

TRADE CREDIT EXTENSION  
THE ROLE OF SUPPLIER COLLATERAL

Final year dissertation in Economics

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# TRADE CREDIT EXTENSION

## THE ROLE OF SUPPLIER COLLATERAL †

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**ABSTRACT** Finance is important for economic growth. This paper analyses one source of finance that has received limited attention in the literature – supplier credit. I explore the hypothesis that the willingness of suppliers to extend trade credit to their buyers depends on the effectiveness of their collateral. I develop a new industry score of collateral effectiveness based on product and technology aspects and find that there is more supplier lending in industries, in which collateral is more effective. This effect is more pronounced in countries where suppliers face a higher risk of defaults, and in those where collateral rights and debt enforcement are better. The results, by extension, suggest an asymmetry in finance provision and access to finance across industries, and may shed light on patterns of industry development across countries. 6432 WORDS PLUS 4 SIDES OF TABLES.

† I am grateful to my supervisor for countless helpful comments and to Thomas Steger for his help with understanding and rating the effectiveness of collateral in different industries.

## INTRODUCTION AND MOTIVATION

A growing body of economic literature provides evidence that financial development leads to economic growth.<sup>1</sup> Rajan and Zingales (1998), for example, show that industries, which depend more on external finance, grow relatively faster in countries with more developed financial systems. Understanding financial development is therefore of obvious economic concern.

One aspect of the development of a financial system is the effectiveness of its financial intermediaries in channelling funds to the most efficient use, and conversely, the ability of firms to source the funds that their business opportunities merit. To be able to understand and influence what drives the effectiveness of financial intermediaries, it is instrumental to know what determines their decision whether to provide funds, to whom and under what conditions.

This paper looks at one group of financial intermediaries that has been relatively neglected in the literature: suppliers. Most research and models focus on the role of *traditional* financial intermediaries, such as banks, which specialize in the extension of credit. Consequently, the development of the banking sector has become almost synonymous to the development of the financial system. However, suppliers, too, regularly act as *quasi* financial intermediaries and extend credit – called trade credit – to their buyers, namely whenever they offer or tolerate deferred payment after delivery of their products.

Statistically, the volume of trade credit is very significant. Lee and Stowe (1993) find that the volume of trade credit far exceeds that of business lending by banks in the US. In my worldwide dataset, trade credit constitutes nearly fifteen per cent of the total assets of firms, and about twenty per cent of the volume of sales is made on account. Petersen and Rajan (1997) report similar findings. Further, Ng et al. (1999) allude to the potential of supplier lending as an alternative credit channel, pointing out that trade credit exceeds the primary money supply (M1) by a factor of more than one-and-a-half.

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<sup>1</sup> For a review of the literature, see for example Levine (1997).

The evidence suggest that supplier lending should be taken seriously as an alternative to bank credit, both as a source of finance for individual firms and as a channel for funds in the economy at large. Indeed, Fisman and Love (2003), in a study analogous to Rajan and Zingales (1998), find that trade credit promotes growth in the absence of bank credit. The authors document that industries, which are more constrained in access to bank credit and rely more on trade credit, grow relatively faster in countries with less developed banking systems. The finance-growth link exists for trade credit, as it does for bank credit.

This paper analyses one particular factor that potentially influences the decision of suppliers to extend trade credit: collateral, or rather the effectiveness of collateral. Creditors in most jurisdictions can secure their claims with a charge over assets of their debtors. These assets constitute collateral and, in the case of default of the debtors, can be repossessed and resold by the creditors to recover their claims. In the case of supplier credit, the products delivered are the supplier collateral. Effective collateral matters for the willingness to extend supplier credit because *secured* creditors with collateral commonly recover significantly more in debt enforcement than *unsecured* creditors, who usually receive only “Pence for the Pound”.

However, there is likely to be significant variation in collateral effectiveness. For supplier collateral, I postulate that this is driven by product and technology aspects – intuitively, consider using milk *versus* Rolex watches as collateral. One innovation of this paper is an industry collateral score, which I construct to measure collateral effectiveness based on factors indentified in interviews (Dec 2009) with an experienced bankruptcy administrator. I find that there is more supplier lending in industries, in which products and technologies are more suitable to collateral use.

In order to clearly identify the effect of collateral effectiveness and increase confidence in the results, I take advantage of variation along a further dimension: institutional quality. Effective collateral requires proper *de jure* rights and efficient *de facto* enforcement. Using interactions of the industry collateral score with country measures of institutional quality, I find that effective collateral is more important in countries where suppliers face a higher risk of default, and in those where collateral rights and debt enforcement are more effective.

The aim of this paper is therefore to explore the collateral hypothesis that the willingness of suppliers to lend to their buyers depends on the effectiveness of their collateral. The remainder of this paper is organized as follows: Section A reviews theories of trade credit extension. Section B discusses the collateral hypothesis. Section C describes data and estimation strategies. Section D reports the results, and Section E concludes.

## A THEORIES OF TRADE CREDIT EXTENSION

In this section, I provide an overview of the main theories of trade credit extension. Further, I show how this paper relates and contributes to the existing literature. The questions addressed in the literature are why suppliers lend at all (given the existence of specialized financial institutions), and why the amount of trade credit extension varies across suppliers.

As a starting point and to focus the discussion, I propose the following static model of supplier lending (inspired by Burkart et al. 2004). Suppliers optimally extend trade credit to their buyers as long as the expected returns exceed the value of the funds in alternative use:

$$(1 - \pi) * (FaceValue + Gains) + (\pi) * (RecoveryValue) > (FaceValue + Opp.Cost)$$

The expected returns (LHS) are the weighted sum of the nominal amount of the credit (*FaceValue*) plus gains such as interest or implicit benefits (*Gains*) and the amount recovered in the event of default (*RecoveryValue*), weighted by the probability of default ( $\pi$ ). The value of the funds in alternative use (RHS) is the nominal amount (*FaceValue*) plus the opportunity cost foregone (*Opp.Cost*).

