0.613 [0.697]	0.668 [0.761]	0.630 [0.726]	0.411 [0.382]	0.489 [0.521]	0.511 [0.593]	0.116 [0.000]
SUB	0.000 [0.000]	0.001 [0.000]	0.013 [0.000]	0.021 [0.000]	0.125 [0.000]	0.100 [0.000]	0.141 [0.000]	0.008 [0.000]
TL	0.156 [0.035]	0.155 [0.054]	0.156 [0.026]	0.188 [0.022]	0.288 [0.126]	0.278 [0.084]	0.225 [0.084]	0.555 [0.621]
Panel B: Sample firms listed in Civil Law Countries								
CL	0.007 [0.002]	0.028 [0.006]	0.011 [0.003]	0.020 [0.003]	0.018 [0.000]	0.024 [0.006]	0.031 [0.000]	0.035 [0.000]
CP	0.119 [0.010]	0.072 [0.025]	0.039 [0.000]	0.021 [0.000]	0.008 [0.000]	0.006 [0.000]	0.000 [0.000]	0.005 [0.000]
DC	0.000 [0.000]	0.012 [0.000]	0.016 [0.000]	0.044 [0.000]	0.062 [0.000]	0.126 [0.000]	0.018 [0.000]	0.134 [0.000]
HHI	0.231 [0.230]	0.522 [0.467]	0.590 [0.569]	0.538 [0.473]	0.569 [0.485]	0.614 [0.584]	0.512 [0.473]	0.743 [0.819]
OTH	0.169 [0.135]	0.117 [0.013]	0.105 [0.009]	0.086 [0.001]	0.065 [0.000]	0.038 [0.000]	0.089 [0.000]	0.066 [0.710]
SBN	0.316 [0.279]	0.605 [0.673]	0.594 [0.688]	0.519 [0.566]	0.373 [0.359]	0.382 [0.295]	0.423 [0.350]	0.104 [0.000]
SUB	0.000 [0.000]	0.002 [0.000]	0.012 [0.000]	0.006 [0.000]	0.014 [0.000]	0.035 [0.000]	0.003 [0.000]	0.003 [0.000]
TL	0.389 [0.482]	0.163 [0.120]	0.222 [0.133]	0.301 [0.225]	0.458 [0.473]	0.388 [0.222]	0.434 [0.473]	0.652 [0.803]
Panel C: Sample firms listed in Non-Civil Law Countries								
CL	0.023 [0.015]	0.053 [0.000]	0.011 [0.000]	0.014 [0.000]	0.016 [0.000]	0.020 [0.000]	0.016 [0.000]	0.042 [0.000]
CP	0.136 [0.020]	0.082 [0.000]	0.058 [0.000]	0.023 [0.000]	0.002 [0.000]	0.000 [0.000]	0.004 [0.000]	0.003 [0.000]
DC	0.001 [0.000]	0.016 [0.000]	0.032 [0.000]	0.093 [0.000]	0.129 [0.011]	0.084 [0.000]	0.095 [0.017]	0.201 [0.000]
HHI	0.540 [0.455]	0.613 [0.566]	0.657 [0.656]	0.677 [0.682]	0.625 [0.562]	0.657 [0.642]	0.659 [0.649]	0.722 [0.766]
OTH	0.095 [0.019]	0.080 [0.000]	0.055 [0.003]	0.025 [0.000]	0.033 [0.000]	0.016 [0.000]	0.008 [0.000]	0.052 [0.000]
SBN	0.602 [0.630]	0.615 [0.707]	0.690 [0.783]	0.667 [0.787]	0.422 [0.396]	0.510 [0.564]	0.522 [0.636]	0.158 [0.000]
SUB	0.000 [0.000]	0.000 [0.000]	0.013 [0.000]	0.025 [0.000]	0.151 [0.000]	0.113 [0.000]	0.158 [0.000]	0.014 [0.000]
TL	0.143 [0.033]	0.153 [0.021]	0.141 [0.002]	0.152 [0.000]	0.247 [0.038]	0.256 [0.035]	0.198 [0.045]	0.530 [0.594]
Panel D: Non-US firms								
CL	0.014 [0.000]	0.067 [0.002]	0.016 [0.000]	0.019 [0.001]	0.017 [0.000]	0.026 [0.001]	0.018 [0.000]	0.031 [0.000]
CP	0.012 [0.000]	0.038 [0.000]	0.034 [0.000]	0.025 [0.000]	0.007 [0.000]	0.003 [0.000]	0.000 [0.000]	0.004 [0.000]
DC	0.001 [0.000]	0.018 [0.000]	0.035 [0.000]	0.062 [0.000]	0.070 [0.000]	0.112 [0.000]	0.056 [0.000]	0.193 [0.001]
HHI	0.677 [0.612]	0.568 [0.513]	0.568 [0.529]	0.577 [0.519]	0.592 [0.521]	0.610 [0.576]	0.632 [0.527]	0.697 [0.710]
OTH	0.064 [0.000]	0.112 [0.000]	0.095 [0.000]	0.054 [0.000]	0.067 [0.000]	0.034 [0.000]	0.035 [0.000]	0.090 [0.000]
SBN	0.634 [0.748]	0.554 [0.639]	0.527 [0.568]	0.504 [0.527]	0.376 [0.336]	0.448 [0.443]	0.524 [0.593]	0.091 [0.000]
SUB	0.000 [0.000]	0.001 [0.000]	0.007 [0.000]	0.014 [0.000]	0.028 [0.000]	0.047 [0.000]	0.042 [0.000]	0.003 [0.000]
TL	0.275 [0.182]	0.210 [0.121]	0.285 [0.173]	0.322 [0.210]	0.434 [0.414]	0.328 [0.189]	0.324 [0.166]	0.588 [0.670]

on average ranges between 0.524 to 0.646. However, for the same range of credit rating term loans is between 16% and 19%. Further, firms with lower credit rating or unrated firms are significant users of term loans and drawn credit line. Mean HHI for the unrated firms is 0.700, and this is higher compared to any rated firms suggesting that the unrated firms have very little scope for diversifying debt by sourcing debt from different sources compared to the rated firms.

Panel B in the table 3.9 suggest that the debt diversification index for civil law countries firms which belong to higher spectrum of credit rating ranges between 0.231 and 0.590. This suggest that the firms in the civil law countries use a wide range of debt. However, for the same group of rated firms in the non-civil law countries (non-US countries) HHI ranges between 0.540 and 0.677 (0.568 and 0.677). This suggests that despite having higher credit rating, firms in the non-civil law and the non-US countries use more concentrated debt. Though, it is found that the firms in the civil law countries have higher debt diversification, it should also be noted that the firms at are rated AAA have on average have 32% (39%) of debt as senior bonds and notes (term loans), whereas for the non-civil law countries it is 60% (14%). This suggest that the civil law countries debt mainly comprises term loans even though the firms have utmost credit rating, but the non-civil law countries exploit being rated as AAA by using lower cost public debt. Also, firms in the civil law countries that are unrated firms on average use 65% of debt as term loan, whereas for non-civil law and the non-US countries it is 53% and 59% respectively.

