May 2017

The International Trade Credit Channel: Implications for Industry Performance

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by

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A Dissertation Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
in Economics

at
the University of Wisconsin Milwaukee
May 2017

ABSTRACT

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Under the Supervision of Professor Rebecca Neumann

Chapter II: The international trade credit channel: Implications for industry investment

Abstract: Trade credit is an important feature of many trade contracts offering buyers a means of financing purchases using credit from suppliers. This paper aims to identify a channel through which international trade credit and international trade affect industry investment. I use an interaction variable approach, first implemented by Rajan and Zingales (1998), where industries are ranked by different propensities to use trade credit according to their industry specific production properties. This ranking is then interacted with measures of aggregate trade credit and trade openness at the country level to examine how industry investment in industries with higher or lower dependence on trade credit responds to the availability of trade credit. The dataset includes 23 manufacturing industries in 20 countries from 1999-2009. Controlling for industry size along with access to and dependence on domestic external finance, I show that industries with a higher propensity to use trade credit benefit from greater international trade credit and greater trade openness in terms of a higher investment share relative to economy-wide investment.

Chapter III: "The role of international trade credit for investment volatility"

Abstract: In this study, I analyze another aspect of the link between international trade credit and industry investment. Specifically, I examine the effect of access to international trade credit on the volatility of industry investment. A decrease in aggregate investment volatility has

previously been shown to be linked to a decrease in aggregate output volatility. While some literature indicates that trade credit might dampen the investment volatility by providing additional internal finance and reducing informational asymmetries where financial institutions are limited, other literature suggests trade credit might increase the investment volatility by building up credit chains, such that potential liquidity shocks might be transmitted via credit connected firms. Using data from 23 manufacturing industries in 20 countries over the period 1999-2009, I construct measures of the volatility in each industry's investment share across countries. I test the effect of various measures of trade credit, while accounting for the industry propensity to use trade credit. My initial results imply that higher average international trade credit in trade credit dependent industries increases the volatility in the investment share.

Chapter IV: "The link between International Trade Credit and Industry value added"

Abstract: In this paper, I aim to examine the role of international trade credit on industry value added. Rajan and Zingales (1998) and many other authors suggest that well developed financial institutions play a crucial role for growth in value added. Fisman and Love (2003) expand this idea to the usage of trade credit and show that more trade credit dependent industries have higher industry growth in value added in countries with weak financial institutions. These findings suggest that firms in countries with a lack of access to external finance substitute trade credit for bank credit. In this paper, I examine explicitly the impact of international trade credit. While Fisman and Love (2003) use a cross sectional dataset and regress a 10 year compounding growth rate in industry value added on interactions between financial development and external finance dependence and trade credit dependence, I make use of a panel dataset using the value added share as the dependent variable. The dataset includes 23 manufacturing industries in 30 countries from 1986-2010. Controlling for the different countries' levels of overall development along with access to and dependence on domestic external finance, I show that industries with a higher

propensity to use trade credit exhibit a higher value added share when international trade credit is less available, consistent with Fisman and Love's finding on financial development and suggestive that international trade credit is a poor substitute for domestic financial development

To

my Parents,

my Sister

and Rebecca

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Chapter I: Introduction and Literature Review

Introduction

This dissertation aims to identify a link between international trade credit and industry performance measures, namely the investment share and growth in value added. This question is important as a large fraction of international trade utilizes trade credit as an additional source of finance. Scotiabank (2007) and International Chamber of Commerce (2009, 2010) provide estimates that open account terms, which is the granting of supplier credit, are used in 47% to 80% of international transactions. Given the large volumes of international trade, it comes naturally to mind that trade credit might be an additional source of financing for firms and also might affect performance variables.

Firms have to choose between different payment methods to process the payment whenever they exchange goods. The payment can be made in advance (cash in advance) whereby the customer carries the risk of non-delivery, or after delivery (open account) whereby the supplier carries the risk of nonpayment. Trade credit or supplier credit arises from open account in which the supplier allows a customer to delay the payment after the goods are already delivered. Typical post-shipment payment terms include a deduction of the outstanding amount if it is paid within a week or the full amount is due within 30 days (30 to 90 days in international trade). Ng et al. (1999) report that the main payment terms in the US are "2-10 net 30" implying 2% deduction if payment is made within 10 days with full payment due after 30 days. Also common are terms "8-30 net 50" implying an 8% deduction if paid within 30 days with full payment due after 50 days. This trade credit granted is marked as accounts receivable in the supplier's balance sheet and as accounts payable in the customer's balance sheet. In international trade a third payment method comes into play, namely letters of credit. There are often longer times between shipment and delivery than in

national transactions and the contractual enforcement may differ between countries. Therefore, the exporter can choose letters of credit to ensure the transaction against nonpayment risk. This contract involves a bank in the exporter's country and a bank in the importer's country. The buyer's bank guarantees the seller's bank a payment. The seller's bank is by contract obligated to pay the seller, whether or not she received the payment from the buyer's bank.

In my dissertation, I explore he financing aspects of international trade credit. Some authors find that firms use trade credit more heavily in a financially constrained setting. The financial constraints can arise from a lack in the development of financial institutions (Fisman and Love (2003)), monetary policy tightening (Mateut et al. (2006)) or financial crisis (Love et al (2007)). These empirical studies all have one commonality: They do not distinguish between the national form of trade credit and the international form of trade credit. My goal is to identify a channel through which international trade may affect industry finance and then, as a result, industry performance variables. The proposed channel is through access to international trade credit, which I suggest serves as an additional source of finance for firms engaging in international trade. The implications are that trade restricting policies or other barriers to trade not only restrict the flow in goods and services across countries but also restrict an important source of finance for industries.

This dissertation is structured as follows. Chapter I provides an overview of the literature on (i) why trade credit is used in inter firm trade, (ii) the interaction between trade credit and other external finance and (iii) trade credit in international trade. Chapter II "The International Trade credit channel: Implications for Industry Investment" examines the link between international trade credit and industry investment. Chapter III "The role of international Trade credit for Investment volatility" examines the link between international trade credit and volatility in industry investment. Chapter IV shows how international trade credit impacts industry value added.

Literature Review

Trade credit as product warranty and signal

Much of the literature on trade credit has focused on the informational structure between customers and suppliers. Researchers argue that suppliers of input factors have an informational advantage over banks by aggregating the private information they have access to and the information that is available to banks. Moreover, some authors point out that received trade credit also serves as a signal about the creditworthiness to banks, which then in turn are more likely to provide bank credit. Another rationale behind the reasons why trade credit is supplied is the argument that trade credit serves as a signal for the quality of a product. It is often hard to measure the quality of a product objectively as required for a product quality warranty, especially in sectors with tailor made products. Trade credit can here solve a twofold problem: Firstly, it can serve as a signal about the quality of the product supplied and, secondly, it facilitates the return of an unsatisfactory product. These arguments also apply for international trade relationships, where the delivery time and differences in contractual enforcement might cause problems.

Lee and Stowe (1993) analyze the role of trade credit as warranty and signal about the product quality, claiming that it is hard for customers to get a refund for low quality products once the payment is made while returning an unsatisfactory product before payment is relatively easy. They further argue that low quality producers will offer high discounts on early payments (implicitly high interest rate for supplier credit), hereby sending an implicit signal to their trading partners about their type. They then study a customer's choice between using the granted trade credit or a regular product quality warranty. As using a product quality requires an objective proof of lack of quality, the authors argue that customers choose trade credit for more specialized products, e.g. tailor made products, and warranty contracts for standardized products. Therefore, the choice

whether to use supplier credit or not is also determined by the properties of the product traded and these vary across industries but not within.

Bias and Gollier (1997) build a model based on information asymmetries where the trading partner has an informational advantage over the bank from aggregating the bank information and her private information about the supplier. Thus, the supplier has an advantage in deciding whether or not a customers' project in which he or she is involved will lead to a positive future outcome. Hence, trade credit might be granted even if bank credit is not approved. In turn, receiving trade credit from a trading partner sends a signal about the creditworthiness of the customer to the bank such that the bank might also become more willing to lend. So, in this model, trade credit itself serves as a signal.

In line with the former paper, Demirgüç-Kunt and Maksimovic (2001) focus their analysis on the view that banks may be less efficient in gathering information than suppliers. They expand the above mentioned arguments by one more idea, the role of trade credit as a complement for bank credit. Their rationale is that, if banks are less efficient in gaining information than trading partners, then it will be more efficient for banks to lend to suppliers who then in turn, will lend it to their customers. This would imply that trade credit is positively related to the amount of lending in the bank sector. Using firm level data for 39 countries, the authors find that firms in countries with larger banking systems extend more trade credit, indicating a complementary effect. However, this positive relationship could also capture a higher willingness of banks to extend credit to firms, which already received trade credit because of the implicit positive signal inherent in trade credit like Biais and Gollier (1997) argue. Looking at firm specific variables, the authors find high ratio of sales to fixed assets to be negatively correlated with trade credit financing. This measure serves as an indicator for a firms capital intensity and firms with a low value may be able to obtain more

long term financing relative to their sales. Hence, those firms do not seem to need trade credit finance as they have sufficient access to other loans. Empirical evidence shows that those firms make use of supplier credit on a smaller portion of their transactions. This gives raise to the thought that trade credit might not only serve as working capital but also as a substitute for longer term financing, maybe through rolling debt over.

Cunat (2007) implements a similar, yet different idea about the provision of trade credit: His argument is based on gains from interacting with a trade partner over a longer time horizon. These gains result from a longer interaction between trading partners, learning by doing, specialized products and so on and are shared between the trading partners. In case of default of the customer, the trading partnership will be suspended and the gains will be lost. This serves as a credible threat that gives trading partner an advantage over banks in enforcing repayment. He further argues that this also gives the supplier an incentive to act as lender in last minute, in case the customer faces a liquidity shock or monetary tightening policies are in force. He then tests these implications on a panel dataset of 55000 UK firms and finds that, consistent with the predictions of his model, young firms' trade credit increases in the first years. This indicates that those firms get more and more trade credit as they develop bonds with trading partners. Furthermore, the empirical analysis shows that firms facing a negative liquidity shock borrow more from their suppliers, consistent with the argument that suppliers have an incentive to act as last resort lender.

In line with Cunat (2007), Gianetti et al. (2011) find in an empirical analysis of US trade credit data that suppliers of differentiated or specialized products supply more trade credit to buyers. They also find that firms receiving Trade credit lend from more banks, cooperate with more distant banks and borrow at lower cost. This gives support for the theory mentioned by Bias and Gollier (1997) about the implicit signal to banks in trade credit provision. Moreover, Gianetti et al. (2011)

find larger firms and firms with many suppliers to be offered more trade credit. The authors suggest this to be due to a market power effect, but one could also argue, that it is the large firms that have many suppliers and hence more signals about their creditworthiness in turn affecting the terms at which they receive bank and trade credit.

In line with the above-mentioned properties of trade credit when it comes to specialized or tailor made input products, Burkart and Ellingsen (2004) present another argument. They argue sellers might lend trade credit to customers even if banks don't, because it is harder to alienate this form of credit. Cash can easily be misused for other purposes whereas, because there is no competitive market for specialized products, liquidizing those is hard. This gives the supplier an advantage over banks, as customer moral hazard is reduced. Furthermore, because of the illiquidity of trade credit, firms have higher returns on investment. Banks will anticipate this and be willing to lend more because it ensures them that their loan is not diverted. So, finally, bank and trade credit become complements in this model. Moreover, their model predicts that suppliers are willing to offer trade credit because they then can get bank credit through accounts receivable serving as self liqudizing collateral.

Trade credit and the inventory channel

A smaller, yet not less important part of the literature focuses on the interaction between inventories and trade credit. Supplier credit is hereby thought to be an incentive for customers to buy and thereby lower the suppliers' inventory as well as his/her cost of holding inventories.

Daripa and Nilsen (2005) develop a model in a market for intermediate products, where the demand for intermediate products is assumed to be stochastic. They find trade credit to be the solution to a negative externality generated by holding inventories. The logic behind this argument is the following: Input factor producing firms face a stochastic demand from their customers which use these raw input factors to produce a final product. The final product producer faces the decision

that he or she can either immediately buy input factors and produce the final product with the risk of having to build up inventories, or, not to buy and potentially loose sales. This tradeoff between holding inventories and lost final sales then generates a negative externality for the input factor seller as he faces this stochastic demand and also carries the risk that he or she has to build inventories and carry the attached costs. The authors now find supplier credit granted from input factor producer, assumed to be at zero interest rate, to act as a subsidy that solves the negative externality he or she faces. This argument also works in the other direction, seeing the final goods producer facing the same externality caused by the intermediate goods producer and then offering cash in advance payments. In this case the cash in advance payment is the subsidy that resolves the externality. This is in line with the general observation that firms use both, cash in advance and supplier credit for mercantile transactions.