The optimal amount of supplier credit is implicitly determined in the model, which effectively constitutes a stopping rule. The literature postulates different effects on the main variables in this model. Some suggest that differences in the gains or opportunity costs of trade credit extension explain both advantages over financial institutions and variation across suppliers. The focus of this paper, however, is the recovery value and the probability of default. For completeness, I provide a brief overview of the alternative theories.

Some theories postulate real business effects impacting the gains or opportunity costs of supplier lending. One prominent suggestion is that firms practice hidden price discrimination by offering different credit terms to different buyers, both to circumvent antitrust regulation and to conceal discounts to marginal customers from intra-marginal customers (Petersen and Rajan 1997). Alternatively, suppliers may grant flexible payment targets to allow customers to smooth cash flow or inventory holdings (Schwartz 1974; Emery 1987), or to give buyers time to inspect products as a signal of quality (Lee and Stowe 1993). Suppliers gain by implicitly pricing these services. The opportunity cost of trade credit extension may also vary, depending on business opportunities and access to finance. These theories account for differences in supplier lending without considering default.

Another important strand of the literature concerns the risks and consequences of default. One broad suggestion is that the probability of default matters. Theories in this line focus on the importance of overcoming information asymmetries for credit (in the spirit of Stiglitz and Weiss (1981)). Suppliers may obtain information about creditworthiness of buyers more easily as a by-product of ordinary business (Ng et al. 1999). Further, offering trade credit may provide a screening mechanism to identify lemons among the buyers, while *not taking it* may be a signalling device for creditworthy buyers. Suppliers can also threaten foreclosure of vital inputs, so buyers may be less tempted to strategically default (Cunat 2007).

The other broad suggestion is that the ability to recover claims in the event of default matters. Petersen and Rajan (1997), for example, suggest that suppliers have an advantage over financial intermediaries, because of their expertise in dealing with their collateral: supplier collateral constitutes of their own products, whereas the collateral of financial intermediaries is unrelated to their ordinary business. This may explain why suppliers lend at all, but not the variation across suppliers. Maksimovic and Frank (2005) suggest that “trade credit use depends on the value of collateral in a repossession,” implicitly recognising that *variation* in collateral effectiveness matters – an issue that has otherwise received only limited attention in the literature. This paper contributes to the existing work by exploring the determinants and importance of collateral effectiveness in more detail.

A number of papers are related to my work. Mian and Smith (1992) suggest that more *durable* products are more effective as collateral, because it is more likely that value can be salvaged from these products. This has not been tested. Further *differentiated* products may constitute more effective collateral (Burkart and Ellingsen 2004): the specific advantage of suppliers in salvaging value is more pronounced and such products are more difficult to divert. Burkart et al. (2004) find that a dummy-variable identifying differentiated products is associated with more supplier lending across industries in the US.

There may be other suggestions in the fragmented literature, but I am not aware of a general treatment. I contribute to this work by systematically exploring a wider range of aspects that influence collateral effectiveness and I use a broader, worldwide sample to increase the validity of the results.

Finally, there is another important dimension, which I discuss separately: the institutional environment. Empirically, Demirguc-Kunt and Maksimovic (2001) find that better institutions (creditor rights and court efficiency) are associated with more supplier lending across countries. This relation may arise because proper creditor rights and efficient law enforcement make collateral more effective, but better institutions also reduce the risk of default occurring in the first place. Hence, the effects may not be separately identified. Further, better institutional quality is likely to be simultaneously conducive to both trade credit and bank credit. Given that trade credit and bank credit are substitutes<sup>2</sup>, the effect of institutional quality on each individually is then also not clearly identified.

To test the collateral hypothesis, I carefully disentangle these effects. I approach the identification in a novel way, using interactions of my industry collateral score with country measures of institutional quality following the work of Rajan and Zingales (1998). This allows me to identify the relevant isolated impact of institutional quality on supplier lending through collateral effectiveness.

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<sup>2</sup> De Blasio (2004) finds that Italian manufacturing firms rely more on supplier lending in periods of monetary tightening, and Petersen and Rajan (1997) show that small credit-constrained firms in the US use more trade credit. In unreported work, I confirm that there is more trade credit extension in countries with smaller banking systems, measured by the private-credit-to-GDP ratio.

## B THE COLLATERAL HYPOTHESIS

The collateral hypothesis postulates that the willingness of suppliers to extend trade credit is a function of the effectiveness of their collateral. In this section, I first explain why this hypothesis is reasonable in theory and in practice, and then explore the factors that I believe influence collateral effectiveness.

### THE COLLATERAL HYPOTHESIS

To understand the importance of collateral, it is necessary to consider the mechanisms of debt enforcement. Generally, all creditors such as banks, supplier, workers and the authorities have a claim *in personam* against the debtor, either for a sum of money or, failing that, for a *pro rata* share of the assets of the debtor. For suppliers, this claim arises from the contract of sale. Creditors with collateral, however, have a prior right *in rem* to the assets that constitute their collateral. This right arises from securing a charge over assets like a residual right of ownership.

Collateral is crucial in the event of default: First, the assets that constitute collateral are removed from the debtor's estate and turned over to the creditors that hold a charge over these assets. Then, all remaining claims (of unsecured and secured creditors) are satisfied *pro rata* by division of the *remaining* assets of the estate. Since in bankruptcy, liabilities commonly exceed assets significantly<sup>3</sup>, secured creditors with collateral necessarily recover significantly more than unsecured creditors. It may thus be fair to assume that the amount recovered is mainly driven by collateral.

In practice, collateral may not actually be removed from the estate. Instead, collateral is "bought back" from the secured creditors, because it is useful to the business as a going concern. In that case, the effectiveness of their collateral determines the *bargaining power* of the suppliers, because it determines the outside option: the more effective their collateral, the more the suppliers need to be paid for not removing it. So the link from collateral effectiveness to the willingness to extend trade credit also holds in practice.

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<sup>3</sup> Djankov et al. (2008) in a careful study of debt enforcement across the world find that on average, "almost half [the estate] is lost in debt enforcement," that is, due to administrative inefficiency alone.