3.4.3 Distress Risk and Debt Structure

Franks and Sussman (2005) suggest that the financial distress of the firm is resolved by allocating the control rights of the firm upon nonpayment to a large creditor to reorganize or liquidate the firm, as per the loan contract. It has been argued in the literature that the firms with higher risk of default will use concentrated (usually bank debt) to reduce the risk of liquidation, whereas dispersed debt (usually corporate bonds and commercial papers) are used by the firm with lower financial distress to reduce strategic default (see Bolton and Scharfstein (1996)). Therefore, this study examines the impact of financial distress risk on the choice of debt types. To do so, we divide our sample firms into five

group based on the financial distress of the firm. Initially, for each year t we find the 20, 40, 60, and 80 percentiles based on the financial distress risk of the firm. Firms with default probability below 20th percentile are considered as low financial distress firms, similarly rest of the groups are defined. The firms with default probability above the 80th percentile have higher risk and we name this group as *High Distress*. Thereafter, assigning a firm-year into a certain group based on the calculated percentile this study calculates the mean and median for each group. The results are reported in table 3.10.

In panel A, we find that the firms with lower financial distress use term loans and senior bonds and notes as 46%, and 29% of total debt (on average) respectively. Whereas, the firms that have higher financial distress have 57% and 13%, respectively. This suggests that the firms in higher financial distress use higher level of term loans which is usually concentrated debt whereby, the firm reduces the probability of inefficient liquidation and benefit from bank monitoring. Contrarily, firms with lower financial distress optimally choose higher percentage of public debt such as senior bonds and notes in an attempt to reduce the likelihood of strategic default. The mean(median) differences between term loans and senior bonds and notes for the low distress and high distress risk firms are -10.3% and 15.7% respectively and both are significant at 1%.

Later, this study finds the mean and median use of different types of debt by low to high distress risk firms. Panel B, reports for the civil law countries, panel C reports for the non-civil law countries, and panel D reports for the non-US countries. The results reported for each of the panel is similar to what we found for all firms reported in panel A. For instance, the firms in the higher distress risk use more term loans and less senior bonds and notes compared to the low distress firms. However, there is substantial difference between the difference in low and high distress firms use of term loans and senior bonds and notes for civil law and non-civil law countries. Firms in the civil law countries rely more on the term loans despite low financial distress risk compared to the non-civil law countries. This could be due to difference in the market structure as found by [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1998\)](#) and [Fan, Titman, and Twite \(2012\)](#).

Table 3.10: Distress Risk and Debt Structure

This table reports mean and median (in square brackets) values of different debt types to total debt across five groups. To do so, we divide the sample firms in five groups based on financial distress risk measured by the probability of default. The symbol ***, **, * indicate statistical significance at 1%, 5% and 10% respectively. For the variable definition see notes in table 3.16.

	HHI	CP	DC	TL	SBN	SUB	CL	OTH
Panel A: All firms								
(1) [Low Distress]	0.725 [0.771]	0.012 [0.000]	0.136 [0.000]	0.463 [0.426]	0.286 [0.000]	0.015 [0.000]	0.033 [0.000]	0.055 [0.000]
(2)	0.732 [0.791]	0.005 [0.000]	0.1795 [0.000]	0.5635 [0.667]	0.145 [0.000]	0.015 [0.000]	0.038 [0.000]	0.054 [0.000]
(3)	0.705 [0.727]	0.045 [0.000]	0.1995 [0.000]	0.585 [0.674]	0.118 [0.000]	0.012 [0.000]	0.038 [0.000]	0.050 [0.000]
(4)	0.703 [0.722]	0.035 [0.000]	0.2005 [0.006]	0.5885 [0.685]	0.110 [0.000]	0.012 [0.000]	0.037 [0.000]	0.050 [0.000]
(5) [High Distress]	0.702 [0.719]	0.025 [0.000]	0.191 [0.000]	0.566 [0.639]	0.129 [0.000]	0.012 [0.000]	0.043 [0.000]	0.056 [0.000]
(5)-(1)	-0.023*** [-0.052***]	0.013*** [0.000***]	0.055*** [0.000***]	0.103*** [0.213***]	-0.157*** [0.000***]	-0.003* [0.000***]	0.010*** [0.000***]	0.001 [0.000***]
Panel B: Sample firms listed in Civil Law Countries								
(1) [Low Distress]	0.718 [0.754]	0.010 [0.000]	0.108 [0.000]	0.571 [0.649]	0.205 [0.000]	0.004 [0.000]	0.031 [0.000]	0.071 [0.000]
(2)	0.740 [0.806]	0.007 [0.000]	0.126 [0.000]	0.639 [0.784]	0.123 [0.000]	0.004 [0.000]	0.034 [0.000]	0.066 [0.000]
(3)	0.725 [0.770]	0.007 [0.000]	0.136 [0.000]	0.662 [0.798]	0.102 [0.000]	0.002 [0.000]	0.035 [0.000]	0.055 [0.000]
(4)	0.733 [0.794]	0.005 [0.000]	0.145 [0.000]	0.667 [0.812]	0.095 [0.000]	0.003 [0.000]	0.035 [0.000]	0.050 [0.000]
(5) [High Distress]	0.738 [0.807]	0.002 [0.000]	0.156 [0.000]	0.658 [0.806]	0.086 [0.000]	0.002 [0.000]	0.040 [0.000]	0.055 [0.000]
(5)-(1)	0.020*** [0.053***]	-0.008*** [0.000***]	0.048*** [0.000***]	0.087*** [0.157***]	-0.119*** [0.000***]	-0.002** [0.000***]	0.009*** [0.000]	-0.016*** [0.000***]
Panel C: Sample firms listed in Non-Civil Law Countries								
(1) [Low Distress]	0.734 [0.788]	0.014 [0.000]	0.141 [0.000]	0.416 [0.315]	0.333 [0.060]	0.020 [0.000]	0.032 [0.000]	0.043 [0.000]
(2)	0.726 [0.775]	0.004 [0.000]	0.204 [0.000]	0.516 [0.570]	0.171 [0.000]	0.021 [0.000]	0.040 [0.000]	0.044 [0.000]
(3)	0.700 [0.718]	0.003 [0.000]	0.234 [0.020]	0.529 [0.587]	0.129 [0.000]	0.019 [0.000]	0.042 [0.000]	0.044 [0.000]
(4)	0.689 [0.695]	0.002 [0.000]	0.235 [0.034]	0.530 [0.572]	0.125 [0.000]	0.020 [0.000]	0.040 [0.000]	0.050 [0.000]
(5) [High Distress]	0.695 [0.711]	0.001 [0.000]	0.198 [0.001]	0.507 [0.521]	0.168 [0.000]	0.022 [0.000]	0.048 [0.000]	0.057 [0.000]
(5)-(1)	-0.039*** [-0.077***]	-0.013*** [0.000***]	0.057*** [0.001***]	0.091*** [0.206***]	-0.165*** [-0.060***]	-0.002 [0.000]	0.016*** [0.000***]	0.014*** [0.000***]
Panel D: Non-US firms								
(1) [Low Distress]	0.727 [0.772]	0.008 [0.000]	0.133 [0.000]	0.568 [0.656]	0.191 [0.000]	0.003 [0.000]	0.036 [0.000]	0.061 [0.000]
(2)	0.734 [0.795]	0.005 [0.000]	0.170 [0.000]	0.621 [0.754]	0.106 [0.000]	0.004 [0.000]	0.039 [0.000]	0.055 [0.000]
(3)	0.705 [0.728]	0.005 [0.000]	0.191 [0.000]	0.616 [0.721]	0.094 [0.000]	0.004 [0.000]	0.037 [0.000]	0.052 [0.000]
(4)	0.704 [0.724]	0.003 [0.000]	0.192 [0.004]	0.627 [0.742]	0.087 [0.000]	0.004 [0.000]	0.037 [0.000]	0.051 [0.000]
(5) [High Distress]	0.703 [0.726]	0.002 [0.000]	0.188 [0.000]	0.605 [0.699]	0.102 [0.000]	0.004 [0.000]	0.042 [0.000]	0.057 [0.000]
(5)-(1)	-0.024*** [-0.046***]	-0.006*** [0.000***]	0.055*** [0.000***]	0.037*** [0.043***]	-0.089*** [0.000***]	0.001 [0.000**]	0.006*** [0.000***]	-0.004 [0.000***]