Bougheas et al. (2009) take this theoretical idea to the data arguing that firms building up inventories face the classical cost of holding goods in stocks (e.g. warehousing and stockout costs). In their view, offering good terms on trade credit can help firms sell their inventories to financially constrained customers. Firms therefore face a tradeoff between extending trade credit and holding inventories. They show in a theoretical model with stochastic demand for input factors, that accounts receivable increase in output, given that demand is uncertain. To apply this argument to the data, they translate this into an increase in the supply of trade credit to push sales, and to prevent an increase in the stock of inventories to avoid the above described costs. They then test these predictions empirically on a panel dataset of UK manufacturing firms. The findings confirm the model predictions, the stock of inventories has a negative significant influence on accounts receivable, this can be translated in an increase in trade credit granted as the level of inventories increases. Further results indicate that changes in the cost of holding inventories influence accounts

receivable and payable in the expected direction. Important to note is, that here, the tradeoff between trade credit and the cost of holding inventory works through a production channel which in turn, is affected by different other macroeconomic determinants.

Petersen and Rajan (1997) find further empirical evidence that firms might use trade credit to push their sales. Analyzing a panel dataset on small businesses in the US, they find that firms whose sales decrease or profits decline increase their accounts receivable. They also suggest that this could be simply due customers refusing to repay their credit as credible threats aren't effective once a firm is in financial distress as signaled by the lower profits or sales.

Trade credit and financial institutions

Another strain of literature looks at the relationship between the use of trade credit and country level variables, namely a country's level of financial development as well as the effect of country level financial shocks on the use of trade credit and its effects on firms' performances. These authors argue that trade credit could act as a substitute for bank credit if firms face financial restrictions caused by either a crisis, discrimination by banks or weak developed financial institutions.

Fisman and Love (2003) analyze trade credit and trade credit usage empirically from an industry perspective. They aim to find, using cross sectional data on 37 industries in 43 countries, a relationship between a country's financial development, an industry's propensity to use trade credit and industries' growth in value added. The main goal of this study is to find out, whether trade credit could help to alleviate the effect of constrained access to capital within the financial system. The results show that there is actually a positive relationship between a country's financial development, an industry's propensity to use trade credit and an industry's growth in value added. Firms in countries with lower developed financial institutions grow better if they are in an industry with a higher predisposition to make use of trade credit.

Ge, and Qiu (2007) focus their analysis on the Chinese capital market. They use a data set on Chinese state and non-state owned firms to find differences in trade versus bank credit use. In China, non-state owned firms face financial constraints because they get very limited access to bank credit whereas state owned firms do not face this constraint. Nevertheless, the former experience a higher growth than the latter. The question the authors try to answer is, what sources of funding restricted non state owned firms use to finance their growth. To identify a potential trade credit channel, the authors exclude firms with access to international financial markets and stock markets from the sample. Empirically, the authors show, that state owned firms have larger amounts of accounts payable over assets and net accounts payable over assets, even after controlling for other potential determinants. Moreover, the data set allows the authors to distinguish between trade credit repaid prior to expiration and trade credit expired (debt outstanding). Confirming their previous results, they find a large and significant difference between state owned and non-state owned firms. Non state owned firms' debt outstanding in trade credit is almost six times higher than state owned firms'. The picture is reversed for outstanding bank debt. This implies that trade credit is an important source of funding for bank discriminated firms in China and, gives them the opportunity to perform even better than state owned, non-discriminated firms.

McGuinness and Hogan (2016) evaluate the use of trade credit during and after the financial crisis. Using a dataset of Irish small and medium size firms, they test whether during the financial crisis and the aftermath (i) financially stronger firms extend more trade credit to more financially vulnerable firms to compensate a drastic decline in bank credits given to those firms and (ii) trade credit can act as a substitute for bank credit in small and medium sized enterprises. They find that firms entering the crisis with a higher cash availability, therefore more "healthy firms", extend

more trade credit et vice versa. Firms with greater stocks in collateralizable assets and better established bank relationships, proxied by size and age of a firm, also extend more trade credit. Also the time frame in which the repayment of trade credit occurs differs between smaller and larger as well as younger and older firms. While older and larger firms repay faster than before the crisis, the opposite is true for younger and smaller firms. These results indicate a substitution of bank credit against trade credit in small and financially constrained firms in the aftermath of the financial crisis in 2008, but also a redistribution of trade credit from stronger to weaker firms. One can imagine that this effect could also be observed across international borders. While this analysis focuses on a global financial crisis with a broad drying out of capital markets, one idea could be that the substitution and redistribution even works better in an international setting, where only a fraction of countries is affected. International trade credit could therefore lessen the effects on the affected economy.

In contrast to the previous paper, Love et al. (2007) use a more local crisis setting to answer the same questions. They use a dataset on firms in emerging markets in Asia and Mexico and look at the effects of the 1997 Asian crisis and the 1994 Peso devaluation. They find that accounts receivable increase immediately after the crisis whereas accounts payable remain constant. They argue that this could be due to a delay in repayments when the crisis hit. Further analysis shows that firms with a good financial position in terms of lower short term debt and higher liquidity increase their level of trade credit provided, whereas firms with a bad financial position decrease trade credit provided. The findings for accounts receivable, in contrast, are not robust to the measure of financial health. They further find empirical evidence for a supply side explanation of the contraction in overall trade credit granted, countries with a higher contraction in bank credit also experience a stronger decline in accounts receivable. This gives further rise to the idea whether

international trade credit received affects the amount of accounts payable in a crisis time. The Pesos devaluation for example made firms certainly unable to repay their foreign denominated debt. So, firms that have stronger bonds with their foreign suppliers should be able to receive more supplier credit and also for a longer time as the trading partner has an incentive to act as last resort lender (Cunat (2007)).

Trade credit and monetary policy

Closely related to the previous section, another important part of research focuses on the relation between trade credit and monetary policy. Empirical work was able to show how monetary policy affects different sized firms and how the firms affected the most change their balance sheet with regard to accounts payable and accounts receivable.

Kohler et al. (2000) aim to explore a trade credit channel that possibly offsets the classical bank credit channel. For this purpose, they look at the trade credit flows between on 2000 firms publicly traded in the UK combined a panel data set. The authors' main idea is that the publicly traded firms should extend more trade credit to non publicly traded firms in recession periods or periods of monetary tightening. The empirical findings show that, on the one hand, accounts payable increase during recessions and decrease during booms. The picture for accounts receivable is reversed. On the other hand, accounts payable and accounts receivable fall during monetary policy tightening. But, the net effect shows that accounts payable fall by more than accounts receivable, indicating that the publicly traded firms in the sample still extend more trade credit in net terms.

Nilsen (2002) provides empirical evidence for the trade credit channel using a Dataset of US firms published by the Census Bureau. He finds that the accounts payable to sales ratio increases after a shock, for both large and small firms. This result seems kind of puzzling in first place as large firms are assumed to have better access to alternative financing as they have more collateral. However, further analysis sheds light on this issue: Using a different dataset, which distinguishes

between firms with bond rating and firms without bond rating, the authors can show that it is the large firms without bond rating who increase their accounts payable to sales. Moreover, those firms with higher net assets in their balance sheet do not demand more trade credit.

Mateut et al. (2006) seek to identify a relationship between monetary policy tightening and the use of trade credit of small and financially weak firms. Using a Dataset of 16000 in the UK registered firms, the authors find an increase in trade credit relative to short term debt by all firms as result of monetary policy tightening. Also, this effect is more pronounced for small and financially weaker firms. Further findings show an increase in supplier credit to total liabilities for all firms in the sample along with a decline in bank credit to total liabilities. In addition, small firms have a much higher decline in bank credit than larger firms. This implies that monetary policy tightening affects small firms' and financially weak firms by a much greater magnitude than larger and financially strong firms. It also indicates that the former might use trade credit as a substitute for bank lending once this becomes more scarce.

Trade credit in international Trade

A recently growing literature analyzes the role and use of trade credit in international trade. The main focus here is on the three dominantly used payment methods, open account, cash in advance and letter of credit and how firms choose optimally, given differences in financing cost, contract enforceability and financial constraints between the countries.

Hoefele et al. (2013) analyze the optimal contract choice in international trade in a theoretical one shot model with focus on two country specific conditions: contract enforcement and financing cost. They argue that the characteristics of both, source and destination country matter and that the financing of working capital is carried by the party with the lower financing cost and lower contract enforcement, where the lower financing cost is relatively more important. As contract enforcement is more difficult for industries producing more complex and specialized products, for these

industries, better contract enforcement is the main determinant for the contract choice. Empirical findings from a panel data set on enterprise data in developing countries verifiy these predictions. Firms grant less trade credit when exporting to firms in countries with lower contractual enforcement and when financing cost are lower in the source country.

In line with Hoefele et al. (2013), Schmidt-Eisenlohr (2013) focuses his analysis on a firm's optimal trade financing choice. He extends the analysis by one more payment option in international trade transactions, letters of credit. His model predicts in likewise manner, that firms utilize trade contracts to optimally compensate differences in contract enforcement and in financing cost between exporting and importing country. Also, similar with the previously described findings, trade financing is expected to be carried by the trade partner with the lower financing cost and weaker law enforcement environment. Furthermore he shows in an empirical analysis that in cases of strong contract enforcement and low financing cost only the lower net interest rate margin determines the payment contract. The author uses both, the net interest rate margin representing a measure for market efficiency, and financial development as proxy for the external financing cost of trade. These findings gives support to the idea that firms in countries with low developed financial institutions and hence facing financial constraints benefit from international trade with firms in better financially developed countries and less financial constraints.

Ahn (2014) develops a model on the optimal contract choice in international trade taking, in addition to contract enforceability, the development of the accounts receivable financing market into account. This market is characterized by short term lending through banks, factoring and trade credit insurance. He argues that open account terms offered by exporters often have to be backed up by one of these forms of financing. Accounts receivable financing has a special property

because it is self-liquidating and only fails if both, the importing and the exporting party become unable to meet the obligations. He finds that a development in the accounts receivable market in the exporting country improves the efficiency of transactions between importer and exporter and therefore profitability for both, lowering the financing cost under post shipment payment terms. He proposes this channel, through which financial development promotes international trade, as an additional source for comparative advantage in international trade. An empirical analysis of Chile's and Columbia's trade interactions with other countries show, consistent with this hypothesis, that transactions are more likely to occur using post-shipment terms when the exporters country has better developed accounts receivable financing opportunities. The sample shows a high usage of post shipment payment terms (80%-90%) for importers in Chile and Columbia, both countries with low contractual enforcement, when the exporters accounts receivable market is well developed. Moreover, the data reveals that a stronger relationship between trading partners increases the probability that post shipment payment is choosen.

Antras and Foley (2015) present a model on the optimal trade financing decision based on cross country differences in contractual enforcement. The model predicts an intuitive outcome: Trading partners in countries with low quality in institutions optimally choose open account payment if they receive goods and services from abroad, or, cash in advance payment terms if they are exporting abroad. Implementing endogenous external bank trade finance in the model yields an outcome in line with Ahn (2014), namely that the frequency of cash in advance payment of an importer in a country with low contractual enforcement decreases only if domestic banks are more efficient, implying lower financing cost. Expanding this argument for the choice of letter of credit financing yields to the prediction that the strength of institutional development in the choice between cash in advance and letter of credit. On the other hand, the exporter's optimal choice

between these two payment options is predicted to be letter of credit, independent of the cost linked to this financial tool. Testing these theoretical results in an empirical application on a dataset covering the transactions of an US exporter trading frozen and refrigerated eatables with partners in over 140 countries, findings suggest, that in fact, letter of credit is the least used payment method, whereas the use of open account or cash in advance terms is strongly related to institutional development in the importers' country. In countries with weak developed contractual enforcement, banks in the importing country are better able to enforce repayment of credit given for cash in advance payment of trade transactions. Therefore, this appears to be the better term of contract for engaging in international trade in this setting. In addition, as relationships between exporter and importer evolve over time, the importer can overcome the issue of weak contractual enforcement by building a reputation and so use the relationship to acquire capital through open account transactions.