## PRODUCT AND TECHNOLOGY CHARACTERISTICS

To open the black-box ‘collateral value,’ I conducted a series of interviews with an experienced bankruptcy administrator. What emerged are the following categories of potential constraints faced by suppliers using collateral. These provide the basis for the collateral score. The categories are:

(1) The products that serve as collateral must still exist in substantially unchanged form. In most jurisdictions, a security charge over an asset is destroyed once the product is substantially transformed (for example, wood that is cut up, or steel that is formed). This constraint increases with the speed of transformation and turnover of the products by the buyer. For example, milk is likely to be transformed rapidly by the manufacturer of dairy products and constitutes bad collateral; but the machine used to pasteurise the milk is used for years so the supplier of the machine has good collateral. Petersen and Rajan (1997) provide some evidence for this idea: the authors find that firms with lower inventory holdings and faster turnover receive less trade credit.

(2) The supplier must provide unambiguous proof that the products claimed as collateral are *the very products* delivered by *that* supplier. Bankruptcy laws are careful not to advantage any creditors, so claims to assets that may be the collateral of other creditors are rejected. This issue arises if products come from several sources and are unidentifiable. For instance, sand from different suppliers may be unmarked and mixed in inventory, so no one may be able to claim it as collateral. This constraint is more pronounced for products with lower piece value (less likely to be marked), and for more generic, less differentiated products (less clearly identifiable). For instance, the study by Burkart et al. (2004) confirms that suppliers of less differentiated products extend less trade credit. To provide an example, Rolex watches are clearly identifiable, and thus constitute better collateral than sand.

(3) It must be economically viable for the supplier to incur the transaction costs of physical repossession of the products. This constraint increases with transportation costs, which are higher for products with lower piece value and products that are held in more dispersed locations. Taking the same example, the transportation costs for sand are significant, but negligible for Rolex watches.

Similarly, collecting a large quantity of toys from the central storage place of a defaulting wholesaler may be worthwhile, but collecting individual toys from widely dispersed consumer outlets is not viable. Even if no physical repossession takes place, this constraint affects the bargaining power.

(4) The resale price that a supplier can command for the repossessed can be severely reduced. This is a constraint for perishable, non-durable products, and for products with faster rates of innovation. (Repossession in practice takes considerable time.) For instance, vegetables have as little resale value as yesterday's newspapers; and the value of cloths or high-tech products is reduced over time as fashion and technology progress. The constraint also depends on the liquidity of the resale market. This constraint is increasing with the degree of differentiation. For instance, it may be difficult to resell custom-made products such as components for a particular car brand. In contrast, raw materials are easy to resell and lose no value over time.

#### INSTITUTIONAL QUALITY

Dating back to Montesquieu [1748], scholars have recognised the importance of rights and enforcement for creditors. More recently, Aghion and Bolton (1992) and Hart and Moore (1998), amongst others, advance the general idea that that the powers of creditors matter for credit extension. Effective collateral thus requires that suppliers are granted proper rights with respect to their collateral, and these rights must be efficiently enforced. However, the effect of better institutional quality on supplier lending may also arise through a reduction in the risk of defaults where rights and enforcement are more effective. In the next section, I explain how I propose to measure these concepts and disentangle the effects.

#### THE REFINED MODEL

Overall, the analysis in this section suggests that the stopping rule for optimal supplier lending can be refined:

$$[(1 - \pi) * (FaceValue + Interest) + (\pi) * (\psi)] - [(FaceValue + Opp.Cost)] > 0$$

where  $\psi = f(CollateralRights, DebtEnforcement, CollateralEffectiveness, \dots)$   
and  $\pi = g(InstitutionalFactors, \dots)$

## C DATA DESCRIPTION AND EMPIRICAL APPROACH

### TRADE CREDIT DATA

The data on trade credit extension comes from a worldwide dataset of firms drawn from the OSIRIS database. The sample is limited to primary, extraction, manufacturing, and wholesale industries. I exclude service industries, which have no collateral for trade credit; and retail industries, which mainly supply to private consumers, because the nature of credit extension and claims enforcement is likely to differ significantly. I accept this as a limitation to the external validity of my results.

The sample contains balance-sheet information for the years 2005 to 2007 for approx. 15,000 firms from 86 countries and 183 industries at the three-digit level of the Standard Industrial Classification (SIC). As a proxy for trade credit extension, I use accounts receivable from the assets section (AccRec). To make this comparable across firms, I use total assets (Assts) and total sales (Sales) as deflators. I include both as control variables, rather than using a ratio (AccRec/Assts or AccRec/Sales) as dependant variable, because I do not want to pre-impose a relation.

I eliminate observations with negative or missing values of accounts receivable, assets or sales. There is no reason to believe that missing values represent an endogenous choice not to report, so I have no concern that eliminating missing values introduces a selection bias. Further, since balance-sheet information represents a stock on the day the balance sheet is issued, there may be concern if a variable displays seasonal variation. I know of no particular reason why this should be the case and, hence, confine myself to noting this point.

### MEASURING PRODUCT AND TECHNOLOGY CHARACTERISTICS

To capture how the effectiveness of collateral varies with product aspects and technologies, I construct a collateral score (CScore). This score is based on the categories of potential constraints identified above. Recall that the collateral must still exist in substantially unchanged form and be unambiguously identifiable, and that transaction costs and loss in resale value may constrain the collateral value. I propose these categories to split the issue into conceptually distinct and separately manageable portions and facilitate systematic analysis.

In practice, the precise severity of each constraint is likely to vary by supplier, and even by each supplier-buyer relation. It is neither practical, nor meaningful to conduct an analysis at this level of disaggregation. Instead, I confine the analysis to industries. This is not without foundation, as Ng et al. (1999) document that trade credit use varies widely across industries, but little within industries. I can confirm this for my data: in the US, the average of the standard-deviations of the trade-credit-per-sales ratios within industries is only seven per cent, whereas the standard-deviation of the averages of the trade-credit-per-sales ratios in industries is twenty per cent. Furthermore, it is conceivable that products and technologies are similar for firms within the same industry, but different across industries.