Table 3.11: Debt diversification and capital investment

The table reports the regression estimates of investment regressions. The dependent variable is yearly Investment. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes in 3.10.

	(1)	(2)	(3)
HHI_{t-1}	-0.008** (0.003)	-0.007** (0.004)	-0.008** (0.004)
Debt enforcement $_{t-1}$	-0.025*** (0.005)	-0.014*** (0.005)	-0.010** (0.005)
$HHI_{t-1} * \text{Debt enforcement}_{t-1}$	0.016*** (0.006)	0.020*** (0.006)	0.018*** (0.006)
Default $_{t-1}$	-0.145*** (0.007)	-0.162*** (0.007)	-0.177*** (0.008)
Age $_{t-1}$	-0.009*** (0.000)	-0.006*** (0.000)	-0.006*** (0.001)
Size $_{t-1}$	-0.001*** (0.000)	-0.001*** (0.000)	-0.001** (0.000)
MB $_{t-1}$	0.005*** (0.000)	0.005*** (0.000)	0.005*** (0.000)
Cash ratio $_{t-1}$	-0.001*** (0.000)	-0.001*** (0.000)	-0.001** (0.000)
Unrated $_{t-1}$	0.008*** (0.001)	0.003* (0.002)	-0.002 (0.002)
Leverage $_{t-1}$	0.011*** (0.002)	0.012*** (0.002)	0.018*** (0.003)
GDP growth rate $_{t-1}$		0.001*** (0.000)	0.001*** (0.000)
GDP per capita $_{t-1}$		-0.007*** (0.002)	-0.007*** (0.002)
Domestic credit % of GDP $_{t-1}$		-0.003 (0.002)	-0.005** (0.002)
Domestic credit % of GDP by financial institutions $_{t-1}$		0.001 (0.001)	0.001 (0.001)
Constant	0.084*** (0.004)	0.133*** (0.006)	0.143*** (0.007)
Observations	37584	32997	26736
R^2	0.120	0.142	0.113

3.5 Empirical Results

3.5.1 Debt Specialization and Investment

One of the key questions that has received attention in corporate finance is how the financing friction affect the investment of the firm? Many researchers attempted to answer this question and conducted country specific and international empirical studies where the firms' debt financing was assumed to be uniform. In other words, prior studies consider firm use of debt from one source. However, we already found that firms leverage comprises

of different debt types. Firms with different types of debt can help to mitigate the distress risk of the firm as argued by [Gennaioli and Rossi \(2012\)](#). A study by [Asquith, Gertner, and Scharfstein \(1994\)](#) suggests that the firms with higher financial distress forgo investment opportunities. Therefore, the debt structure of the firm will have an impact on investment. Moreover, a contemporary study by [Favara, Morellec, Schroth, and Valta \(2017\)](#) suggests that the firm in higher debt enforcement countries with higher distress have negative association with investment. Therefore, earlier studies focusing on answering this question ignore the fact that the firms could use different types of debt to finance their investment where the firms investment decision is dependent on the debt specialization conditioned on the debt enforcement of the country.

To identify such relationship we use the regression model as expressed in equation [3.3](#). The results for the pooled OLS are reported in table [3.11](#). We control for firm specific characteristics. The results in the table presented in model (1) include all firms in the sample but do not control for country-specific characteristics, whereas model (2) considers country-specific characteristics. Finally, in model (3) we exclude the US firms to identify if our results are driven by the US firms. Results in model (2) and model (3) are qualitatively similar suggesting that our results are not driven by the US firms. This study finds that the firms in high debt enforcement countries with higher debt specialization make higher investment. However, it has been found that investment is negatively related with HHI and debt enforcement. This suggests that, despite such negative association this conditional relationship is helpful for investment.

We also, find that high risk firms invest less which is a conjecture of the theory as financially distressed firms have less access to financing sources which constrain firms from investment activities. Further, age and size are negatively related to investment, whereas high growth firms represented by market-to-book (MB) exhibit positive relationship.

3.5.2 Debt Specialization and Choice of Debt

We further examine, how the financial distress risk which is conditional on the debt enforcement affects the choice of public and private debt. This study conducts such analysis using the model expressed in equation [3.4](#). We consider the dependent variables as

Table 3.12: Debt enforcement and public debt

The table reports the regression estimates of public debt regressions. The dependent variable is yearly public debt. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes in 3.10.