Engemann et al. (2014) extend the previously introduced idea of informational advantages of suppliers over banks to international trade. They develop a model where trade credit sends a signal to banks, which have problems in evaluating the payoff of international transactions. The main difference to previously reviewed models on international trade credit is that the authors develop a model assuming exporters are at the same time importers of intermediate products and therefore twofold engaged in international trade. Similar to the argument in Bias and Gollier (1997) and Gianetti et al. (2011), firms extending trade credit are assumed to send a signal about the product quality to their trading partners and those, in turn, send a signal about their creditworthiness to banks by receiving trade credit. Theoretically, the authors find that trade credit and bank credit act as substitutes and, for financially constrained firms, as complements by reducing risk. Empirically they can confirm these results using a panel dataset of German firms. The signaling effect of

supplier credit is found to be especially strong for financially constrained exporting firms resulting in a positive relationship between trade and bank credit. Those firms have higher accounts payable indicating that they utilize trade credit from their input factor purchases. For financially unconstrained firms, trade credit and bank credit have a negative relationship, indicating the substitutionary relationship between those two sources of finance. Moreover, the empirical analysis shows that exporting firms have less bank credit available. These results indicate the important role of trade credit for a firm's financing in a international setting.

Eck et al. (2012) show, using a cross sectional dataset on German firms, that exporters use trade credit, both receiving cash in advance from their suppliers and granting open account to their customers, more extensively than non-exporters. The effect for importers is less pronounced in receiving trade credit, even lower than for non-importing firms. From these patterns, the authors develop two theoretical models with information asymmetries, one for a financially constrained exporter receiving cash in advance and one for a financially constrained importer receiving trade credit. They then aim to analyze the effect of these payment forms on the intensive and extensive margin of international trade. The model predicts that cash in advance payment promotes financially constrained firms in both, the intensive and the extensive margin. In contrast, trade credit received by importers is only then helpful if it reduces the uncertainty about the type of the trading partner and if it is not too expensive. Testing these predictions empirically shows that receiving cash in advance increases the probability of a firm to export (extensive margin), likewise for financially constrained and unconstrained firms. Moreover these firms have a higher export volume than firms that do not receive cash in advance payments, but here, financial constraints do not seem to play a role. In contrast, receiving supplier credit does not increase the probability of becoming an importer for not financially constrained firms whereas it increases the probability for

financially constrained firms (extensive margin). For the intensive margin, the results equal the previous outcome, receiving supplier credit increases the volume of imports for both, financially constrained and unconstrained firms.

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Chapter II: "The International Trade Credit Channel: Implications for Industry Investment"

Abstract: Trade credit is an important feature of many trade contracts offering buyers a means of financing purchases using credit from suppliers. This paper aims to identify a channel through which international trade credit and international trade affect industry investment. I use an interaction variable approach, first implemented by Rajan and Zingales (1998), where industries are ranked by different propensities to use trade credit according to their industry specific production properties. This ranking is then interacted with measures of aggregate trade credit and trade openness at the country level to examine how industry investment in industries with higher or lower dependence on trade credit responds to the availability of trade credit. The dataset includes 23 manufacturing industries in 20 countries from 1999-2009. Controlling for industry size along with access to and dependence on domestic external finance, I show that industries with a higher propensity to use trade credit benefit from greater international trade credit and greater trade openness in terms of a higher investment share relative to economy-wide investment.

Introduction

Trade credit is an important feature of many trade contracts offering buyers a means of financing purchases using credit from suppliers. Chor and Manova (2011) argue that a tightening of credit leading to a lack of financing is at least partially responsible for the decline in international trade following the global financial crisis in 2008/2009.[1] Short term bank credit, which is an important form of financing working capital, dropped precipitously. Cross-border and domestic short term loans received dropped about 20% between the first quarter and the fourth quarter of 2008 in developing economies, about 40% in the US and 25% in other developed economies (BIS 2010). Consequently, trade credit as an alternative to bank financing has gained interest in the research literature with the idea that that access to trade credit might help international trade to recover. Zlate et al. (2011) and Yang (2011) find empirical evidence that firms relied more on trade credit during the 2008/2009 financial crisis relative to pre-crisis levels. Love et al. 2007 find a redistribution of bank credit from financially stronger to financially weaker firms in times of crisis through a trade credit channel.

Financing choices are important for firms' choices and may be linked to economic growth broadly (Fisman and Love (2003)). I focus on the importance for international trade credit on a firms' investment, utilizing a specification that examples how trade credit dependent industries respond to different levels of trade credit usage across countries. Industry investment share, measured relative to economywide investment, is regressed on interactions between industry trade credit dependence and measures of trade credit usage and measures of trade credit. Trade credit, which is credit extended by suppliers to their buyers, can act as a substitute for bank credit to finance working capital based on two primary payment methods used in intra firm trade, namely

[1]See Bems et al. (2012) for a detailed review of the literature linking the financial crisis to a breakdown in international trade.

cash in advance payments or open account. If firms agree on cash in advance payment, customers finance the working capital by paying the producer before delivery. If firms agree on open account payment, the producer finances the working capital needed in advance and offers the customer payment after delivery is made. Open account terms are mostly such that the customer receives a discount for early payment, otherwise the full amount is due after 30 days upon delivery. In international trade, the payment choices are slightly different. The main options here are cash in advance, open account or letters of credit. Cash in advance and open account work similarly to national transactions, but the timespan between order and delivery in international trade is typically longer due to longer shipping times. Here, if open account is chosen, the payment is often made up to 90 days after delivery. In addition, trading partners can choose letters of credit, a financing form that involves a transaction between a bank in the importer's country and a bank in the exporter's country. The importer's (or buyer's) bank guarantees a payment to the exporter's (or seller's) bank such that the seller's bank is committed to pay the producer whether or not the buyer's bank pays. Thus, the bank in the exporting country takes over the nonpayment risk that the supplier would otherwise face.

While letters of credit were used frequently historically, recent transactions consist of a high fraction of transactions to be financed with cash in advance or open account terms rather than letters of credit. Antras and Foley (2013), for example, report for an exporter of poultry products in the US to more than 140 countries in the world that the main terms used are cash in advance (42.4% of transactions) and open account (41.3% of transactions) whereas letters of credit are only used in 10.7% of transactions. Ahn (2015) finds that post-shipment (i.e. open account) terms account for 90% of total import transactions in Colombia, and 79% of total import transactions in Chile. These findings suggest the importance of supplier credit in international trade. More general

estimates report that open account is used in between 47% (Scotiabank 2007) and 80% (International Chamber of Commerce 2009, 2010) of international transactions.

An important question the literature on trade credit tries to answer is how firms' access to trade credit affects their economic outcomes. The term trade credit here is used equivalently with supplier credit, meaning credit granted to customers as open account. Fisman and Love (2003) find that more trade credit reliant industries have higher growth in value added than less reliant industries in countries with less developed financial institutions. Ge and Qiu (2007) find that private firms, which tend to be discriminated against from access to bank loans in China, grow faster than non-discriminated firms and are able to link this to a higher level of trade credit outstanding in those firms.[2] These findings suggest that access to international trade credit can affect firm performance. However, most of the literature here has focused on trade credit in general without distinguishing cross-border trade credit from within-country trade credit. I focus on international trade credit specifically to ask how access to international trade credit affects firm performance, in particular the amount of investment firms undertake. I also consider other trade policies, such as restricting trade openness, since these could hinder trade credit as a source of finance for firms and therefore lower firm performance. From a policy perspective, trade policies may affect not only the flow of goods and services but also firms' access to an important source of financing.

My contribution to the literature is to identify a potential international trade credit channel that affects industry specific variables, in particular investment in fixed assets. The investment measure I use is the industry investment share, measured as industry investment relative to total investment.

[2] In China, non-state owned firms face financial constraints because they get very limited access to bank credit whereas state owned firms do not face this constraint.

Using an interaction variable approach (similar to Rajan and Zingales (1998) and Fisman and Love (2003)), I explore whether there exists a trade credit channel affecting industry investment. My main hypothesis is that industries that are more reliant on trade credit have a higher investment share in countries with a higher use of international trade credit, indicating that international trade credit acts as an additional important source of financing industry investment. I also examine whether de facto trade openness plays a significant role for trade credit dependent industries. Limited access to bank credit or other sources of finance due to a lack of development of those markets can lead to credit rationing. Thus, I also control for financial development and I interact this measure with industry dependence on external financing. The industry dependence measures for trade credit and external finance dependence are calculated using US data where the US is assumed to have well developed capital markets such that the use of trade credit or external finance represents an optimal choice in equilibrium. The use of US data to calculate the industry dependence measures helps resolve potential endogeneity issues arising in financial analysis and provides an industry ranking that is applied to industries across the country sample.

My findings suggest that access to international trade credit plays a role for a firms' investment decision reflected by a higher relative investment share in more trade credit reliant industries once a country has a higher access to international trade credit. These results are robust with respect to different sensitivity tests and alternative specifications. The results further indicate that there might be a substitutionary relationship between financial development and trade credit regarding industry investment. This result complements a finding by Fisman and Love (2003) who find a substitutionary relationship between trade credit and financial development with respect to industry growth in value added.

The remainder of the paper is structured as followed: Section II establishes an overview of the literature on (i) why trade credit is used in inter firm trade, (ii) the role of trade credit in a financially constrained setting, and (iii) trade credit in international trade. Section III introduces the methodology and the main hypotheses. Section IV highlights the data used with results in Section V. Finally, Section VI concludes and gives some suggestions for further research.

An Overview of the Literature: Theories and Empirics

Trade credit provision

A growing literature addresses the question why suppliers engage in the lending business by offering trade credit to their customers. One part of the literature has focused on the informational structure between consumers and producers. Researchers argue that trade credit serves as a signal for the quality of a product. It is often hard to measure the quality of a product objectively as required for a product quality warranty, especially in sectors with tailor made products. Trade credit here can solve a twofold problem. First, it can serve as a signal about the quality of the product supplied. Second, it makes it easier to return an unsatisfactory product. These arguments also apply for international trade relationships where the delivery time and differences in contractual enforcement might cause additional problems. Lee and Stowe (1993) analyze the role of trade credit as warranty and signal about the product quality, claiming that it is hard for customers to get a refund for low-quality products once the payment is made while returning an unsatisfactory product before payment is relatively easy. They further argue that low-quality producers will offer high discounts on early payments (implicitly high interest rate for supplier credit), hereby sending an implicit signal to their trading partners about their type. Lee and Stowe then study a customer's choice between using the granted trade credit or requesting a product quality warranty. Since redeeming a product quality warranty requires an objective proof of lack of quality, Lee and Stowe show that customers choose trade credit for more specialized products,

e.g. tailor-made products, and warranty contracts for standardized products. Therefore, the choice whether to use supplier credit or not is also determined by the properties of the product traded. These properties tend to vary greatly across industries but less so within industries. In line with the above mentioned properties of trade credit when it comes to specialized or tailor made input products, Burkart and Ellingsen (2004) argue that sellers might extend trade credit to customers even if banks do not, because it is harder to misappropriate this form of credit. Cash can easily be misused for other purposes whereas, because there is no competitive market for specialized products, liquidizing those products is difficult and costly. This gives the supplier an advantage over banks in terms of providing credit since customer moral hazard is reduced.

Another strand of literature argues that suppliers of input factors have an informational advantage over banks by aggregating both the private information they have access to and the information that is available to banks. Bias and Gollier (1997) build a model based on information asymmetries where the trading partner has an informational advantage over the bank by aggregating the bank information and her private information about the supplier. Thus, the supplier has an advantage in deciding whether or not a customers' project in which she is involved will lead to a positive future outcome. Hence, trade credit might be granted even if bank credit is not approved. In turn, receiving trade credit from a trading partner sends a signal about the creditworthiness of the customer to the bank such that the bank might also become more willing to lend. Demirgüç-Kunt and Maksimovic (2001) focus their analysis on the view that banks may be less efficient in gathering information than suppliers, examining the role of trade credit as a complement to bank credit. Their rationale is that, if banks are less efficient in gaining information than trading partners, then it will be more efficient for banks to lend to suppliers who then in turn, will lend it to their customers. This implies that trade credit should be positively related to the

amount of lending in the bank sector. Using firm level data for 39 countries, Demirgüç-Kunt and Maksimovic (2001) show that firms in countries with larger banking systems extend more trade credit, indicating a complementary effect. This positive relationship could also capture a higher willingness of banks to extend credit to firms that already received trade credit because of the implicit positive signal inherent in trade credit, as in Bias and Gollier (1997). Looking at firm specific variables, Demirgüç-Kunt and Maksimovic (2001) find that a high ratio of sales to fixed assets is negatively correlated with trade credit financing. The measure of sales to fixed assets serves as an indicator for a firm's capital intensity and firms with a low value may be able to obtain more long term financing relative to their sales. Hence, those firms with larger relative fixed assets may be not in need of trade credit finance as they have sufficient access to other loans. Empirical evidence in Demirgüç-Kunt and Maksimovic (2001) shows that those firms make use of supplier credit on a smaller portion of their transactions. This gives rise to the thought that trade credit might not only serve as working capital but also as a substitute for longer term financing, perhaps by rolling over debt.