To construct the collateral score, I firstly rate the severity of the four individual constraints for each of the 183 industries at the three-digit level of the Standard Industrial Classification (SIC) scheme in my sample. For example, dairy farms receive a worse rating than luxury watches in constraint (1) because of the relative perishability. The individual ratings I give are: 0 for no constraint, 1 through 3 for small through large constraints, and 9 for a prohibitive constraint.

Secondly, I add these into a single collateral score for each industry, thus treating the constraints as additive<sup>4</sup>. Thirdly, I truncate the score at 9 recognising that this is defined as prohibitive, and finally, reverse the score to aid interpretation. The final collateral score thus ranges from 0 for worthless collateral to 9 for very good collateral. Table 1 over the page shows an extract of the score as an illustration.

I do not claim that the score is completely consistent, or that there are no exceptions within each category. Indeed, that newspaper suppliers extend significant amounts of trade credit is puzzling, for example. However, all I require for the analysis is that the score is *on average* right, and that the inevitable subjectivity does not introduce *systematic* bias. Further, it is worth reiterating that the constraints are important even if actual repossession and resale do not occur because the frictions caused affect the outside option and the bargaining power of suppliers.

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<sup>4</sup> This aggregation makes sense because the overall collateral effectiveness is determined by the severity of all constraints. For example, the value of car components as collateral is reduced because turnover is fast (“just in time management”), and further because car components are custom-made.

**Table 1 – Extract of the Collateral Score**

Industry (SIC, Name)	AccRec per Sales	Std. Dev.	<b>CScore</b>	Category1	Category2	Category3	Category4
011 Cash Grains	12,5%	13,7%	<b>1</b>	M	M	H	L
016 Vegetables and Melons	13,2%	11,3%	<b>0</b>	P	M	H	P
101 Iron Ores	9,9%	7,9%	<b>0</b>	H	H	H	0
104 Gold and Silver Ores	19,6%	37,4%	<b>6</b>	H	0	0	0
144 Sand and Gravel	20,5%	16,5%	<b>0</b>	H	H	H	0
235 Hats and Caps	16,2%	10,1%	<b>5</b>	L	0	L	M
271 Newspapers	19,3%	11,7%	<b>0</b>	P	0	M	P
277 Greeting Cards	7,1%	4,2%	<b>6</b>	L	0	M	0
354 Metalworking Machines	20,0%	11,4%	<b>7</b>	0	0	L	L
365 HH Audio & Video Eq.	19,1%	8,6%	<b>6</b>	L	0	0	M
387 Watches and Clocks	14,3%	7,4%	<b>9</b>	0	0	0	0
502 Wholesale: Furniture	16,5%	8,1%	<b>5</b>	L	0	L	M
514 Wholesale: Groceries	12,2%	10,5%	<b>0</b>	P	M	M	P

#### MEASURING INSTITUTIONAL QUALITY

I argue above that institutional quality can affect the willingness of suppliers to extend trade credit both (1) through collateral effectiveness by reducing the loss incurred in the event of default ( $\psi$  in the model) and (2) by reducing the risk of default occurring in the first place ( $\pi$  in the model).

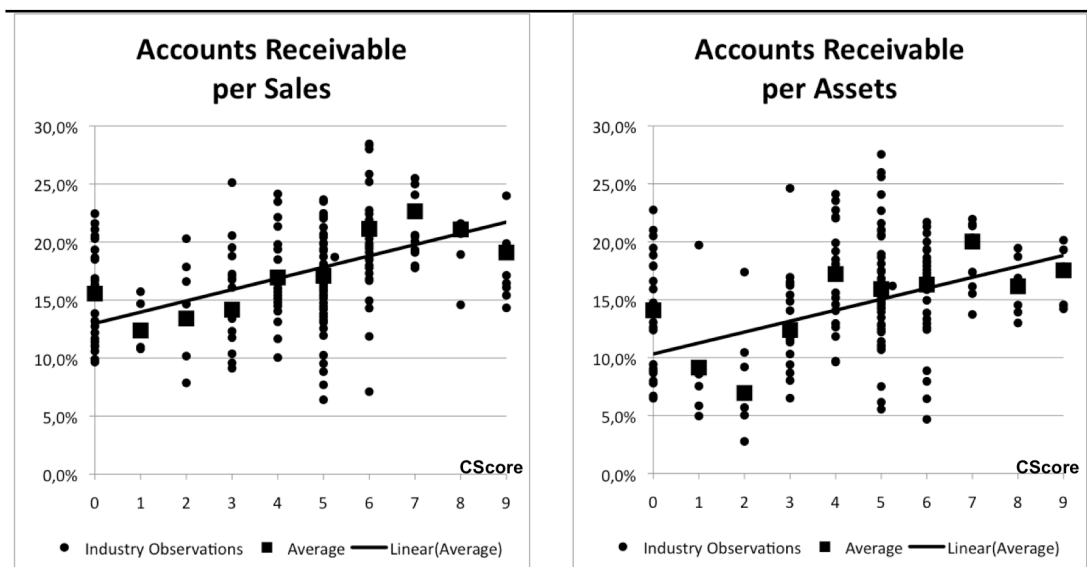
(1) To measure the impact through the effectiveness of collateral, I chose aspects of institutions that pertain specifically to collateral and the case of default. From the work of La Porta et al. (1997; 1998), I take measures of *de jure* collateral rights. The first variable indicates that a country's bankruptcy code does *not* impose an automatic stay on assets (NoStay). Where such a stay is imposed, collateral cannot be immediately removed from the estate and the suppliers' bargaining strength is reduced. The second variable indicates that the legal code has a provision that collateral holders must be paid out before unsecured creditors (PaidFirst). The authors also show that legal codes derived from Common Law are more pro-creditor. Thus, I use an indicator of Common Law legal origin as an alternative measure (CmmnLaw). Djankov et al. (2008) conduct a study of debt enforcement across the world. From their work, I take an estimate of the average duration of bankruptcy proceedings (Duration) as a measure of the *de facto* efficiency of debt enforcement.