	(1)	(2)	(3)
Debt enforcement _{t-1}	-0.270*** (0.020)	-0.544*** (0.022)	-0.305*** (0.023)
Default _{t-1}	-1.340*** (0.165)	-0.593*** (0.169)	-0.833*** (0.172)
Debt enforcement * Default _{t-1}	1.885*** (0.286)	1.719*** (0.298)	2.168*** (0.300)
Size _{t-1}	0.094*** (0.003)	0.093*** (0.003)	0.118*** (0.003)
Age _{t-1}	0.054*** (0.005)	0.029*** (0.005)	0.008 (0.006)
MB _{t-1}	0.043*** (0.004)	0.032*** (0.004)	0.024*** (0.005)
Divident dummy _{t-1}	-0.101*** (0.009)	-0.059*** (0.009)	-0.027** (0.011)
R&D _{t-1}	1.268*** (0.095)	0.827*** (0.102)	0.236 (0.153)
Unrated _{t-1}	-0.505*** (0.013)	-0.408*** (0.014)	-0.340*** (0.020)
Leverage _{t-1}	0.706*** (0.022)	0.642*** (0.022)	0.750*** (0.028)
Cash ratio _{t-1}	0.012*** (0.001)	0.011*** (0.001)	0.007*** (0.001)
Profitability _{t-1}	-0.231*** (0.039)	-0.077* (0.041)	-0.128** (0.051)
GDP growth rate _{t-1}		-0.029*** (0.002)	-0.027*** (0.002)
GDP per capita _{t-1}		0.034*** (0.007)	0.003 (0.007)
Domestic credit % of GDP _{t-1}		0.417*** (0.018)	0.056*** (0.021)
Domestic credit % of GDP by financial institutions _{t-1}		-0.157*** (0.012)	-0.003 (0.013)
Constant	-0.548*** (0.037)	-0.893*** (0.071)	0.679*** (0.072)
Observations	33202	29466	23854
Log likelihood	-20620.96	-17818.75	-12283.01

either bank debt or public debt. The results for public debt is presented in table 3.12.

The model (1) and (2) consider all firms, but model (2) controls for country-specific characteristics. We also, exclude the US firms to further validate that the results are not driven by the US firms. Results suggest that the firms in high debt enforcement countries with higher distress risk have higher public debt, which could be due to risk shifting from equity holders to bondholders. However, debt enforcement and distress risk exhibit

negative relationship which is consistent with the theory that high distress risk firms prefer to have private debt which is not dispersed whereby, the firm can renegotiate at the time of liquidity default. Along with the theoretical prediction, as the firm size and age increase the public debt increases. Size acts as a collateral and age provides the financial strength information over the time for the firm. High growth firms use more public debt, this could be with the notion that is suggested by [Giambona and Golec \(2013\)](#), where they suggest that the firms with high growth opportunities use unsecured debt to preserve financial flexibility. Firms that are unrated exhibit negative relationship with public debt, suggesting rating is a key condition to raise public debt.

In table [3.13](#), we report the results for the determinants of bank debt. Debt enforcement and distress risk exhibit positive relationship with bank debt. This suggests that the firm reduces the probability of inefficient liquidation by using private debt. This provides the scope for renegotiation during liquidity default. Similarly, firms in the higher debt enforcement countries where there is less scope for renegotiation, firms use bank debt. Though, debt enforcement argument suggests that there is less scope of renegotiation due to country bankruptcy procedure, but there is possibility that the banks try to renegotiate due to fact the liquidation will lead to capital loss for the banks. Whereas, renegotiation of the debt contract will allow the firm to be a going concern and the bank can recover its principal and have potential for future income generation.

However, interaction between debt enforcement and distress risk exhibits negative relationship with bank debt. During default of the firm, creditors get the control rights based on the priority structure of debt. However, even after such delegation if there are agency conflicts between shareholders and creditors and creditors have limited knowledge on firm operation then the firm could do risk-shifting whereby firms in the high debt enforcement countries get liquidated and creditors incur the loss.

Moreover, as the firm size increases and grow older the firm bank debt decreases. Also, unrated firms where market has information asymmetry and banks can efficiently process the information leaves the firm to choose costly debt but with monitoring benefit bank debt.

Table 3.13: Debt enforcement and bank debt

The table reports the regression estimates of bank debt regressions. The dependent variable is yearly bank debt. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes in 3.10.

	(1)	(2)	(3)
Debt enforcement _{t-1}	0.056*** (0.013)	0.227*** (0.014)	0.092*** (0.013)
Default _{t-1}	0.623*** (0.103)	0.405*** (0.104)	0.579*** (0.096)
Debt enforcement * Default _{t-1}	-1.108*** (0.181)	-1.199*** (0.185)	-1.343*** (0.168)
Size _{t-1}	-0.042*** (0.002)	-0.041*** (0.002)	-0.041*** (0.002)
Age _{t-1}	-0.036*** (0.003)	-0.023*** (0.003)	-0.011*** (0.003)
MB _{t-1}	-0.030*** (0.003)	-0.020*** (0.003)	-0.015*** (0.003)
Divident dummy _{t-1}	0.081*** (0.006)	0.051*** (0.006)	0.030*** (0.006)
R&D _{t-1}	-0.778*** (0.068)	-0.723*** (0.071)	-0.168* (0.087)
Unrated _{t-1}	0.446*** (0.010)	0.401*** (0.010)	0.324*** (0.014)
Leverage _{t-1}	-0.270*** (0.015)	-0.195*** (0.015)	-0.180*** (0.017)
Cash ratio _{t-1}	-0.008*** (0.001)	-0.008*** (0.001)	-0.005*** (0.001)
Profitability _{t-1}	-0.049* (0.026)	-0.103*** (0.027)	-0.080*** (0.029)
GDP growth rate _{t-1}		0.020*** (0.001)	0.017*** (0.001)
GDP per capita _{t-1}		-0.035*** (0.004)	-0.026*** (0.004)
Domestic credit % of GDP _{t-1}		-0.204*** (0.012)	0.022* (0.013)
Domestic credit % of GDP by financial institutions _{t-1}		0.157*** (0.008)	0.054*** (0.008)
Constant	-0.905*** (0.024)	1.046*** (0.042)	0.946*** (0.040)
Observations	33202	29466	23854
Log likelihood	-22616.09	-19582.72	-13581.80

3.5.3 Robustness Test

We revisit the impact of debt specialization on investment using different proxy for debt specialization. As discussed in section 3.3.2 we consider a firm to be specialized if the firm sources 90% of its debt from one specific type of debt. We use the same framework

as expressed in equation 3.3 to examine such relationship¹⁶. The results are reported in table 3.14. Our result is qualitatively similar to what we presented in table 3.11. The model (1) and model (2) reports for all firms, where model (1) does not consider country specific factors but model (2) does. Finally, model (3) excludes the US firms. This result also affirms that the firms in the higher debt enforcement country that have more than 90% of their debt in one of the seven category exhibit positive relationship with investment.