Gianetti et al. (2011) find in an empirical analysis of US trade credit data that suppliers of differentiated or specialized products supply more trade credit to buyers. They also find that firms receiving trade credit borrow more from more banks, cooperate with more distant banks, and borrow at lower cost. This gives support for the theory in Bias and Gollier (1997) that there is an implicit signal to banks in trade credit provision. Moreover, Gianetti et al. (2011) find larger firms and firms with many suppliers to be offered more trade credit. The authors suggest this is due to a market power effect, but one could also argue that it is the large firms that have many suppliers and hence more signals about their creditworthiness. In turn this affects the terms at which they receive bank and trade credit.

Trade credit and financial institutions

Since trade credit is just one way of financing a firms' activities, it is important to also consider firms' access to other sources of financing, which may be related to the size of domestic financial markets. In particular, trade credit could act as a substitute for bank credit if firms face financial restrictions, Fisman and Love (2003) address the question of how an industry's propensity to use trade credit and a country's level of financial development affect industry performance. The main goal of their study is to explore whether trade credit helps alleviate the effect of constrained access to capital within the financial system. Their results show that there is a positive relationship between a country's financial development interacted with the industry's propensity to use trade credit and the industry's growth in value added. Firms in countries with less developed financial institutions grow faster if they are in an industry with a higher predisposition to make use of trade credit, indicating a substitutability between access to trade credit and financial development.

McGuinness and Hogan (2016) evaluate the use of trade credit during and after the most recent financial crisis. Using a dataset of Irish small and medium size firms, they test (i) whether financially stronger firms extend more trade credit to more financially vulnerable firms to compensate a drastic decline in bank credit given to those firms and, (ii) whether trade credit can act as a substitute for bank credit in small and medium sized enterprises. They find that firms entering the crisis with a higher cash availability, described as "healthy firms", extend more trade credit, relative to those with less cash available. Firms with greater stocks of collateralizable assets and better established bank relationships also extend more trade credit. McGuinness and Hogan (2016) also show that the time frame in which the repayment of trade credit occurs differs between smaller and larger firms as well as between younger and older firms. While older and larger firms repay faster than before the crisis, the opposite is true for younger and smaller firms, which are in general suggested to have limited access to external finance. These results indicate a substitution

of bank credit for trade credit in small and financially constrained firms in the aftermath of the financial crisis in 2008, but also a redistribution of trade credit from stronger to weaker firms.

In contrast to the previous paper, Love et al. (2007) use a more local crisis setting to answer the same questions. They use a dataset on firms in emerging markets in Asia and Mexico and look at the effects of the 1997 Asian crisis and the 1994 Peso devaluation. They find that accounts receivable, which is trade credit granted, increase immediately after the crisis whereas accounts payable, which is trade credit outstanding, remain constant. They argue that this could be due to a delay in repayments when the crisis hit. While accounts receivable fall after the crisis below the pre-crisis level, interestingly accounts payable increase. Further analysis shows that firms with a good financial position in terms of lower short term debt and higher liquidity increase their level of accounts receivable, whereas firms with a bad financial position decrease their level of accounts receivable. The findings for accounts payable, in contrast, are not robust to the measure of financial health, indicating that there is no evidence for a lower use in trade credit for firms with a better financial position. Love et al. (2007) further provide empirical evidence for a supply side explanation of the contraction in overall trade credit granted. Countries with a higher contraction in bank credit also experience a stronger decline in accounts receivable i.e. trade credit provided.

Trade credit in international Trade

While trade credit is used for trade within countries, it may play an even more important role for international trade. The main focus in the existing literature is on the three dominantly used payment methods, namely open account, cash in advance, and letters of credit, and how firms choose optimally, given differences in financing cost, contract enforceability and financial constraints across countries. Hoefele et al. (2013) analyze the optimal contract choice in international trade in a theoretical one shot model with a focus on two country specific conditions: contract enforcement and financing cost. They argue that the characteristics of both the source and

the destination country matter and that the financing of working capital is carried by the party with the lower financing cost and lower contract enforcement, where the lower financing cost is relatively more important. As contract enforcement is more difficult for industries producing more complex and specialized products, for these industries, better contract enforcement is the main determinant for the contract choice. Specialized products require a more complicated contract setting as the objective proof of quality is harder than for standardized products. Hoefele et al. (2013) use a panel data set on enterprise data in developing countries to verify these predictions. Firms grant less trade credit when exporting to firms in countries with lower contractual enforcement and when financing cost are lower in the source country. Extending the model for letters of credit as an additional payment method, Schmidt-Eisenlohr (2013) shows in an empirical analysis of 150 countries that in cases of strong contract enforcement and low financing cost only the lower net interest rate margin determines the payment contract. He uses the net interest rate margin to represent a market efficiency, and financial development as a proxy for the external financing cost of trade. His findings suggest that firms in countries with less developed financial institutions, and hence facing financial constraints, benefit from international trade with firms in better financially developed countries with less financial constraints.

Ahn (2014) develops a model on the optimal contract choice in international trade. In addition to contract enforceability, he takes into account the development of the accounts receivable financing market. This market is characterized by short term lending through banks, factoring, and trade credit insurance. He argues that open account terms offered by exporters often have to be backed up by one of these forms of financing. Accounts receivable financing has a special property because it is self-liquidating and only fails if both the importing and the exporting party become unable to meet the obligations. He finds that development in the accounts receivable market in the

exporting country improves the efficiency of transactions between importer and exporter and therefore profitability for both, lowering the financing cost under post-shipment payment terms. He proposes this channel, through which financial development promotes international trade, as an additional source for comparative advantage in international trade. An empirical analysis of Chile's and Columbia's trade interactions with other countries shows, consistent with this hypothesis, that transactions are more likely to occur using post-shipment terms when the exporter's country has better developed accounts receivable financing opportunities. The sample shows a high usage of post shipment payment terms (80% - 90%) for importers in Chile and Columbia, both of which are countries with low contractual enforcement, when the exporter's accounts receivable market is well developed. Moreover, the data reveal that a stronger relationship between trading partners increases the probability that post-shipment payment is chosen.

Engemann et al. (2014) extend the previously introduced idea of informational advantages of suppliers over banks to international trade. They develop a model where trade credit sends a signal to banks, which have problems in evaluating the payoff of international transactions. Similar to the argument in Bias and Gollier (1997) and Gianetti et al. (2011), firms extending trade credit are assumed to send a signal about the product quality to their trading partners and those, in turn, send a signal about their creditworthiness to banks by receiving trade credit. Theoretically, the authors show that trade credit and bank credit act as substitutes and, for financially constrained firms, as complements by reducing risk. Empirically, they confirm these results using a panel dataset of German firms. The signaling effect of supplier credit is found to be especially strong for financially constrained exporting firms, resulting in a positive relationship between trade and bank credit. Those firms have higher accounts payable indicating that they utilize trade credit obtained from

their input factor purchases. For financially unconstrained firms, trade credit and bank credit have a negative relationship, indicating the substitutionary relationship between those two sources of finance. Moreover, the empirical analysis shows that exporting firms in this dataset have less bank credit available. These results indicate the important role of trade credit for firms' financing in an international setting.

These models and empirical findings taken together lay the groundwork that trade credit plays an important role in inter-firm transactions in both national and international settings. Further, there is an indication that trade credit serves as an additional source of financing for firms. The financing aspect appears to be more pronounced for financially constrained firms and for firms in industries with a higher propensity to use trade credit. Furthermore, obtaining trade credit is dependent on the products traded and varies more across industries than within industries. I utilize these ideas to generate my main hypothesis, which is presented in the next section.

Hypothesis and Approach

The main purpose of this paper is to identify a potential channel through which international trade credit affects industry investment. The idea is to show whether the conclusions of theoretical models and the empirical findings on national inter-firm credit can also be applied to international trade credit. As outlined in the literature section, supplier credit is shown to act as a substitute for access to bank credit in countries with a lack of development in financial institutions. It has been shown that open account terms play a significant role in international trade transactions due to the time lag between order and delivery, differences in financing cost (Hoefele et al. (2013)), for product quality assurance reasons (Engemann et al. (2014)) or due to a lack in institutional development (Schmidt-Eisenlohr (2013)), implying that a large fraction of internationally traded goods inherit some kind of mercantile credit. Given these findings, international trade credit is likely to affect industry investment because, just like national mercantile credit, it gives firms

access to another financing source besides bank credit. Trade credit can be used to finance working capital needed for transactions or it can be used to roll over short term debt. Eck et al. (2012) argue that some firms would not be able to engage in international trade if they did not have access to trade credit. Hence, firms would produce for a smaller market and invest less. Moreover, the World Bank reports in a worldwide survey that 4.8 % of purchases in fixed capital and 10.9 % of working capital are financed by supplier credit.[3] These arguments support the intuition that access to international trade credit should have a positive effect on a firm's capital investment by providing additional finance. Moreover, this effect should be more pronounced for firms in industries that have a higher propensity to use trade credit or are in countries with lower financial development.

To test the hypothesis of an influence of international trade credit on firms' investment in fixed assets, I use an approach first implemented by Rajan and Zingales (1998). The authors make use of across industry variation in external finance dependence to link cross country varying variables to industry growth. Fisman and Love (2003) use the same approach but focus on the impact of trade credit dependence on industry growth. In cross sectional analysis using the compound growth in value added over 10 years as the dependent variable, they find that more trade credit dependent industries have higher industry growth in countries with lower financial development relative to countries with higher financial development. In contrast to their approach, I use a panel data set and focus on the effect of international trade credit on industry investment in more trade credit dependent industries. A related paper by Carlin and Meyer (2003) reports the effect of a country's financial structure interacted with industry dependence on different forms of external finance on growth in value added and on R&D expenditure and fixed investment, both as ratios to value added. They estimate 3 separate cross sectional models using the growth in value added over 25 years,

[3] Enterprise Surveys (http://www.enterprisesurveys.org), The World Bank. A survey conducted by contractors for the World Bank, answered by business owners and top managers.

the average of fixed investment over 20 years, and R&D investment over 20 years. The country and industry specific factors affect an industry's average R&D expenditures and the growth in value added, but not the average fixed investment share. I utilize a similar approach but focus on industry investment relative to total investment and examine how trade credit and trade openness affect this investment share. As I seek to identify an additional source of financing investment in industries more reliant on trade credit, the goal is to identify whether net investment increases relative to the total economy's net investment in those industries once they have more access to international trade credit.

Interacting a trade credit dependence measure and an external finance dependence measure (both obtained from Fisman and Love (2003)) with international trade credit and financial development, I estimate the following regression equation:

$$
\begin{aligned}
FI_{c,i,t} = {} & \beta_0 + \beta_1\left(Industry\ size_{c,i,t}\right) + \beta_2\left(international\ trade\ credit_{c,t}\right) \\
& + \beta_3\left(financial\ development_{c,t}\right) \\
& + \beta_4\left(trade\ credit\ dependence_i * international\ trade\ credit_{c,t}\right) \\
& + \beta_5\left(external\ finance\ dependence_i * international\ trade\ credit_{c,t}\right) \\
& + \beta_6\left(trade\ credit\ dependence_i * financial\ market\ development_{c,t}\right) \\
& + \beta_7(external\ finance\ dependence_i * financial\ market\ development_{c,t}) + \gamma_c \\
& + \gamma_i + \gamma_t + \varepsilon_{c,i,t}
\end{aligned}
\tag{1}
$$

where c is the country, i the industry and t the year index. FI is industry investment relative to total investment and varies by country, industry and time. Following the argument in Rajan and Zingales (1998), the inter action terms give estimates for the within country differences across industries. The primary explanatory variables are trade credit dependence, measured as an industry feature using U.S. data, and international trade credit, measured across countries. I also control for

external finance dependence, the propensity of an industry to rely on external finance and domestic financial development. γ_c and γ_i are country and industry specific effects to control for unobservable industry and country specific factors influencing an industry's investment. γ_t are year specific dummies to control for effects that influence countries and industries the same way (e.g. a global crisis or global interest rate changes). The regressions are estimated using robust standard errors to account for heteroskedasticity in the error terms, which is, as tested following Breusch and Pagan (1979), present in all specifications.[4]

The specification in equation (1) asks whether firms in industries that are more reliant on trade credit invest more in fixed assets for a higher aggregate level of international trade credit. This is designed to capture an international trade credit channel that could work through the same channels that are described in the literature section. As a signal to banks, trade credit could lead to higher lending from banks, hereby loosening credit constraints, or it could be used to finance working capital or roll over debt directly. This idea is captured in the interaction term between trade credit and trade credit dependence. A positive sign for β_4 is expected since those industries that depend more on trade credit are likely to benefit from access to trade credit.