(2) To measure the effect through the risk of defaults, I chose the following indicators. From a study of court efficiency across the world by Djankov et al. (2003), I use an estimate of how many days it takes to enforce a contract over half the GDP per capita (EnforceDays). From the World Bank Governance Indicators, I take a measure of adherence to the rule of law (RuleLaw), which presumably includes the tendency for strategic defaults. Alternatively and all encompassing, I use the GDP per capita (GDPC). Further, Djankov et al. (2007) document the importance of credit registries for credit extension. By sharing information about debtors, these institutions limit adverse selection problems and reduce the risk of defaults. From their work, I take variables indicating the presence of private (PrivReg) and public (PubReg) registries in a country. Alternatively, I use the broader index of credit information depth (InfoDepth) from the World Bank Doing Business Project.

#### DATA DESCRIPTION

Table 2 on the next page contains variable descriptions and summary statistics. Further, inspection of Diagram 1 below already reveals a broad correlation between the collateral score and trade credit extension (deflated by firm size). This is encouraging and will be explored in more detail in the multivariate analysis.

Diagram 1 – Collateral Score



*The round dots plot the combinations of collateral score and average trade credit ratio for every industry. The square dots represent the overall average trade credit ratio for each value of the collateral score.*

**Table 2 – Variable Description and Summary Statistics**

Variables	Mean	StdDev	Min	p50	Max
AccRec	206.865	3 Mil	≈ 0	15.365	721 Mil
Assts	1.359.421	10 Mil	≈ 0	117.764	722 Mil
Sales	1.243.105	8 Mil	≈ 0	102.223	372 Mil
AccRec/Sales	16.2%	0.118	≈ 0	0.145	0.940
AccRec/Assts	18.7%	0.157	≈ 0	0.164	2.649
<i>Source: Firm level data from OSIRIS Database by Bureau van Dijk Electronic Publishing; database accessed Dec 2009, Judge Busines School, Cambridge University. AccRec is the amount due to the firm resulting from the sale of goods. Assts is total assets. Sales is total sales. All averaged over the years 2005 to 2007.</i>					
NoStay	0.277	-	0	-	1
PaidFirst	0.895	-	0	-	1
CmmnLaw	0.644	-	0	-	1
<i>Source: Djankov et al. (2007). All originally developed by La Porta et al. (1997, 1998). NoStay denotes that the country imposes no automatic stay on assets. PaidFirst denotes that the country mandates that collateral holder be paid first in debt enforcement. CmmnLaw denotes that the country's legal system is of Common Law legal origin. All as of 2003.</i>					
Duration	1.775	1.153	0.417	1.670	9.167
EnforceDays	5.215	0.704	3.296	5.485	7.286
<i>Source: Djankov et al. (2008). EnforceDays originally by Djankov et al. (2003). Duration denotes the average estimated length, in years, of dept enforcement proceedings in a country. As of 2008. EnforceDays denotes the logarithm of the average estimated length, in days, it takes to enforce a contract over half the per capita GDP in a country. As of 2003.</i>					
RuleLaw	0.861	0.801	-1.381	0.992	1.987
<i>Source: World Bank Governance Indicators; website accessed Dec 2009. RuleLaw measures the law and order tradition in a country. Averaged over 2005 to 2007.</i>					
GDPC	23.729	17.147	240	27.756	73.185
<i>Source: IMF World Economic Outlook Database; website accessed Dec 2009. GDPC is GDP per capita at current prices in U.S. Dollars. Averaged over the years 2005 to 2007.</i>					
PrivReg	0.746	-	0	-	1
PubReg	0.336	-	0	-	1
<i>Source: Djankov et al. (2007). PrivReg and PubReg repectively denote the presence of private and public registries for information on debtors in a country. All as of 2003.</i>					
InfoDepth	5.135	0.969	0	5	6
<i>Source: World Bank Doing Business Project; website accessed Dec 2009. InfoDepth measures the scope, accessibility and quality of information on debtors available through registries in a country. As of 2009.</i>					
CScore	5.247	1.988	0	5	9
<i>Index of collateral effectiveness, generated by rating potential constraints to collateral use as described in this paper. 0 denotes worst collateral, 9 denotes best collateral. Available from the author on request. As of 2010.</i>					

## ESTIMATION STRATEGY

The basic hypothesis is that suppliers with more effective collateral extend more trade credit, *ceteris paribus*. I propose to capture this with the following basic specification, where  $f$ ,  $i$ , and  $c$  respectively denote firm  $f$ , industry  $i$  and country  $c$ , and the  $\alpha_c$  are country fixed effects to control for unobserved heterogeneity in trade credit extension across countries:

$$\ln AccRec_{f,i,c} = \alpha_c + \varphi_{f,i,c} \ln Assts_{f,i,c} + \gamma_{f,i,c} \ln Sales_{f,i,c} + \beta_i CScore_i + \varepsilon_{f,i,c} \quad (A)$$

The coefficient  $\beta_i$  on  $CScore_i$  captures the effect of interest and is expected to be positive. An absolute quantitative interpretation of the coefficient is not possible because the collateral score has no absolute meaning. However, the coefficient does provide a sense of the direction and magnitude of the relative effect of collateral effectiveness (assuming *ceteris paribus* for now). Further, I adapt the specification by splitting the sample along several dimensions using dummy variables: by country income group, and by firm size. This allows comparing the relationship between supplier lending and collateral effectiveness across income groups and firms of different sizes. Finally, I apply the specification to the individual countries for which I have the most observations. This allows comparing the effect for specific countries with known characteristics, such as political and institutional environment.

The key challenge is to verify if the collateral score is valid and to rule out that it picks up effects of uncontrolled industry factors that also affect supplier lending. One candidate factor is industry concentration: In more concentrated industries, profit margins and thus, incentives to price discriminate to increase sales to marginal customers without cutting prices to intra-marginal customers are higher. Petersen and Rajan (1997) and Fabbri and Klapper (2008) suggest this hypothesis, but find contradictory evidence. While there is nothing in the conceptual make up of the collateral score to suggest that it may be correlated with industry concentration, the only way to conclusively rule out that the results are biased is to control for this factor. However, data constraints mean that this can only be done for a small subset of mostly developed countries. Similarly, other factors can be postulated: for example, business opportunities and access to finance may systematically vary for firms in different industries. It is not feasible to control for all these factors.