3.6 Financial Crises, Investment and Debt Specialization

3.6.1 Investment

The financial crisis that the world experienced in 2007–2009 suggests that we humbly empirically examine such rare but inevitable events and how the credit fluctuations in the macroeconomy could amplify, spread or generate shocks in both normal times and times of financial distress. Campello, Giambona, Graham, and Harvey (2011) empirically examine the impact of financial crisis on real corporate decisions such as investment and employment. We use this as a shock and deploy difference-in-difference technique to further verify our results presented earlier. We consider financial crisis due to the fact that, financial crisis increases economywide distress and this increases financial distress risk of the firm and as the liquidity crisis propagate firm invest less¹⁷. Therefore, we examine if firms that specialize in one debt source have reduced their investment during the financial crisis. To do so, the sample of this study is divided into tercile based on HHI in 2007. We keep first and third tercile. Later, we assign year 2007 as “1” and “0” otherwise. We keep two years before and two years after the financial crisis to check how the financial crisis abruptly affected the investment of the firm. This study uses same

¹⁶We also conduct the differences-in-differences using *One_Debt_90* as a proxy for debt specialization and we find qualitatively similar result. For the purpose of brevity we do not report the results.

¹⁷Bankruptcy code reform has been used in prior studies as an exogenous shock for conducting difference-in-difference application. Undoubtedly, the bankruptcy code reform that help debt renegotiation increase investment which is already found by Favara, Morellec, Schroth, and Valta (2017). However, part of our study interested to identify how the crisis in the economy can affect the investment due to debt market contraction. Economywide financial crisis increases unrest in the economy whereby the financial distress risk of the firm is also affected and debt market contraction leads to firm inability to mitigate its external debt financing need to invest. Hence, financial crisis is considered to be an appropriate exogenous shock to be considered in our set of problem.

Table 3.14: Robustness: Debt diversification and capital investment

The table reports the regression estimates of investment regressions. The dependent variable is yearly Investment. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes in 3.10.

	(1)	(2)	(3)
One_debt_90 _{t-1}	-0.005*** (0.002)	-0.004** (0.002)	-0.004** (0.002)
Debt_enforcement _{t-1}	-0.018*** (0.002)	-0.004* (0.002)	-0.001 (0.003)
One_debt_90 _{t-1} * Debt_enforcement _{t-1}	0.009*** (0.003)	0.010*** (0.003)	0.010*** (0.003)
Default _{t-1}	-0.145*** (0.007)	-0.162*** (0.007)	-0.177*** (0.008)
Age _{t-1}	-0.009*** (0.000)	-0.006*** (0.000)	-0.006*** (0.001)
Size _{t-1}	-0.001*** (0.000)	-0.001*** (0.000)	-0.001** (0.000)
MB _{t-1}	0.005*** (0.000)	0.005*** (0.000)	0.005*** (0.000)
Cash_ratio _{t-1}	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Unrated _{t-1}	0.008*** (0.001)	0.003* (0.002)	-0.002 (0.003)
Leverage _{t-1}	0.011*** (0.002)	0.012*** (0.002)	0.018*** (0.003)
GDP growth rate _{t-1}		0.001*** (0.000)	0.001*** (0.000)
GDP per capita _{t-1}		-0.007*** (0.001)	-0.007*** (0.001)
Domestic credit % of GDP _{t-1}		-0.003 (0.002)	-0.005** (0.002)
Domestic credit % of GDP by financial institutions _{t-1}		0.000 (0.000)	0.000 (0.000)
Constant	0.079*** (0.004)	0.129*** (0.006)	0.139*** (0.006)
Observations	37584	32997	26736
R ²	0.120	0.142	0.113

control variables as used for prior regression models. The results presented in table 3.15 suggest that the firms those have higher HHI have reduced their investment, this suggests that the debt specialization caused reduction in investment.

3.6.2 Choice of Debt

This study also exploits the difference-in-difference technique to identify which financing source (bank or public debt) constraints have led to such reduction in investment. In doing so, we divided our sample into tercile based on financial distress risk of the firm. We keep tercile one and tercile three. As specified earlier we assign year 2007 and prior

Table 3.15: Financial Crisis: Investment and Debt Choice

This table reports the estimates around the financial crisis period for all the countries. In panel A dependent variable is Investment and both model 1 and 2 estimates reported are from pooled OLS regressions. In panel B columns 1 and 2 reports estimate from tobit model, where the dependent variable is Public Debt. Columns 3 and 4 reports estimated result obtained for Bank Debt using tobit model. Post is a financial crisis indicator that takes the value of one from 2007. High HHI_i equals one if the firm's HHI is higher than country's second tercile breakpoint in 2004 and zero if firm's HHI is lower than country's first tercile breakpoint. All specification includes year and Fama-French 12 industry dummies. For the variable definition see notes in table 3.16. See also notes in 3.10.

	Investment	
	(1)	(2)
POST* High HHI_{t-1}	-0.003*** (0.001)	-0.005** (0.002)
Default $_{t-1}$		-0.159*** (0.017)
Age $_{t-1}$		0.011*** (0.001)
Size $_{t-1}$		0.001 (0.001)
MB $_{t-1}$		0.003*** (0.001)
Cash ratio $_{t-1}$		-0.001 (0.001)
Unrated $_{t-1}$		-0.009*** (0.003)
Leverage $_{t-1}$		0.023*** (0.005)
Constant	0.071*** (0.001)	0.088*** (0.006)
Observations	16132	16132
R ²	0.011	0.034

	Public Debt		Bank Debt	
	(1)	(2)	(3)	(4)
POST*Default $_{t-1}$	0.407*** (0.046)	0.196*** (0.051)	-0.131*** (0.022)	-0.105*** (0.027)
Size $_{t-1}$		0.107*** (0.004)		0.021*** (0.002)
Age $_{t-1}$		0.036*** (0.007)		-0.019*** (0.004)
MB $_{t-1}$		0.055*** (0.005)		-0.046*** (0.003)
Dividend dummy $_{t-1}$		-0.096*** (0.013)		0.083*** (0.008)
R&D $_{t-1}$		1.139*** (0.120)		-0.696*** (0.087)
Unrated $_{t-1}$		-0.455*** (0.020)		0.453*** (0.015)
Leverage $_{t-1}$		0.584*** (0.028)		-0.238*** (0.020)
Cash ratio $_{t-1}$		0.002** (0.001)		-0.004*** (0.001)
Profitability $_{t-1}$		-0.465*** (0.041)		0.061** (0.027)
Constant	-0.899*** (0.047)	-0.881*** (0.065)	1.027*** (0.022)	0.785*** (0.038)
Observations	16132	16132	16132	16132
Log likelihood	-20045.59	-9758.52	-21567.01	-10964.76