The interaction between the industry external finance dependence measure and the trade credit variable may also help explain the investment share. A positive sign for β_5 is expected since trade credit provides a form of external finance that may be utilized by firms needing external finance.

Furthermore, I include an interaction of both external finance dependence and trade credit dependence with financial development in Equation 1 to control for the potential explanatory value of those variables. Fisman and Love (2003) test the influence of financial development (interacted with trade credit dependence) on growth in value added and find a negative relationship for growth

[4] Huber (1967); White (1980).

in value added. Their finding indicates that industries with a higher propensity to use trade credit in countries with less developed financial institutions outperform industries with a higher propensity to use trade credit in countries with more developed financial institutions in terms of growth in value added. If their findings also hold for investment, the interaction term between the financial development measure and the trade credit dependence measure is expected to be negative. Moreover, I include a measure for industry size as previous literature suggests that it is important to control for the size when analyzing any kind of industry outcome variables.[5] The basic idea here is to control for industry characteristics that differ across industries. The prediction for investment share is that larger industries' investment share is higher as those may have an advantage over smaller firms.

Data description

Industry level data

I use Data for 23 manufacturing industries in 20 countries from 1999-2009. The range of data is restricted by OECD data availability. The OECD stopped reporting the investment shares in 2009 and switched to a different classification system. Further, the country coverage before 1999 is limited, therefore 1999 is chosen as a cutoff point. The industry level data on investment and output is drawn from the OECD Stan Database and varies by industry, country, and time. The dependent variable of interest is the industry investment share, calculated as industry investment relative to total investment in the economy. This indicator represents the investment composition in the economy. If an industry's investment share increases it can be translated into an increase in

[5]See for example Carlin and Meyer (2003) for regressions on growth in value added or Maskus et al. (2012) for regressions on R&D intensity.

investment in tangible assets in this industry relative to investment in tangible assets economy-wide.

The industry characteristics, trade credit dependence and external finance dependence, are taken from Fisman and Love (2003). The measure for an industry's propensity to use trade credit is based on Compustat data that includes US firms in 37 manufacturing industries. I use the industry ranking by trade credit dependence as reported in their paper. They calculate the measure using the ratio of accounts payable, which is trade credit outstanding and equivalent to the term trade credit throughout the paper, to total assets for each firm in 1980, then take the median of all firm observations in 1980 for each industry as their final measure of this industry characteristic. I use this measure to characterize the propensity of each specific industry to use trade credit, which is then interacted with country-level measures of trade credit or trade openness. Fisman and Love (2003) argue, in line with Rajan and Zingales (1998), that a dependency measure calculated from US data is the appropriate variable to use as the United States represents the "optimal capital market" and therefore firms' decisions on trade credit or external finance are likely to represent the desired level of trade credit or external finance. Further literature suggests that the propensity to use trade credit is related to several industry specific characteristics. As described in the literature review, properties of certain goods increase the regularity to use trade credit as a warranty for the quality or signal for the quality.[6] These properties do vary less within industries than across industries. Ng et al. (1999) provide empirical evidence for little variation in credit terms within industries but wide variation across industries drawn from a dataset on US firms. Using these arguments, I use this measure as a proxy for an industry's natural level of trade credit usage, excluding the United States from the sample. Importantly, it is the ranking of industries by this

[6]See for example Lee and Stowe (1993). Cunat (2007) and Engemann et al. (2014) extend the idea to international trade.

measure that matters, rather than the actual value of the measure. To compare my results to previous literature and to show whether my proposed interactions provide additional explanatory value, I also use the external finance dependence measure as reported in Fisman and Love (2003). A similar measure was first used by Rajan and Zingales (1999) and represents the portion of assets externally financed. It is calculated using the same US data as the trade credit dependence measure. External finance dependence is calculated as total assets minus retained earnings as a ratio to total assets for each firm in 1980. The industry median in 1980 for each industry is used as the industry characteristic. Like the trade credit dependence measure, I interact the external finance dependence measure with the country-level variables of interest (in this case domestic financial development and aggregate international trade credit).

Table 1 shows these two industry measures for the included industries, ranked by the trade credit measure.

Table 2 1: Trade credit dependence (Apay/Ta) and external finance dependence (EXTFIN)

ISIC3.1	Industry	Apay/Ta 1980[c]	EXTFIN 1980[c]
3400	Motor vehicles, trailers and semi-trailers	0.112	0.75
1800	Wearing apparel, dressing and dyeing of fur	0.111	0.66
3435	Transport equipment	0.105	0.71
1500	Food products and beverages	0.1015	0.665
1700	Textiles	0.101	0.68
3510	Building and repairing of ships and boats	0.101	0.83
2500	Rubber and plastics products	0.099	0.8
2300	Coke, refined petroleum products and nuclear fuel	0.096	0.65
2713	Iron and steel	0.094	0.72
2000	Wood and products of wood and cork	0.088	0.75
2800	Fabricated metal products, except machinery and equipment	0.088	0.71
2900	Machinery and equipment, n.e.c.	0.086	0.73
2600	Other non-metallic mineral products	0.0845	0.6775
2401	Chemicals excluding pharmaceuticals	0.083	0.68
3000	Office, accounting and computing machinery	0.083	0.89
3100	Electrical machinery and apparatus, n.e.c.	0.082	0.8
2100	Pulp, paper and paper products	0.081	0.67
2723	Non-ferrous metals	0.078	0.73
3200	Radio, television and communication equipment	0.076	0.83
2200	Printing and publishing	0.075	0.64
1900	Leather, leather products and footwear	0.074	0.615
1600	Tobacco products	0.066	0.63
2423	Pharmaceuticals	0.055	0.94

c: calculated for each firm in each industry in 1980, median median of all firm observations in 1980.
Source: Fisman and Love (2003).

To match the industry level data on investment, I used the equivalence Table provided by the United Nations statistics division to match the ISIC revision 2 codes to ISIC revision 3.1. Due to changes in reporting, some industries had to be aggregated and averaged such that the number of industries shrinks from 36 to 23 industries. Take industry food and beverages, number 1500 in ISIC revision 3.1, as an example. In ISIC revision 2, food and beverages were reported separately. To match this with ISIC revision 3.1, both dependence measures were averaged over the two separated industries in ISIC revision 2. This did not change the order such that a "high" dependent industry in ISIC revision 2 became a "low" dependent industry in ISIC revision 3.1.

Industry 1900 (leather products) is in the 10th percentile of the trade credit dependency distribution with a dependency of 7.4% (of total assets); Industry 3435 (transport equipment) is in the 90th percentile with a trade credit dependency of 10.5%. This fits in the previously outlined theories of trade credit usage. While the leather producing industry uses relatively qualitatively homogenous products in production, manufacturing of transport equipment which includes for example manufacture of disabled transportation and manufacture of hand-propelled vehicles often requires relatively specialized input factors. Following Lee and Stowe (1993), trade credit can serve as a quality signal and a warranty assurance for specialized or tailor made products. This explains why manufacturing of transport equipment has a higher value in this ranking.

Previous literature suggests that it is important to control for industry size when analyzing any kind of industry outcome variables.[7] The prediction here is that larger industries will have a higher investment share as larger industries may have an advantage over smaller industries. I include two different measures for industry size, namely gross industry output as a ratio to gross domestic product and the gross industry output as a ratio to gross aggregate industry output. I then choose the appropriate measure using the Bayesian and the Akaike Information criterion.[8] According to both criteria, industry output as a fraction of output by all industries is the better measure to control for industry size in all specifications. Both measures provide similar results in the regression analysis.

Country level Data

The main country variables of interest are aggregate international trade credit used by all firms in a country, de facto trade openness, and a country's level of financial development.

[7]See for example Carlin and Meyer (2003) for regressions on growth in value added and Maskus et al. (2012) for regressions on R&D intensity.
[8]Akaike (1974); Schwarz (1978).

Equation (1) above focuses on international trade credit. The measure used here is solely international trade credit and differs from previous papers that use aggregate trade credit, which might be domestic or international credit granted by suppliers. The measure for international trade credit is from the IMF balance of payments statistics and represents the aggregate of trade credit liabilities used by both the private sector and the government within a year. Trade credit liabilities are of interest as my goal is to see whether trade credit can act as a substitute or complement for bank credit availability as measured by financial development. As my goal is to examine private investment by firms, trade credit liabilities in the private sector would be a preferred measure. However, the data coverage for trade credit liabilities in the private sector is very limited. For those that do exist, the individual numbers show that there are rarely any differences between the private sector and the private sector plus government. Moreover, the correlation is close to one as will be shown in the data section. In the regression equation, I use international trade credit as a percentage of GDP to account for a country's size.

A second specification in the robustness tests focuses on trade openness as an alternative to international trade credit. De facto trade openness is, in line with the literature, calculated as exports plus imports as a ratio to GDP.[9] The reason for utilizing de facto trade openness rather than a de jure measure is that the actual real flows in goods and services are what matters for this question, rather than the legal allowance or governments' intent. The actual flow in goods and services gives a closer approximation to the trade credit available to a firm. Supplier credit can only be granted if an actual inflow of goods occurs. Therefore, to test whether trade openness helps industries that are more trade credit dependent requires the actual flow. The raw data on exports,

[9] See for example Aizenman (2008) who analyzes the link between de facto trade openness and de facto financial openness.

imports and GDP are drawn from World Bank national accounts data and OECD national accounts data.

While focusing on the trade measures, I also include measures for domestic financial development to account for the availability of financing at the domestic level.[10] The primary measure I use is the ratio of private credit by deposit money banks to GDP. I also consider stock market capitalization as an alternative measure of domestic financial development and the ratio of private credit by deposit money banks and other financial institutions to GDP. The private credit measures represent a firm's access to bank financing while stock market capitalization represents a firm's access to stock market financing. The main measure used here is private credit by deposit money banks to GDP as stock market financing always requires firms to be publicly traded. The data are drawn from the financial development and structure dataset published by Beck et al. (2000) and updated by Čihák et al. (2012).

Descriptive Statistics

The data set used in the analysis comprises observations on the above described measures for 23 manufacturing industries in 20 countries from 1999 to 2009.[11] Table 2 presents some descriptive statistics.

[10]Similar measures are used by Maskus et al. (2012) who show the relationship of financial development to R&D.
[11] namely Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom.

Table 2 2: Descriptive Statistics

Variable	Mean	Standard deviation	Minimum	Maximum	25th percentile	50th percentile	75th percentile	Number of obs.
Investment share[a]	.732%	.947	-.283%	14.503%	.147%	.442%	.959%	4260
Private credit by deposit banks/GDP[b]	84.31	42.346	22.911	209.780	43.232	85.969	115.051	264
Stock market Capitalization[b]	68.501	47.784	3.349	246.050	28.115	58.374	101.753	275
De facto trade openness[b]	.956	.511	.447	3.484	.5503	.790	1.153	276
Trade credit/GDP[b]	2.616%	2.763%	0.0000006%	13.467%	.483%	1.870%	3.543%	254
Industry output fraction[a]	.014	.015	.00001	.091	.004	.010	.018	5383

a: calculated across all industries, countries and time.
b: calculated across all countries and time.

Table 3 provides a correlation analysis between the industry specific characteristics and the main country specific variables.

Table 2 3: Correlation analysis

	Investment share	Trade openness	Trade credit	External Finance dependence	Private credit by deposit banks/GDP
Investment share	1	0.0504	0.1299	-0.044	-0.251
Trade credit dependence	0.238	0.022	0.024	-0.193	-0.005
External Finance dependence	-0.044	-0.012	-0.008	1	0.003

The correlation analysis shows that an industry's investment share is positively related to trade credit and to trade openness while it is negatively related to private credit. Aggregate trade credit and international trade openness are both negatively related to the measure of external finance dependence but positively related to the measure of trade credit dependence. The trade credit

dependence measure and external finance dependence measure are negatively correlated. Thus, these industry measures are picking up different industry characteristics. The industry's investment share is negatively related to external finance dependence but positively to trade credit dependence.