Instead, I use a method developed by Rajan and Zingales (1998), which proposes the use of both country and industry fixed effects to control for all unobserved sources of heterogeneity in supplier lending across countries and industries. The fixed effects pick up factors such as industry concentration or the stance of monetary policy in a country. To identify the effect of collateral effectiveness on supplier lending, I use interactions of the industry collateral score with country measures of institutional quality.

Thus, I propose the following additional specification, where  $f$ ,  $i$ , and  $c$  denote dimensions,  $CScore_i$  is the collateral score,  $Z_c$  is a vector of measures of the institutional environment, and  $\alpha'_c$  and  $\xi'_i$  are country and industry fixed effects (so  $CScore_i$  or the elements of  $Z_c$  do not enter the specification on their own):

$$\ln AccRec_{f,i,c} = \alpha'_c + \xi'_i + \varphi'_{f,i,c} \ln Assts_{f,i,c} + \gamma'_{f,i,c} \ln Sales_{f,i,c} + \beta'_{i,c} CScore_i * Z_c + \varepsilon'_{f,i,c} \quad (B)$$

The coefficients  $\beta'_{i,c}$  on the interaction terms capture how the effect of the  $CScore_i$  varies with the measures of the institutional environment in  $Z_c$ . From the model proposed earlier, I derive the following hypotheses:

(1) The effect of the collateral score is stronger if collateral rights are better (NoStay, PaidFirst, or CmmnLaw) or if debt enforcement is more efficient (*smaller* Duration), because this magnifies the advantage of collateralised creditors.

(2) The importance of effective collateral is lower if *general* compliance and law enforcement are better (RuleLaw, *smaller* EnforceDays, or alternatively, GDPC), because this reduces the risk of default and the need for collateral.

(3) The effect of the collateral score is less pronounced if information-sharing institutions (PrivReg, PubReg, or InfoDepth) are better, because the adverse selection problem and the probability of default are reduced, so that collateral is less important.

The key assumption I make is that the institutional measures in (1) affect trade credit extension by improving collateral effectiveness (through  $\psi$  in the model), whereas those in (2) affect supplier lending by reducing the probability of defaults (through  $\pi$  in the model). This is reasonable because of the way I chose the measures. If anything, the concepts in (2) are more general and subsume the concepts in (1). If those narrower concepts still retain significance, this provides evidence that the measures pick up the precise effect I postulate.

I want to be precise about what this estimation strategy can and cannot do. It does not identify the *magnitude* of the impact of variation in collateral effectiveness on trade credit extension, but it clearly disentangles and identifies *directional* effects. At the same time, it does not suffer from omitted variable problems in the way pure cross-country or cross-industry studies do (as discussed for the Demirguc-Kunt and Maksimovic (2001) study and my own earlier specification).

Furthermore, there is an additional advantage: if the collateral score and the institutional variables interact in the postulated ways, this provides significant evidence that these variables are indeed *valid measures* of these concepts as I postulate. It is not easily conceivable that the collateral score would interact with the institutional measures in the same way if it were picking up industry concentration, for example. This in turn means that the results of the earlier specification are very likely to be valid, and I make full use of both approaches.

#### DATA ISSUES

First, since I cannot take advantage panel data methods due to the time-invariant collateral score, I instead average the firm level variables and GDP per capita over the years 2005-2007 to reduce the impact of random shocks. The period is relatively stable, so I have no concerns about averaging over structural breaks.

Second, I use the logarithm of the main firm level variables, as well as of GDP per capita (and EnforceDays is already transformed in the source). The resulting series are more linear, the impact of outliers is reduced, and it is easier to interpret the effects as percentages.

Thirdly, I analyse variation across industries and countries. Firms from the same industry/country represent multiple drawings from the distribution of the same cluster. To allow for correlations of the error terms within industry/country clusters due to uncontrolled heterogeneity, I report cluster adjusted robust standard errors.

Fourthly, the *observed* amount of trade credit extended is the *equilibrium* of supply and demand. The focus of interest is the supply side (trade credit *extension*), but I am limited to reduced-form estimations due to data constraints. This introduces simultaneity bias if a determinant of supply also systematically affects demand. I cannot think of such a factor, but I have to accept that concern.

## D RESULTS AND DISCUSSION

### BASIC SPECIFICATION

Table 3 presents the results of specification (A). The coefficient on the collateral score in Panel A is consistently positive and statistically significant<sup>5</sup>. On average, across the whole sample, a unit increase in the collateral effectiveness rating is associated with a 6.5% increase in supplier lending, *ceteris paribus*. To put this effect into perspective, it suggests that producers of sand (CScore=0) lend on average almost sixty per cent less than watch producers (CScore=9). Inspection of the income group specification reveals that the positive effect of more effective collateral is more than halved moving from the poorest to the richest countries (+10.4% in low income countries versus 10.4%-5.9%=+4.5% in high income countries; statistically significant at the 10%-level). This provides some evidence for the hypothesis postulated above: since compliance is generally higher in richer countries, the need to resort to collateral is lower, and so it is expected that collateral is less important. The firm size specification reveals that the response of larger firms to better collateral is minimally lower, but this effect is not economically or statistically significant.

Panel B reports the results of regressions by country. Importantly, the results consistently hold (with the exception of South Korea) in countries that differ considerably along several dimensions, including: the level of economic *development* (the developed US and Japan, versus emerging Taiwan, and versus developing India and China) and economic *growth* (2.1% in Japan over the 2005 to 2007 period, versus 11.7% in China and 9.7% in India)<sup>6</sup>; the general economic and political system in the US and China; and the financial sector, which is relatively deregulated and large in the US (Private-Credit-to-GDP ratio of 2), but centred on close bank-firm relations and smaller in Japan (Private-Credit-to-GDP ratio of less than 1)<sup>7</sup>. In general, this increases my confidence that the results have general validity, and are not, for example, driven by a random correlation between industry patterns and country characteristics in my sample.