two year as “1” and “0” otherwise. Further, this study keeps two year before and two year after to check how the financial crisis potentially dried up the liquidity sources for the firm and firms’ increase in financial distress due to economywide distress plausibly forced to reduce investment. The results are reported in 3.15. We find that during the financial crisis public firms use less bank debt. This suggests that during the crisis time, due to restricted supply of bank debt the firm is forced to underinvest. This finding is consistent with the prior findings of (Ivashina and Scharfstein, 2010; Kahle and Stulz, 2013). Whereas, post financial crisis with higher default risk firm can issue public debt. This suggests that the pervasive effect of investment due to external financing can be mitigated via debt market development. More precisely, the development of the public debt market can alleviate the underinvestment problem during the financial crisis period. However, following the argument made by Drozd and Serrano-Padial (2016) argue that economywide financial distress can propagate due to the adverse effect of enforcement of credit contracts. Crouzet (2017) argues that during the crisis time firms issue bonds due to banks restricted credit supply. However, this is not one-to-one. For example, if the firm’s reduction or demand for bank debt is £100 million then firm with access to the public bond market might issue bonds of £70 million to avoid the increased probability of liquidation at the time of financial distress. Because, bonds are held by disbursed creditors and during the financial distress of the firm it is hard to negotiate with the large number of creditors while with bank debt (except syndicated bank debt) it is easier for the firm to renegotiate the payment terms and other covenants. Therefore, this study recommends not only the public bond market development whereby it is easier for the firms to issue public debt to avoid underinvestment but also recommends changes in enforcement law whereby the debt renegotiation opportunity will allow the firm to avoid inefficient liquidation.

3.7 Conclusion

The pioneering work by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) provides the nexus between law and finance. They show the importance of shareholders and creditors protection rights which is vital for the well functioning equity and debt financ-

ing. To complement this growing literature, we examine initially, how the leveraged firms choose debt types in different countries where debt enforcement are different. We also examine the pivotal issue that has always been in the interest of policy makers, economist and finance how the financing affect investment. Earlier studies examining such issues consider the impact of debt and equity financing and assume that the leverage of the firm is uniform. In reality the firm uses different types of debt as found in this study. Therefore, a substantial part of how the firm's choice of debt type affects the investment is not previously considered.

Therefore, this study sought to answer this question by linking debt specialization and debt enforcement with the firm investment decision. Using a sample of 19054 firms from 46 countries between 2002 and 2015, we find that during the normal times firms in higher debt enforcement countries with less diversified debt exhibit positive association with investment. However, during the financial crisis when the firms are more prone the financial distress and liquidity default, we find that the renegotiation frictions that strengthen the enforcement of debt contracts relate to investment and firm debt diversification through their interactions with the firm-specific debt diversification. Indicating that the firms debt diversification that is conditional on debt enforcement of the country is important to reduce the underinvestment problem that the firms face during crisis period.

It has been found that for many countries bank debt is the main source of financing due to the market structure. During the financial crisis the banks become more conservative in their lending activities, whereby the bank dependent firms forgo investment opportunities and the adverse effect of financial crisis gets more prolonged. Firms with access to public debt market allow the firm to mitigate such risk of underinvestment. Henceforth, policymakers should design such policies whereby the debt enforcement or more specifically bankruptcy code reform and judicial system contribute to efficiency for restructuring the liquidity default firms. Also policies should contribute to debt market development whereby the abrasive effect of economywide crisis can be reduced or prolonged financial crisis can be avoided. As argued by [Drozd and Serrano-Padial \(2016\)](#) we also want the policy makers to note that the reform of the default code or debt renegotiation practice

should be aligned with the judicial expertise otherwise it will be perilous.

Appendix

Table 3.16: Variables Definition and Construction

The details description of the variables are provided in this table. Firm characteristics and debt structure data are collected from S&P Capital IQ. Country-specific data are collected from World Bank database. Other country data collected from [La Porta, Lopez-de-Silanes, Shleifer, and Vishny \(1997\)](#) and [Djankov, Hart, McLiesh, and Shleifer \(2008\)](#) paper.

Variable Name	Definition
Firm characteristics and Debt Structure	
Size	Natural logarithm of total assets.
Firm age	Firm age since IPO using the first year that a firm appears in Capital IQ.
MB	Market value of equity to book value of equity.
Default	Probability that the firm will default within one year.
Cash ratio	Cash and short-term investment to lagged total assets
Unrated	Dummy variable takes the value of “1” if the firm is not rated by S&P
Investment	Capital expenditure to lagged total assets.
Leverage	Natural logarithm of total debt.
Profitability	Earnings before interest and tax to lagged total assets.
R&D	Research and development expenses to lagged total assets
CP	Commercial paper
DC	Drawn credit line.
TL	Term loans.
SEBN	Senior bonds and notes.
SUBN	Subordinated bonds and notes.
CL	Capital leases.
OTH	Other debt
HHI	$\left[\left(\frac{CP_{i,t}}{TD_{i,t}} \right)^2 + \left(\frac{DC_{i,t}}{TD_{i,t}} \right)^2 + \left(\frac{TL_{i,t}}{TD_{i,t}} \right)^2 + \left(\frac{SEBN_{i,t}}{TD_{i,t}} \right)^2 + \left(\frac{SUBN_{i,t}}{TD_{i,t}} \right)^2 + \left(\frac{CL_{i,t}}{TD_{i,t}} \right)^2 + \left(\frac{OTH_{i,t}}{TD_{i,t}} \right)^2 \right. \\ \left. - \frac{1}{7} \right] / \left(1 - \frac{1}{7} \right)$
Country Data	
GDP growth rate	The annual growth of gross domestic product.
GDP per capita	The natural logarithm of gross national income per capita.
Domestic credit	The financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment.
Domestic credit FIs	The domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net.
Other Country Data	
Legal origin	Indicates if the country belongs to English, French, German or Nordic origin. This is taken from La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) .
Civil	Dummy variable takes the value of “1” if the country is a civil law country and “0” otherwise. This is taken from Djankov, Hart, McLiesh, and Shleifer (2008) .

Table 3.17: Correlations of firm characteristics

The table reports Pearson correlation coefficients of firm characteristics. Numbers in *italic* denote statistical significance at the 1% level. For the variable definition see notes in table 3.16. See also notes to Tables 3.2–3.4 and 3.8.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
HHI	(1)	1.0000										
Size	(2)	−0.037***	1.000									
Age	(3)	−0.040***	0.318***	1.000								
MB	(4)	0.049***	0.091***	−0.036***	1.000							
Default	(5)	−0.027***	−0.419***	−0.157***	−0.047***	1.000						
Cash ratio	(6)	0.187***	0.053***	−0.106***	0.128***	−0.153***	1.000					
Profitability	(7)	−0.031***	0.271***	0.143***	0.062***	−0.526***	0.053***	1.000				
Leverage	(8)	−0.015***	−0.069***	−0.044***	0.003	0.191***	−0.075***	−0.129***	1.000			
Investment	(9)	−0.036***	0.050***	−0.107***	0.084***	−0.075***	0.054***	0.149***	0.039***	1.000		
R&D	(10)	0.073***	−0.081***	−0.096***	0.103***	0.045***	0.231***	−0.218***	−0.053***	−0.025***	1.000	
Debt enforcement	(11)	0.031***	−0.085***	−0.029***	−0.036***	−0.031***	0.019***	−0.065***	0.017***	−0.016***	0.015***	1.000

Table 3.18: Determinants of Commercial Papers

The table reports the regression estimates of commercial papers regressions. The dependent variable is yearly commercial papers. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes to Tables 3.2 and 3.3.