In terms of country level variables, I consider both aggregate trade credit and trade openness as measures indicating access to international credit through trade channels. These two country variables are positively correlated with a correlation (across all countries and time in the sample) of 0.69. As described in the previous section, the international trade credit measure used includes aggregate liabilities of both the government and the private sector. There is a measure for trade credit limited to the private sector, but using this shrinks the trade credit observations from 190 to 104 observations and the overall sample size from 3736 to 1976 observations covering only 12 countries. Comparing the two measures for different country year observations shows that the numbers are quite similar for those reported separately. The correlation between the measures limited to the private sector and the measure including both is 0.999. While industry investment is positively related to trade credit dependence and to trade credit usage, the correlations are less than 0.5. What may matter, however, is how the trade credit dependence interacted with aggregate trade credit or trade openness affects the industry investment share.

Results

Main findings

Table 4 shows the results from Equation (1) using a pooled ordinary least squares regression of industry investment share on the interaction terms with international trade credit, the main measure through which the international trade credit channel is suggested to work. The coefficient on the interaction between trade credit dependence and aggregate trade credit (β_4) is positive and statistically significant in all 6 columns in Table 4. This provides confirmation of the stated

hypothesis that industries with a higher propensity to use trade credit benefit from the availability of trade credit at the aggregate level. Including the interaction term between external finance dependence and international trade credit, β_5, (columns (2), (4), and (6)) does not add any explanatory power to the model and the interaction term is insignificant in all specifications. Adding the interaction term between trade credit dependence and financial development β_6, (columns (3)-(6)) improves the model and lowers the coefficient on the interaction between trade credit dependence and international trade credit. The coefficient on the additional interaction term (between trade credit dependence and financial development) is significant and negative, which is similar to the finding in Fisman and Love (2003) for their regressions on the industry growth in value added.[12] Here, industries that are more reliant on trade credit do not benefit from financial development in terms of investment. In other words, more trade credit dependent industries have higher investment shares in countries with lower financial development relative to countries with higher financial development, perhaps indicating that trade credit substitutes for other forms of credit.

The implemented model selection criteria both indicate that column (3) is the best fitted model. Thus, I focus on the coefficients from this specification noting however the similarity across all 6 columns. The coefficient on the interaction term between trade credit dependence and international trade credit in specification (3) is equal to 0.966. The magnitude of this coefficient can be interpreted in the following way:[13] An industry with the average trade credit dependence of 0.088 benefits from an increase in the inflow of international trade credit by 1 standard deviation (0.027)

[12]Testing a specification similar to Fisman and Love (2003) for investment share by regressing financial development interacted with external finance dependence and trade credit dependence on the investment share rather than growth in value added yields similar signs to Fisman and Love (2003) for my coefficients. The interaction term with external finance dependence is significant and positive, the interaction term with trade credit dependence is significant and negative. These results imply that trade credit dependent industries have a higher investment share in countries with a lower financial development whereas the opposite is true for industries with a higher dependence on external finance.

[13] see for example Hu and Png (2013) who analyze the effect of patent rights on economic growth.

(or approximately increasing trade credit from the level of the Netherlands in 2005 to the level of the Slovak Republic in 2005) by an increase of the investment share by 0.966*0.088*0.027=0.23% points. Compared to the average investment share over all countries in 2005, which is 0.749%, this effect is also economically significant.

Overall, the positive significant coefficient on the primary interaction term (β_4) implies that international trade credit plays a role for the investment decision of trade credit dependent industries. Being located in a country that has a higher share of trade credit liabilities in the Balance of Payments statistics within a year gives trade credit dependent industries an advantage with respect to investment in fixed assets. While trade credit dependent industries invest less where financial development is higher, as indicated by the negative sign on the interaction term, they invest more in countries with higher levels of international trade credit. The findings on these two interaction terms are suggestive that the availability of trade credit substitutes for domestic financial development. Industries that are more trade-credit dependent invest more when trade credit is higher. Also, from the same specification, more trade credit dependent industries invest more in countries with lower financial development. The coefficient on industry output is positive and significant in all 6 columns implying that industries with a higher relative output invest more.

Table 2 4: Equation (1): Benchmark Results

Pooled OLS regression of Investment share on international trade credit interacted with external finance dependence and trade credit dependence and financial development interacted with external finance dependence and trade credit dependence.

	(1)	(2)	(3)	(4)	(5)	(6)
Industry output	.528***	.480***	.470***	.470***	.471***	.471***
	(.021)	(.020)	(.020)	(.020)	(.020)	(.020)
Trade credit	-.129***	-.121**	-.080**	-.086*	-.079**	-.095*
	(.034)	(.047)	(.031)	(.044)	(.031)	(.042)
Financial development			.011***	.011***	.009***	.009***
			(.001)	(.001)	(.002)	(.002)
Trade credit*Trade credit dependence	1.530***	1.520***	.966**	.973***	.958**	.976***
	(.410)	(.416)	(.373)	(.378)	(.375)	(.378)
Trade credit*external finance dependence		-.010		.008		.020
		(.036)		(.036)		(.035044)
Financial development*Trade credit dependence			-.121***	-.122***	-.119***	-.119***
			(.015)	(.015)	(.016)	(.016)
Financial development*External finance dependence					.002	.020
					(.002)	(.035)
Number of observations	3687	3687	3687	3687	3687	3687
F-test	170.12***	168.60***	168.50***	173.98***	171.97***	171.46***
R^2	0.697	0.697	0.698	0.702	0.702	0.702
Root mean squared error	.528	.528	.527	.524	.524	.524
Bayesian Information Criterion	6147.321	6155.479	6104.763	6112.942	6112.257	6120.264
Akaike Information Citerion	5805.629	5807.575	5750.647	5752.613	5751.928	5753.723
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Endogeneity

In this section, I address concerns about potential endogeneity between the country level variables and the industry investment shares.

First, one could argue that external finance dependence and trade credit dependence might be influenced by the investment level of an Industry. Industries with a higher investment might use more external finance and trade credit. The external finance dependence and the trade credit reliance measures are calculated using US data in 1980 and do not vary across time or countries. Therefore, I argue in line with Fisman and Love (2003) and Rajan and Zingales (1998) that endogeneity is not of concern here. If trade credit dependence were calculated for each country, it would be possible to capture the underlying needs for trade credit in each industry because the use of trade credit was already influenced by a variable of interest, financial development. Here, however, the trade credit dependence measure indicates an equilibrium value that comes from the underlying characteristics of the industry. Thus, there is little reason to believe that it is endogenously determined by industry investment shares. I follow the previous literature and drop the US from the sample.

Second, one might be worried that countries with greater investment increase the demand for domestic financial development and trade credit. The use of industry level data for investment shares should mitigate this since it is unlikely that higher industry investment relative to total investment will drive the country-level financial development and trade credit variables. To explore this further, however, I use an instrumental variables approach to examine the exogeneity of the country-level variables. Previous literature has used the origin of the legal system as an instrument for financial development.[14] In contrast to these authors who use a cross sectional data

[14] Carlin and Meyer (2003); Rajan and Zingales (1998).

set, I use a panel data set in my analysis, which allows me to estimate a pooled two stage least square model with lagged exogenous variables as instruments. Shea's (1997) adjusted R^2 indicates that the fifth and sixth lag of the financial development is a strong instrument for financial development. Validity is confirmed by Sargan's test for overidentification. The same approach is used for the international trade credit variable. Also, here, Shea's R^2 indicates that the fifth and the sixth lag of international trade credit are strong instruments for current international trade credit, and Sargan's overidentification test confirms the validity of the instruments. Therefore, I use two stage least squares with the fifth and sixth lag of financial development to instrument for current financial development as well as the fifth and sixth lag of international trade credit to GDP to instrument for current trade credit to GDP. I then test the two specifications for endogeneity in each of the variables. As I am using heteroskedasticity adjusted robust errors, the appropriate statistic is Wooldridge's (1995) robust score Chi squared and a robust regression F-test. The test for exogeneity proceeds in two steps: in the first step, the instruments are regressed on the potential endogenous variable and the residuals are obtained. In the second step, the residuals are included in the original model and the model is estimated. If the coefficient on the residual is insignificant, then the potential endogenous variable is exogenous because there is no correlation between the endogenous regressor and the error term. As the instrument is uncorrelated with the error term in the first step, the only way through which the potential endogenous variable could be correlated with the error term in the second step is through the error term in the first step. Hence, if this coefficient is insignificant in step 2, the potential endogenous variable can be treated as exogenous.

Table 5 reports the results from the two stage least square regressions using the main interaction terms for each instrumented variable. As two stage least squares estimators suffers from a loss in efficiency, Wooldridge's robust score Chi squared and robust F- test statistics is reported to test

for endogeneity. The null hypothesis of exogeneity of financial development, and trade credit cannot be rejected, therefore the variable can be treated as exogenous.

Table 2 5: Endogeneity test

Two stage least square regressions of investment share on financial development and trade credit instrumented by its 5th and 6th lag[15] and interacted with external finance dependence and trade credit dependence.

Industry output	.502*** (.015)	Industry output	0.500*** (.01)
Trade credit	-.337 (.037)	Financial development	-.016* (.003)
Trade credit* Trade credit dependence	3.714*** (.603)	Financial development*Trade credit dependence	-.110** (.015)
Trade credit* External finance dependence	.086 (.030)	Financial development*External finance dependence	.0004 (.002)
Number of observations	3002	Number of observations	3002
Sargan chi2	.113	Sargan chi2	.464
R^2	0.621	R^2	0.626
Root mean squared error	.586	Root mean squared error	.582
Robust score Chi squared	3.207 (p = 0.361)	Robust score Chi squared	1.574 (p = 0.21)
Robust F-test	1.074 (p = 0.359)	Robust F-test	1.572 (p = 0.21)
Fixed effects	Country, Industry, Year	Fixed effects	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level. Wooldridge's Robust score Chi squared and Robust F-test: Ho: variables are exogenous.

Clustering the standard errors

In this section, I examine the sensitivity of the benchmark regression result to the specification chosen. One issue is whether and how the standard errors should be clustered. Potential correlation of observations within a group can lead to overestimated standard errors and hence an over-rejection of the null hypothesis that the coefficients of interest are actually statistically significantly

[15] Sargan's (1958) test for over identification was applied to test the validity of the instruments. One concern is that the test might be biased if the instruments are autocorrelated with the potential endogenous regressor. I therefore use the 5th and the 6th lag as instrument to avoid this potential bias. The results hold for higher order lags, for example the 7th and 8th lag.

different from zero. While Table 5 includes robust standard errors, some previous literature suggests clustering the errors to ensure correct statistical inference.[16] A question arising when considering clustering the errors in a multi-dimensional panel data set concerns the correct level of clustering. I address this question with a one-way ANOVA (Analysis of Variance) of the variables of interest, namely the country level ratio of trade credit to GDP and the country-industry investment share. This analysis also reveals interesting results with respect to source of variation in the dataset.

The results of the ANOVA of the ratio of trade credit to GDP shows that

(1) There is intra-class correlation on the country level but almost no intra-class correlation on the year level

(2) The sum of squares are higher across countries than within countries, indicating the variation in trade credit has its source from across-country rather than within-country variation.

The results for the ANOVA of the investment-share shows that

(1) There is intra-class correlation on both the country and country-industry level but the intra-class correlation on the country-industry level exceeds the intra-class correlation on the country level. There is almost no intra-class correlation on the year level.

(2) The sum of squares are higher across countries and across country-industry pairs than within countries or within industries, indicating the variation in investment share has its source from across country-industry variation rather than within countries or industries.

These results suggest that the variation in the data has its source from the country level for real trade credit to GDP, and the country-industry level for the investment share. Thus, clustering the

[16] For example: Moulton (1986); Cameron and Miller (2008)

errors on the country-industry level is the correct approach as clustering controls for the correlation of observations within groups. As described above, ignoring such intra-class correlation might lead to wrong statistical inferences.[17] Table 6 reports the results from equation (1) column (3) estimated with errors clustered on the country-industry level. The second column shows a loss of significance with clustered errors and all fixed effects included (significance at 14.1%). The third column shows that the results are robust to clustering on the country-industry level without country and industry fixed effects (as suggested by Thompson (2011)). The magnitude of the coefficient on the interaction term between international trade credit and trade credit is larger in column 3, providing an upper bound on the response of the investment share.