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<sup>5</sup> I do not interpret  $R^2$ , because it is mainly driven by firm size controls.

<sup>6</sup> IMF World Economic Outlook Database.

<sup>7</sup> Djankov et al (2007).

**Table 3 – Specification (A)**

The *dependant variable* is the *logarithm of Accounts Receivable*. The logarithm of Assets, the logarithm of Sales, and (in Panel A) dummy variables for 86 Countries are not reported. Country fixed effects are included by means of dummy variables. P-values are in parentheses, with indicators +  $p < 0.10$ , \*  $p < 0.05$ . All standard errors are adjusted for industry clusters.

*Panel A*

	Full Sample	Income Group Dummies		Firm Size Dummies	
CScore <sub>i</sub>	0,065* (0,000)	CScore <sub>i</sub>	0,104* (0,005)	CScore <sub>i</sub>	0,068* (0,000)
		CScore <sub>i</sub>	0,020 *LowMidGDPC <sub>c</sub> (0,548)	CScore <sub>i</sub>	-0,005 *SmallMid <sub>f,i,c</sub> (0,299)
		CScore <sub>i</sub>	-0,027 *UpMidGDPC <sub>c</sub> (0,475)	CScore <sub>i</sub>	-0,005 *LargeMid <sub>f,i,c</sub> (0,483)
		CScore <sub>i</sub>	-0,059+ *HighGDPC <sub>c</sub> (0,074)	CScore <sub>i</sub>	-0,008 *Large <sub>f,i,c</sub> (0,495)
Clusters	183	Clusters	183	Clusters	183
N	14310	N	14310	N	14310
adj. R2	0.866	adj. R2	0.867	adj. R2	0.866

*Income classification using the World Bank Atlas method: low income (omitted) up to \$975; lower middle income up to \$3,855; upper middle income up to \$11,905; and high income more than \$11,906. Size classification by Sales: small (omitted) up to \$75,000, smaller middle up to \$300.000, larger middle up to \$1.200.000, large more than \$1.200.000.*

*Panel B*

	USA	JPN	KOR	TWN	MYS	IND	CHN
CScore <sub>i</sub>	0,056* (0,000)	0,044* (0,017)	0,026 (0,106)	0,086* (0,015)	0,104* (0,001)	0,108* (0,004)	0,145* (0,000)
Clusters	156	149	116	100	114	131	138
N	2118	1789	858	1051	504	1242	1206
adj. R2	0.950	0.917	0.905	0.808	0.690	0.471	0.471

*Regressions by country, for the seven countries with the most observations (more than 500 observations) in my sample.*

## INTERACTION SPECIFICATION

Table 4 reports the results for specification (B). I discuss these by hypotheses:

(1) The importance of more effective collateral is considerably higher in countries mandating that collateral holders be paid first in debt enforcement (PaidFirst). This effect is economically and statistically significant: the *difference* in supplier lending between industries with a unit difference in collateral effectiveness is 4.8% points higher in countries with this provision. Surprisingly, the impact of collateral effectiveness is independent of the provision imposing an automatic stay on assets (NoStay), as this effect is not significant.

Inspection of the alternative specification reveals that the Common Law origin dummy (CmmnLaw in Spec.I) that indicates a pro-collateral-holder stance has a positive and significant effect. Overall, this suggests that better collateral rights increase the importance of effective collateral, in line with my hypothesis. Further, effective collateral is more important in countries, in which debt enforcement is quicker and more efficient (*smaller* Duration). A one-year (one standard-deviation) decrease in duration increases the impact of a unit improvement in collateral effectiveness by about one percent.

(2) In countries with better general law enforcement (*smaller* EnforceDays) and overall adherence to the rule of law (RuleLaw), collateral effectiveness has a smaller impact. This is in line with the hypothesis: the reduced likelihood of default makes reliance on collateral less important in such countries. The result is significant in all specifications, and is robust to the alternative use of per capita GDP (GDPC in Spec.II): The impact of the collateral score is generally smaller in richer countries, which presumably have higher compliance rates, as suggested in the earlier results.

(3) The presence of a private registry (PrivReg) in a country reduces the impact of better collateral significantly. The impact of a unit improvement in collateral effectiveness is 4.4% points higher. This is as postulated: information sharing reduces adverse selection and the need to use collateral. Surprisingly, the presence of a public registry (PubReg) has the opposite effect, but it is not significant. Using the general information index (InfoDepth in Spec.III) confirms that collateral is less important where more information on debtors is available.

**Table 4 – Specification (B)**

The *dependant variable* is the *logarithm of Accounts Receivable*. The *logarithm of Assets*, the *logarithm of Sales*, and *dummy variables for 86 Countries and 186 Industries* are not reported. *Country and Industry fixed effects* are included by means of *dummy variables*. *P-values* are in parentheses, with indicators +  $p < 0.10$ , \*  $p < 0.05$ . All standard errors are adjusted for country-industry clusters.

<b>Interactions</b>	<b>Expected Sign</b>	<b>Main Results</b>	<b>Alternative Spec.I</b>	<b>Alternative Spec.II</b>	<b>Alternative Spec.III</b>
CScore <sub>i</sub> *NoStay <sub>c</sub>	+ve	<b>-0,007</b> <b>(0,439)</b>	—	-0,008 (0,407)	-0,013 (0,133)
CScore <sub>i</sub> *PaidFirst <sub>c</sub>	+ve	<b>0,048*</b> <b>(0,000)</b>	—	0,041* (0,001)	0,047* (0,000)
CScore <sub>i</sub> *CmmnLaw <sub>c</sub>	+ve	—	0,023* (0,042)	—	—
CScore <sub>i</sub> *Duration <sub>c</sub>	-ve	<b>-0,009+</b> <b>(0,063)</b>	-0,012* (0,016)	-0,012* (0,012)	-0,007 (0,113)
CScore <sub>i</sub> *EnforceDays <sub>c</sub>	+ve	<b>0,015*</b> <b>(0,019)</b>	0,015* (0,027)	0,014* (0,024)	0,013* (0,027)
CScore <sub>i</sub> *RuleLaw <sub>c</sub>	-ve	<b>-0,008</b> <b>(0,315)</b>	-0,006 (0,459)	—	-0,022* (0,004)
CScore <sub>i</sub> *lnGDPC <sub>c</sub>	-ve	—	—	-0,016* (0,006)	—
CScore <sub>i</sub> *PrivReg <sub>c</sub>	-ve	<b>-0,044*</b> <b>(0,012)</b>	-0,054* (0,001)	-0,033+ (0,056)	—
CScore <sub>i</sub> *PubReg <sub>c</sub>	-ve	<b>0,017</b> <b>(0,141)</b>	0,025* (0,046)	0,010 (0,427)	—
CScore <sub>i</sub> *InfoDepth <sub>c</sub>	-ve	—	—	—	-0,008+ (0,090)
Clusters		<b>2978</b>	2978	2978	2978
N		<b>12811</b>	12811	12811	12811
adj. R2		<b>0.898</b>	0.898	0.898	0.898