	(1)	(2)	(3)
Debt enforcement _{t-1}	0.031 (0.025)	0.078** (0.035)	0.121*** (0.042)
Default _{t-1}	-0.040 (0.283)	-0.143 (0.384)	-0.042 (0.460)
Debt enforcement * Default _{t-1}	0.219 (0.503)	0.126 (0.775)	0.901 (0.906)
Size _{t-1}	0.094*** (0.004)	0.123*** (0.006)	0.126*** (0.008)
Age _{t-1}	0.035*** (0.006)	0.052*** (0.008)	0.030*** (0.010)
MB _{t-1}	-0.012** (0.005)	-0.002 (0.006)	-0.009 (0.009)
Dividend dummy _{t-1}	0.064*** (0.012)	0.053*** (0.016)	0.009 (0.021)
R&D _{t-1}	-0.233 (0.180)	-0.654** (0.260)	-0.316 (0.350)
Unrated _{t-1}	-0.055*** (0.014)	-0.066*** (0.017)	-0.029 (0.025)
Leverage _{t-1}	0.054 (0.036)	0.020 (0.045)	0.101* (0.060)
Cash ratio _{t-1}	0.000 (0.001)	0.000 (0.001)	0.001 (0.001)
Profitability _{t-1}	-0.058 (0.060)	-0.072 (0.076)	-0.430*** (0.120)
GDP growth rate _{t-1}		-0.016*** (0.004)	-0.019*** (0.004)
GDP per capita _{t-1}		-0.034*** (0.011)	-0.035*** (0.013)
Domestic credit % of GDP _{t-1}		-0.025 (0.028)	-0.062* (0.038)
Domestic credit % of GDP by financial institutions _{t-1}		0.011 (0.017)	0.015 (0.022)
Constant	-1.301*** (0.056)	-1.322*** (0.120)	0.946*** (0.040)
Observations	33202	29466	23854
Log likelihood	-3242.155	-2411.549	-1764.159

Table 3.19: Determinants of Drawn Credit Line

The table reports the regression estimates of drawn credit line regressions. The dependent variable is yearly revolving credit. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes to Tables 3.2 and 3.3.

	(1)	(2)	(3)
Debt enforcement _{t-1}	0.310*** (0.016)	0.164*** (0.018)	0.315*** (0.019)
Default _{t-1}	1.126*** (0.128)	0.690*** (0.130)	0.609*** (0.128)
Debt enforcement * Default _{t-1}	-1.808*** (0.232)	-1.422*** (0.233)	-1.100*** (0.227)
Size _{t-1}	-0.046*** (0.002)	-0.041*** (0.002)	-0.036*** (0.003)
Age _{t-1}	-0.010** (0.004)	-0.016*** (0.004)	-0.004 (0.005)
MB _{t-1}	-0.005 (0.003)	-0.008** (0.004)	-0.011*** (0.004)
Dividend dummy _{t-1}	-0.050*** (0.007)	-0.055*** (0.008)	-0.009 (0.009)
R&D _{t-1}	-0.592*** (0.095)	-0.441*** (0.101)	-0.317** (0.128)
Unrated _{t-1}	0.009 (0.013)	0.026* (0.013)	0.046** (0.021)
Leverage _{t-1}	-0.188*** (0.020)	-0.237*** (0.021)	-0.306*** (0.025)
Cash ratio _{t-1}	-0.035*** (0.002)	-0.036*** (0.002)	-0.040*** (0.003)
Profitability _{t-1}	0.345*** (0.034)	0.265*** (0.035)	0.226*** (0.041)
GDP growth rate _{t-1}		-0.017*** (0.002)	-0.013*** (0.002)
GDP per capita _{t-1}		-0.026*** (0.005)	-0.033*** (0.005)
Domestic credit % of GDP _{t-1}		0.346*** (0.016)	0.106*** (0.018)
Domestic credit % of GDP by financial institutions _{t-1}		-0.332*** (0.011)	-0.227*** (0.012)
Constant	0.261*** (0.031)	0.644*** (0.052)	0.731*** (0.055)
Observations	33202	29466	23854
Log likelihood	-23479.764	-20128.586	-15358.841

Table 3.20: Determinants of Senior Bonds & Notes

The table reports the regression estimates of senior bonds and notes regressions. The dependent variable is yearly senior bonds and notes. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes to Tables 3.2 and 3.3.

	(1)	(2)	(3)
Debt enforcement _{t-1}	-0.266*** (0.021)	-0.514*** (0.023)	-0.299*** (0.023)
Default _{t-1}	-1.235*** (0.170)	-0.609*** (0.174)	-0.766*** (0.172)
Debt enforcement * Default _{t-1}	2.024*** (0.295)	1.956*** (0.309)	2.196*** (0.301)
Size _{t-1}	0.097*** (0.003)	0.094*** (0.003)	0.117*** (0.003)
Age _{t-1}	0.053*** (0.005)	0.027*** (0.005)	0.005 (0.006)
MB _{t-1}	0.040*** (0.004)	0.031*** (0.004)	0.024*** (0.005)
Dividend dummy _{t-1}	-0.065*** (0.009)	-0.020** (0.010)	-0.021* (0.011)
R&D _{t-1}	0.838*** (0.101)	0.408*** (0.108)	0.201 (0.155)
Unrated _{t-1}	-0.451*** (0.014)	-0.365*** (0.014)	-0.315*** (0.020)
Leverage _{t-1}	0.650*** (0.022)	0.590*** (0.023)	0.735*** (0.028)
Cash ratio _{t-1}	0.010*** (0.001)	0.009*** (0.001)	0.007*** (0.001)
Profitability _{t-1}	-0.228*** (0.040)	-0.101** (0.043)	-0.100* (0.052)
GDP growth rate _{t-1}		-0.029*** (0.002)	-0.026*** (0.002)
GDP per capita _{t-1}		0.033*** (0.007)	0.001 (0.007)
Domestic credit % of GDP _{t-1}		0.352*** (0.019)	0.053** (0.021)
Domestic credit % of GDP by financial institutions _{t-1}		-0.124*** (0.012)	-0.006 (0.013)
Constant	-0.652*** (0.038)	-0.944*** (0.073)	-0.695*** (0.073)
Observations	33202	29466	23854
Log likelihood	-20156.884	-17604.259	-11977.185

Table 3.21: Determinants of Subordinated Bonds & Notes

The table reports the regression estimates of subordinated bonds and notes regressions. The dependent variable is yearly subordinated bonds and notes. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes to Tables 3.2 and 3.3.