There is also the possibility that correlation and autocorrelation in the error structure are the result of common shocks affecting clusters. Allowing for autocorrelation in the error terms, combined with fixed effects to control heterogeneity induced by shocks, should also sufficiently solve a potential correlation in the error terms and the potentially incorrect statistical inference. The fixed effects ideally capture potential shocks which could lead to intra-class correlation, while allowing the error terms to follow an AR (1) process captures potential autocorrelation. Estimating the model with the generalized least squares method and allowing for a panel specific AR (1) process in the error terms yields a statistically significant coefficient on the interaction term between international trade credit and trade credit dependence as shown in Column 4 in Table 6. The magnitude on the coefficient of interest increases from 0.96 to 2.19. This suggests that controlling for industry and country fixed effects and clustering at the country-industry level at the same time might be too conservative as it over controls for shocks inducing intra-class correlation.

[17] Clustering on the country-industry level also avoids the problem of a too small number of clusters. There would be 23 clusters on the industry and 20 clusters on the country level. Bertrand et al. (2004) suggest the number of clusters to be greater than 50 to be optimal for a balanced panel set; Cameron et al. (2008) suggest even more clusters for unbalanced panel sets. Clustering on the country-industry level generates 418 clusters.

Table 2 6: Robustness test: Cluster robust standard errors and panel specific AR (1) errors

Pooled OLS regression of Investment share on financial development interacted with trade credit dependence and international trade credit interacted with trade credit dependence. GLS regression with AR (1) error term of investment share on financial development interacted with trade credit dependence and international trade credit interacted with trade credit dependence.

	Equation (1) benchmark specification with robust SE	Equation (1) benchmark specification with Clustered SE	Equation (1) benchmark specification with Clustered SE	Equation (1) benchmark specification allowing for panel specific AR (1) process
Industry output	.470*** (.020)	.470*** (.027)	.498*** (.029)	.431*** .015)
Trade credit	-.080** (.031)	-.080 (.055)	-.111* (.031)	-.188*** (.040)
Financial development	.011*** (.001)	.011*** (.003)	.003** (.002)	.016*** (.002)
Trade credit*Trade credit dependence	.966** (.373)	.966 (.658)	1.591** (.796)	2.189*** (.432)
Financial development*Trade credit dependence	-.121*** (.015)	-.121*** (.028)	-.057*** (.018)	-.180*** (.025)
Number of observations	3687	3687	3687	3684
F-test, Wald Chi squared test	168.50***	52.36***	53.58***	4467.15***
R^2	0.698	0.702	0.638	
Root mean squared error	.527	.524	.574	
Number of groups Estimated autocorrelations				415
Bayesian Information Criterion	6104.763	6104.763	6479.591	
Akaike Information Citerion	5750.647	5750.647	6380.19	
Fixed effects	Country; Industry; Year	Country; Industry; Year	Year	Country; Industry; Year

Standard errors clustered on the country-industry-level in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Clustering the errors in a variety of ways or accounting for autocorrelation in the error terms provides evidence of a larger magnitude than that utilized in the benchmark regression.

Therefore, the estimation of equation (1) in column 1 with fixed effects and without country-industry clustered errors may be interpreted as a lower bound of the point estimate of the coefficient on the interaction term between international trade credit and trade credit dependence.

Importing sectors

International trade credit is synonymous in this paper with supplier credit, which can only be received if a firm is trading abroad. In particular, it is firms that are importing goods and services from abroad that take advantage of supplier credit from the foreign exporters. Consequently, more trade credit dependent industries with higher levels of imports should benefit more from international trade credit. I examine this idea here by examining differences across industries based on their level of importability. I utilize a dummy variable importability measure, calculated by taking the average over all years and countries of imports per industry as a ratio to GDP. The dummy takes the value 1 if an industry's average imports over GDP exceeds the median value for imports over GDP and takes the value 0 otherwise.[18] To test for statistically significant differences, I use the Wald test for difference in coefficients (Wald and Wolfowitz (1940)).

Table 7 reports the results for Equation (1) when the sample is divided into sectors with an average ratio of imports to GDP above the median versus sectors with an average ratio of imports below the median for interactions with international trade credit. The first column reports the results based on column (3) in Table 5. Column (2) reports the results based on column (3) in Table 5 where the interaction term between trade credit dependence and trade credit is interacted with the importability dummy to split the sample. The results show a smaller magnitude on the

[18]See a similar calculation with exports in Rajan and Subramanian (2011) who analyze the effects of aid on growth in manufacturing industries.

interaction coefficient for both, low and high importability sectors, where the coefficient is statistically significant for low importability sectors, but now for high importability sectors.

Table 2 7: Importability indicator regression

Pooled OLS regression of Investment share on trade credit interacted with trade credit dependence and financial development interacted with trade credit dependence and a dummy variable for importability.

	(1)	(2)	(3)
Industry output	.470***	.471***	.474***
	(.020)	(.020)	(.020)
Trade credit	-.080**	-.071**	-.091**
	(.031)	(.029)	(.042)
Financial development	.011***	.011***	.011***
	(.001)	(.001)	(.002)
Trade credit*Trade credit dependence	.966**		
	(.373)		
Trade credit*Trade credit dependence* importability=1		.941**	2.393***
		(.364)	(.560)
Trade credit*Trade credit dependence* importability=0		.797**	-.418
		(.324)	(.270)
Trade credit*external finance dependence* importability=1			-.157***
			(.040)
Trade credit*external finance dependence* importability=0			.180***
			(.054)
Financial development*Trade credit dependence	-.121***	-.122***	-.130***
	(.015)	(.015)	(.016)
Number of observations	3687	3687	3687
F-test	168.50***	173.51***	170.61***
R^2	0.698	0.702	0.706
Root mean squared error	.527	.523	.520
Wald statistics F		3.02	29.43***
			32.14***
Bayesian Information Criterion	6104.763	6109.192	6070.061
Akaike Information Criterion	5750.647	5748.863	5697.307
Fixed effects	Country, Industry, Year	Country; Industry; Year	Country; Industry; Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

The third column of Table 7 includes the interaction term (following column (4) from Table 5) between external finance dependence and international trade credit where the sample is split for sectors with higher importability versus lower importability. The specification in Column 3 outperforms that in Column 2, based on a lower Akaike and Bayesian Information Criterion. This yields interesting results: First, the coefficient on the interaction of trade credit with trade credit dependence increases in magnitude for high importability sectors while the coefficient for low

importability sectors becomes insignificant. The difference between the coefficients is statistically significant. Thus, there may be some indication of a relationship once external finance is also accounted for. Second, the coefficient on the interaction of trade credit with external finance dependence becomes statistically significant for both types of sectors, with a statistically significant difference between the coefficients as shown by the Wald test statistics. Interestingly, the coefficient on this second interaction term for sectors that are importing more is significantly negative and the coefficient for sectors importing less is positively significant. This can be interpreted as follows: Firms in industries that are more dependent on external finance invest more where trade credit is less available when they have higher imports. This relates to the previous finding that firms in more trade credit dependent industries are invest more in countries with lower financial development. The previous correlation analysis showed that external finance dependence and trade credit dependence have a negative relationship. Therefore, a higher ranking in external finance dependence implies a lower ranking in trade credit dependence.

Robustness tests

Alternative Specification with Trade openness

Given the results above that more trade credit dependent industries benefit from higher levels of international trade credit in terms of their investment in fixed assets, it is worth examining whether those industries also benefit from higher trade openness since it is the trade in goods and services that gives access to international trade credit.

Equation 2 provides that example whether trade openness, measured at the country level, has an effect on the fixed investment share in industries that are more reliant on trade credit. De facto trade openness is measured as the sum of exports plus imports as ratio to GDP. The interaction term between trade credit reliance and de facto trade openness is expected to be positive, following

Eck et al. (2012) who find that receiving trade credit or cash in advance is important for firms' opportunities to import and export and hence, invest. Thus β_3 in the Equation 2 is also expected to be positive.

$$FI_{c,i,t} = \beta_0 + \beta_1(Industry\ size_{c,i,t}) + \beta_2(Trade\ openness_{c,t}) + \beta_3(trade\ credit\ dependence_i * Trade\ openness_{c,t}) + \beta_4(external\ finance\ dependence_i * Trade\ openness) + \beta_5(trade\ credit\ dependence_i * financial\ market\ development_{c,t}) + \beta_6(external\ finance\ dependence_i * financial\ market\ development_{c,t}) + \gamma_c + \gamma_i + \gamma_t + \varepsilon_{c,i,t} \quad (2)$$

Table 8 reports the results from Equation 2 using a pooled panel ordinary least squares regression with trade openness as the proposed channel through which investment in industries that are more reliant on trade credit affects investment. Trade openness itself does not have a significant impact on industry fixed investment, consistent across all 6 columns in Table 8. The primary interaction of interest between trade credit dependence and trade openness (β_3) provides statistically significant coefficients in all specifications. The sign of the coefficient is positive, indicating a positive effect of trade openness on industry investment in industries that are more reliant on trade credit. Adding the interaction of trade openness with external finance dependence does not provide any additional explanatory value and the coefficient on the added interaction remains insignificant. Adding the interactions with financial development, consistent with the results in Table 5, shows an additional explanatory value for trade credit dependence but not for external finance dependence. Model selection criteria imply that column (3) surpasses the other specifications, where the selected model includes interactions of trade credit dependence with financial development and trade openness. In this specification, the coefficient on the interaction between financial development and trade credit dependence is negative and has a similar

magnitude to those interactions in Table 8. The coefficient on the interaction between trade openness and trade credit dependence is equal to 0.039. An industry with the average trade credit dependence of 0.088 benefits from an increase in the trade openness by 1 standard deviation (0.537 in 2005) by an increase of the investment share by 0.039*0.088*0.537 =0.181 % points. The average investment share over all countries in 2005 is 0.749%.

Generally, Table 8 provides similar implications to those in Table 5. While trade credit dependent industries invest less where financial development is higher, as indicated by the negative sign on the interaction term, they invest more in countries with higher levels of trade openness. Here, trade openness is an indicator for the potential availability of trade credit and the results are again suggestive of trade credit substituting for domestic financial development as a channel by which firms can finance investment expenditures.

Table 2 8: Robustness test: Equation (2) Benchmark Results

Pooled OLS regression of Investment share on de facto trade openness interacted with external finance dependence and trade credit dependence and financial development interacted with external finance dependence and trade credit dependence.

	(1)	(2)	(3)	(4)	(5)	(6)
Industry output	.477*** (.020)	.477*** (.020)	.468*** (.019)	.468*** (0198)	.468*** (.019)	.468*** (.0198)
Trade openness	-.001 (.002)	-.0003 (.211)	-.001 (.002)	-.001 (.002)	-.001 (.002)	-.001 (.002)
Trade openness*Trade credit dependence	.037** (.015)	.036** (.015)	.039*** (.005)	.039** (.002)	.038*** (.015)	.038** (.015)
Trade openness*external finance dependence		-.001 (.002)		.0003 (.001)		.004 (.148)
Financial development			.0124*** (.002)	.0124*** (.012)	.011*** (.003)	.011*** (.003)
Financial development*Trade credit dependence			-.140*** (.019)	-.140*** (.019)	-.137*** (.020)	-.137*** (.020)
Financial development*External finance dependence					.002 (.002)	.002 (.002)
Number of observations	3687	3687	3687	3687	3687	3687
F-test	165.34***	162.24***	172.15***	169.95***	169.73***	167.59***
R^2	0.695	0.695	0.702	0.702	0.702	0.702
Root mean squared error	.530	.530	.524	.524	.524	.524
Bayesian Information Criterion	6174.519	6182.559	6106.183	6114.395	6113.691	6121.904
Akaike Information Citerion	5832.827	5834.655	5752.066	5754.066	5753.362	5755.362
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Financial crisis

There has been a breakdown in international trade following the 2008 financial crisis. This implies that there has also been a breakdown in finance through trade credit, with less trade credit available for trade credit dependent industries. On the other hand, one reason for the breakdown in international trade was credit tightening (Chor and Manova (2011)). Trade credit could potentially have alleviated the effect as an additional source of financing for firms in industries that were still engaging in trade. Some authors find empirical evidence that firms relied more on trade credit during the 2008/2009 financial crisis (Zlate et al. (2011); Yang (2011)). Other authors find a redistribution of bank credit from financially stronger to financially weaker firms in times of crisis through a trade credit channel (Love et al. (2007)). To test for the effect of the financial crisis, I re-estimate the main specifications excluding 2008 and 2009 from the sample. The results do not differ, with the magnitude of the coefficients nearly the same in all specifications and statistical significance of the coefficients showing similar values.