## ROBUSTNESS

One concern is that the sample of firms is unbalanced across countries. For seven countries, I have more than 500 observations, for 30 less than ten. In “pooled” regressions, the industry/country clusters with more observations are essentially given more weight. This may introduce bias if the number of observations is systematically related to a variable. As a robustness-check, I exclude observations with more than 500 and less than ten observations. Further, I check if the results differ by firm size, which may be systematically related both to the number of observations through inclusion criteria of the database and also to trade credit extension behaviour. Table 5 in the appendix shows that the interpretations are generally not affected, except that the relations are weaker for small firms.

## E CONCLUDING REMARKS

In this paper, I have shown that suppliers tend to offer more trade credit to buyers in industries, in which products and technologies provide more effective collateral. Further, I have shown evidence that this effect is more pronounced in countries where suppliers face a higher risk of default, and in those where rights with respect to collateral and debt enforcement are more effective. The work further provides evidence that my collateral score is a *valid measure* of collateral effectiveness, and may be used in further research.

While this paper generally confirms the collateral hypothesis, the work can be meaningfully extended. One could refine the analysis by considering the impacts of the constraints separately. In addition, it would be interesting to further try more objective measures of collateral effectiveness, such as industry turnover rates or value added proportions. This leaves room for future research.

Furthermore, it is important to acknowledge that effective collateral is no absolute requirement. Supplier lending does take place without good collateral, as the case of newspapers illustrates. One promising alternative line of research emphasises reliance on reputation and mutual trust to ensure compliance (see, for example, the work of Fafchamps (1995)). A combination of both approaches could analyse how collateral effectiveness and measures of social capital interact.

To conclude, I would like to offer my own reading of the results. One implication is an asymmetry across industries in finance provision and access to finance: firms from some industries have a disadvantage in providing credit and, conversely, firms receiving products from these industries have a disadvantage in sourcing credit. This is particularly important for otherwise credit-constrained small and young firms, as well as firms in less developed countries, which rely relatively more on trade credit (Petersen and Rajan 1997, Fisman and Love 2003). While further research is certainly required, one tentative policy option is to improve information sharing to reduce these asymmetries.

The results may further shed some light on an important question in economic development: the patterns of industry development across countries. It is conceivable, for instance, that industries with lower collateral effectiveness may find it difficult to establish in poorer countries, where effective collateral is important according to my results. A rudimentary reading of my data seems to contradict this link: The average of the collateral score in a country, which indicates the typical quality of collateral of its industries, is *lower* for poorer countries. However, further research may go beyond a simple average and distinguish different reasons for collateral ineffectiveness. For instance, both primitive low value products and intangible intellectual property have low collateral value, but their values for development and growth are very different. This is another starting point for further research.

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## APPENDIX

**Table 5 – Robustness**

*The dependant variable is the logarithm of Accounts Receivable. The logarithm of Assets, the logarithm of Sales, and dummy variables for 86 Countries and 186 Industries are not reported. Country and Industry fixed effects are included by means of dummy variables. P-values are in parentheses, with indicators +  $p < 0.10$ , \*  $p < 0.05$ . All standard errors are adjusted for country-industry clusters.*

<b>Interactions</b>	<b>Expected Sign</b>	<b>Full Sample</b>	<b>Excluding many and few Obs.</b>	<b>Small Firms</b>	<b>Large Firms</b>
CScore <sub>i</sub> *NoStay <sub>c</sub>	+ve	<b>-0,007</b> <b>(0,439)</b>	0,008 (0,507)	-0,005 (0,715)	-0,007 (0,543)
CScore <sub>i</sub> *PaidFirst <sub>c</sub>	+ve	<b>0,048*</b> <b>(0,000)</b>	0,032* (0,023)	0,017 (0,353)	0,075* (0,000)
CScore <sub>i</sub> *Duration <sub>c</sub>	-ve	<b>-0,009+</b> <b>(0,063)</b>	-0,004 (0,392)	-0,011 (0,132)	-0,004 (0,547)
CScore <sub>i</sub> *EnforceDays <sub>c</sub>	+ve	<b>0,015*</b> <b>(0,019)</b>	0,014+ (0,086)	0,013 (0,250)	0,018* (0,012)
CScore <sub>i</sub> *RuleLaw <sub>c</sub>	-ve	<b>-0,008</b> <b>(0,315)</b>	-0,002 (0,853)	0,007 (0,525)	-0,014 (0,100)
CScore <sub>i</sub> *PrivReg <sub>c</sub>	-ve	<b>-0,044*</b> <b>(0,012)</b>	-0,043* (0,030)	-0,026 (0,253)	-0,050* (0,019)
CScore <sub>i</sub> *PubReg <sub>c</sub>	-ve	<b>0,017</b> <b>(0,141)</b>	-0,007 (0,565)	0,042* (0,012)	0,009 (0,592)
Clusters		<b>2978</b>	2253	1929	2015
N		<b>12811</b>	5715	5937	6874
adj. R2		<b>0.898</b>	0.897	0.769	0.837

*Excluding observations from countries with more than 500 and less than 10 observations. Small and large firms are divided along the median of Sales, which is about \$100.000.*