	(1)	(2)	(3)
Debt enforcement _{t-1}	-0.279*** (0.103)	-1.135*** (0.120)	-0.491*** (0.154)
Default _{t-1}	-2.759*** (0.864)	-0.750 (0.860)	-1.504 (1.267)
Debt enforcement * Default _{t-1}	0.157 (1.389)	0.235 (1.384)	0.397 (1.840)
Size _{t-1}	0.003 (0.011)	0.024** (0.012)	0.068*** (0.022)
Age _{t-1}	-0.005 (0.020)	-0.025 (0.021)	-0.009 (0.038)
MB _{t-1}	0.066*** (0.015)	0.021 (0.016)	0.058* (0.030)
Dividend dummy _{t-1}	-0.667*** (0.041)	-0.519*** (0.042)	-0.246*** (0.073)
R&D _{t-1}	2.187*** (0.284)	1.282*** (0.297)	0.018 (0.891)
Unrated _{t-1}	-0.822*** (0.053)	-0.500*** (0.050)	-0.618*** (0.107)
Leverage _{t-1}	1.116*** (0.073)	0.876*** (0.070)	1.144*** (0.149)
Cash ratio _{t-1}	0.009*** (0.003)	0.011*** (0.003)	0.004 (0.006)
Profitability _{t-1}	-0.435*** (0.158)	-0.058 (0.157)	-0.273 (0.330)
GDP growth rate _{t-1}		-0.005 (0.011)	-0.012 (0.014)
GDP per capita _{t-1}		0.243*** (0.042)	0.147*** (0.049)
Domestic credit % of GDP _{t-1}		1.269*** (0.099)	0.285* (0.152)
Domestic credit % of GDP by financial institutions _{t-1}		-0.627*** (0.070)	-0.309*** (0.099)
Constant	-1.965*** (0.181)	-4.875*** (0.468)	-4.223*** (0.613)
Observations	33202	29466	23854
Log likelihood	-3989.893	-3513.649	-1095.201

Table 3.22: Determinants of Capital Leases

The table reports the regression estimates of capital leases regressions. The dependent variable is yearly capital leases. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes to Tables 3.2 and 3.3.

	(1)	(2)	(3)
Debt enforcement _{t-1}	0.092*** (0.006)	0.084*** (0.007)	0.079*** (0.007)
Default _{t-1}	0.080 (0.051)	0.016 (0.053)	0.013 (0.051)
Debt enforcement * Default _{t-1}	0.027 (0.090)	0.098 (0.093)	0.139 (0.089)
Size _{t-1}	-0.000 (0.001)	-0.001 (0.001)	-0.003*** (0.001)
Age _{t-1}	-0.007*** (0.002)	-0.004*** (0.002)	-0.004** (0.002)
MB _{t-1}	-0.002 (0.001)	-0.003** (0.001)	-0.003** (0.002)
Dividend dummy _{t-1}	-0.043*** (0.003)	-0.036*** (0.003)	-0.030*** (0.003)
R&D _{t-1}	-0.154*** (0.035)	-0.098*** (0.036)	-0.138*** (0.046)
Unrated _{t-1}	-0.002 (0.005)	-0.004 (0.005)	-0.030*** (0.007)
Leverage _{t-1}	-0.103*** (0.008)	-0.139*** (0.008)	-0.154*** (0.010)
Cash ratio _{t-1}	-0.002*** (0.000)	-0.002*** (0.000)	-0.001* (0.000)
Profitability _{t-1}	0.064*** (0.013)	0.046*** (0.014)	0.069*** (0.015)
GDP growth rate _{t-1}		-0.006*** (0.001)	-0.005*** (0.001)
GDP per capita _{t-1}		0.021*** (0.002)	0.022*** (0.002)
Domestic credit % of GDP _{t-1}		-0.083*** (0.006)	-0.084*** (0.007)
Domestic credit % of GDP by financial institutions _{t-1}		0.009** (0.004)	0.012*** (0.004)
Constant	-0.125*** (0.012)	-0.154*** (0.021)	-0.122*** (0.021)
Observations	33202	29466	23854
Log likelihood	-7334.420	-5639.830	-3773.633

Table 3.23: Determinants of Term Loans

The table reports the regression estimates of term loans regressions. The dependent variable is yearly term loan. All the model specification includes year and Fama-French 12 industry fixed effects. Standard errors are clustered by firm-level and reported in the parenthesis. For the variable definition see notes in table 3.16. See also notes to Tables 3.2 and 3.3.

	(1)	(2)	(3)
Debt enforcement _{<i>t-1</i>}	0.121*** (0.015)	0.149*** (0.017)	0.096*** (0.016)
Default _{<i>t-1</i>}	-0.104 (0.120)	-0.218* (0.122)	-0.018 (0.112)
Debt enforcement * Default _{<i>t-1</i>}	0.200 (0.213)	0.022 (0.216)	0.430** (0.198)
Size _{<i>t-1</i>}	-0.009*** (0.002)	-0.010*** (0.002)	-0.013*** (0.002)
Age _{<i>t-1</i>}	-0.034*** (0.004)	-0.035*** (0.004)	-0.013*** (0.004)
MB _{<i>t-1</i>}	-0.035*** (0.003)	-0.020*** (0.003)	-0.014*** (0.003)
Dividend dummy _{<i>t-1</i>}	0.119*** (0.007)	0.091*** (0.007)	0.031*** (0.007)
R&D _{<i>t-1</i>}	-0.739*** (0.082)	-0.694*** (0.086)	-0.136 (0.104)
Unrated _{<i>t-1</i>}	0.494*** (0.012)	0.426*** (0.013)	0.302*** (0.017)
Leverage _{<i>t-1</i>}	-0.087*** (0.018)	-0.008 (0.018)	-0.060*** (0.020)
Cash ratio _{<i>t-1</i>}	-0.004*** (0.001)	-0.004*** (0.001)	-0.001 (0.001)
Profitability _{<i>t-1</i>}	-0.291*** (0.031)	-0.336*** (0.033)	-0.261*** (0.035)
GDP growth rate _{<i>t-1</i>}		0.029*** (0.001)	0.022*** (0.001)
GDP per capita _{<i>t-1</i>}		-0.023*** (0.005)	-0.010** (0.004)
Domestic credit % of GDP _{<i>t-1</i>}		-0.421*** (0.014)	-0.008 (0.015)
Domestic credit % of GDP by financial institutions _{<i>t-1</i>}		0.328*** (0.009)	0.140*** (0.009)
Constant	0.415*** (0.029)	0.438*** (0.049)	0.333*** (0.047)
Observations	33202	29466	23854
Log likelihood	-27794.367	-23791.252	-17473.476

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