Trend

Another issue of concern is that the main results from equation (1) might be driven by a common time trend. In order to address this concern, I re-estimate the model after de-trending the variables with an industry-country specific linear time trend.[19] This controls for a potential common time trend in each industry in each country to avoid spurious regression. Table 9 reports the results from re-estimating equation (1) column specification (3) in Table 5. The results are robust to de-trending, the sign of the variables of interest remain the same and the magnitude of the coefficients is similar.

[19] Thanks to Professor Scott Drewianka for providing me a residual regression code for Stata.

Table 2 9: Robustness test: Cluster robust standard errors and Trend

Pooled OLS regression of Investment share on financial development interacted with trade credit dependence and international trade credit interacted with trade credit dependence.

	Baseline Specification	Specification trend adjusted	Baseline Specification controlled for Business Cycles
Industry output	.470*** (.020)	.510*** (.015)	.469*** (.021)
Trade credit	-.080** (.031)	.028 (.023)	-.066 (.023)
Financial development	.011*** (.001)	-.001 (.001)	.001*** (.002)
Trade credit*Trade credit dependence	.966** (.373)	1.066*** (.247)	.836*** (.247)
Trade credit*external finance dependence		-.044*** (.007)	
Financial development*Trade credit dependence	-.121*** (.015)	-.126*** (.032)	-.123*** (.016)
Financial development*External finance dependence		.004*** (.001)	
Growth in real GDP			.025 (.268)
Number of observations	3687	3684	3390
F-test	168.50***	260.4***	163.18***
R^2	0.698	0.858	0.705
Bayesian Information Criterion	6104.763	88862.94	5519.429
Akaike Information Citerion	5750.647	88813.25	5170.1

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level

Table 9 column (3) reports the results of equation (1) Table 5 column (3) including the growth rate of real GDP as a control for cyclical components that might affect industry investment. The coefficient on the cyclical component of real GDP is insignificant and the other coefficient do not change in sign or magnitude.

Sensitivity to excluding observations

The sample consists of 19 EU countries and Canada. While trading is not restricted by any forms of tariff or non-tariff measures within Europe, trade between Canada and the EU is not covered by a free trade agreement during the sample period. To test whether the exclusion of Canada changes the outcome, I re-estimate Equation (1) excluding Canada from the sample. The results are robust with a significant positive, and slightly higher coefficient on the interaction term of interest.

Five countries in the sample show a relatively high ratio of trade credit to GDP. One might therefore be concerned that those countries could drive the results. I therefore exclude the countries with a relative trade credit share of greater than 5%, namely Hungary, Luxembourg, Estonia, Slovenia and the Slovak Republic and re-estimate Equation (1). The coefficient of interest remains positive and significant and increases in magnitude. Furthermore, the coefficient on external finance dependence interacted with financial development becomes significant and positive, indicating a positive effect of financial development on industry investment for more external finance dependent industries.

Alternative measures of financial development

To check the sensitivity of the results with regard to the financial development measure used, this section tests the stability of the coefficients once different proxies for financial development are considered. First, in place of private credit by deposit money banks, I use private credit by deposit money banks and other institutions as a ratio to GDP. This measure provides a broader measure of private credit, although it is highly correlated with the narrower measure of private credit used so far. I also consider a measure for stock market activity in each country, namely the level of stock market capitalization. For both international trade credit and trade openness I estimate the regression similar to that in Column (3) in Tables 5 and 9 since these outperform the other specifications in both settings. The results in Table 10 indicate that the findings are robust with respect to the financial development measure. The coefficients remain the same in terms of magnitude, sign and significance for private credit by deposit money banks and other financial institutions. This is in line with the high correlation between the two measures. Using stock market capitalization as a measure for financial development increases the coefficients on the interaction term between trade credit dependence and international trade credit and the interaction between trade credit dependence and trade openness respectively, with similar statistical significance as before.

Table 2 10: Robustness test: Alternative measures of financial development

Pooled OLS regression of Investment share on private credit by deposit banks and other financial institutions/GDP as proxy for financial development interacted with trade credit dependence; international trade credit and trade openness interacted with trade credit dependence. Stock market capitalization as proxy financial development interacted with trade credit dependence; de facto trade openness and trade credit interacted trade credit dependence.

Equation (1)			Equation (2)		
Industry output	.470*** (.020)	.469*** (.020)	Industry output	.468*** (.019)	.465 *** (.019)
Trade credit	-.075 ** (.031)	-.097** (.031)	Trade openness	-.098 (.164)	-.156 (.181)
Trade credit*Trade credit dependence	.921** (.370)	1.169 ** (.371)	Trade openness*Trade credit dependence	.037** (.015)	.042** (.015)
Private credit by deposit banks and other financial institutions/GDP	.011 *** (.001)		Private credit by deposit banks and other financial institutions/GDP	.013 *** (.002)	
Private credit by deposit banks and other financial institutions/GDP*Trade credit dependence	-.124*** (.015)		Private credit by deposit banks and other financial institutions/GDP*Trade credit dependence	-.142*** (.019)	
Stock market capitalization		.008*** (.001)	Stock market capitalization		.009 *** (.002)
Stock market capitalization*trade credit dependence		-.085*** (.015)	Stock market capitalization*trade credit dependence		-.102 *** (.019)
Number of observations	3687	3687	Number of observations	3687	3687
F-test	174.30 ***	168.96 ***	F-test	172.02 ***	165.41 ***
R^2	0.7020	0.700	R^2	0.7020	0.70
Root mean squared error	.52341	.525	Root mean squared error	.52344	.526
Bayesian Information Criterion	6100.071	6124.325	Bayesian Information Criterion	6100.52	6132.111
Akaike Information Citerion	5745.954	5770.209	Akaike Information Citerion	5746.403	5777.994

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

The role of international financial development

The benchmark results in Table 5 suggest that trade credit might act as a substitute for financial development with regard to industry investment. In addition, other forms of access to external finance might also impact a firm's investment decision. Access to international financial markets could either complement access to international trade credit or trade credit use could, in line with the main results, substitute for this form of financial development. To identify these potential channels, this section examines the question whether trade credit or external finance dependent industries benefit from greater access to international financial markets and whether the main findings are robust to the inclusion of international financial market development. The measure for international financial development is a de facto measure calculated as the ratio of the sum of a country's external assets plus external liabilities to GDP. This measure is from Lane and Milesi-Ferretti (2007) is widely used as a measure for capital account openness. Maskus et al. (2012) use this measure in a similar specification to examine industry research and development. Table 11 reports the results from Equation (1) column (3) with financial development measured as private credit as a ratio to GDP in column (1) and the ratio of the sum of a country's external assets plus external liabilities to GDP as measure for international financial development in column (2) and (3).

The interaction term between trade credit dependence and international trade credit remains positive and significant implying that the main results are robust to the inclusion of an international financial development measure. Further, the coefficient on international financial development interacted with trade credit dependence is significant and negative. This result suggests that access to trade credit might act as a substitute for a country's international financial development

measured as capital account openness. This finding complements the main result that trade credit might act as a substitute for a country's domestic financial development.

Table 2 11: Robustness test: International financial development

Pooled OLS regression of Investment share on international trade credit interacted with trade credit dependence and international financial development interacted with trade credit dependence.

	(1)	(2)
Industry output	.470*** (.020)	.477*** (.020)
Trade credit	-.080** (.031)	-.168*** (.043)
Trade credit*Trade credit dependence	.966** (.373)	1.972*** (.508)
Private credit	.011*** (.001)	
Private credit *Trade credit dependence	-.121*** (.015)	
International financial development		.030*** (.008)
International financial development*Trade credit dependence		-.285*** (.075)
Number of observations	3687	3687
F-test	168.50***	167.12***
R^2	0.698	0.698
Root mean squared error	.527	.527
Bayesian Information Criterion	6104.763	6147.877
Akaike Information Citerion	5750.647	5793.761
Fixed effects	Country; Industry; Year	Country; Industry; Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Conclusions

In this paper, I examine a trade credit channel through which international trade can affect industry specific performance. Applying an approach first implemented by Rajan and Zingales (1998) on a dataset on international trade credit, I am able to show that international trade credit and trade flows, both relative to GDP, have a significant positive effect on industry investment for those industries with a higher propensity to use trade credit. The effect is even more pronounced for industries with relatively higher imports. While a large literature focuses on financial openness as a source of financing for firms and hence on output and investment, I am able to show that trade also plays an important role. This gives rise to potential policy implications: trade openness not only benefits a country in the sense of comparative advantage and broader markets but it also may open a channel for financing investment. Thus, import restricting policies may harm a country by cutting off a form of finance.

There is much room for further research. First, it may be interesting to see which other firm specific variables are influenced by access to international trade credit, for example liquidity or growth in value added. Second, as recent literature suggests a beneficial effect of national trade credit in times of crisis or monetary tightening, it would be interesting to see the role of international trade credit, especially if only one isolated country is affected (for example the Mexican Peso crisis). Third, to test for policy implications, it would be interesting to measure the relation between international trade credit and import restricting policies.

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Chapter III: "The role of international trade credit for investment volatility"

Abstract: In this study, I analyze another aspect of the link between international trade credit and industry investment. Specifically, I examine the effect of access to international trade credit on the volatility of industry investment. A decrease in aggregate investment volatility has previously been shown to be linked to a decrease in aggregate output volatility. While some literature indicates that trade credit might dampen the investment volatility by providing additional internal finance and reducing informational asymmetries where financial institutions are limited, other literature suggests trade credit might increase the investment volatility by building up credit chains, such that potential liquidity shocks might be transmitted via credit connected firms. Using data from 23 manufacturing industries in 20 countries over the period 1999-2009, I construct measures of the volatility in each industry's investment share across countries. I test the effect of various measures of trade credit, while accounting for the industry propensity to use trade credit. My initial results imply that higher average international trade credit in trade credit dependent industries increases the volatility in the investment share.

Introduction

International trade credit is an important determinant of industries' investment for trade credit dependent industries. In this chapter, I investigate the impact of international trade credit on industry level investment volatility, taking into account each industries' propensity to rely on trade credit. The previous chapter shows that international trade credit has an effect on industry investment in industries with a higher propensity to use trade credit. With this implication, international trade credit may also influence the volatility of industry investment through different channels. The main motivation for this question comes from a decline in aggregate output volatility since the late 1980's (e.g., see Stock and Watson, 2002, for example). This development can be attributed to several factors of which one is a reduction in investment volatility. For example, Blanchard and Simon (2002) point to this link in their introduction to their analysis of the effects of declined aggregate output volatility. Dynan et al. (2006) argue that financial development lowers the volatility in business fixed investment which leads, in combination with other factors, to lower output volatility. Hence, if trade credit can be linked to industry investment volatility, this might feed into several aspects of the economy, including output. The direction of the impact from trade credit to investment volatility could go in either direction, such that greater access to trade credit could dampen or increase investment volatility. Trade credit might serve industries as an additional source of finance investment and working capital hereby lowering he investment volatility. On the other hand, trade credit might connect firms and promote shocks through this firm network. If international trade credit gives a firm stable access to additional external finance and a source of cash flows, then it should dampen the investment volatility. If international trade credit amplifies shocks through a network of firms connected via international trade, then it could increase the investment volatility.

Previous literature has found evidence of both of these effects. First, trade credit is shown to be an additional source of financing working capital (e.g. Eck et al. (2012)), thereby helping a firm to generate cash flow through sales. From their world-wide enterprise survey, the World Bank (2016) reports that firms finance about 20% of their working capital with trade credit. While some authors note the irrelevance of a firm's financial structure to its investment decision under the assumption of perfect capital markets (e.g. Modigliani and Miller (1958)), other authors place emphasis on the importance of internal funds (Kuh (1963); Meyer and Kuh (1957)) relative to external funds. If internal finance has a cost advantage over external finance or access to external finance is restricted, then higher sales and higher cash flows may increase corporate investment as they increase internal funds. Firms in industries with a higher propensity to use trade credit therefore should have a relative advantage through this additional source of financing, as it generates cash flow without taking on additional external financing. In addition, the World Bank (2016) also reports that on average 4.7% of fixed investment is financed with supplier credit. Hence trade credit may also serve as an additional source of external finance for investment. Under the assumption that the inflow of trade credit is stable, being able to access this additional source of liquidity and finance could have a relatively more stabilizing effect on investment volatility in these industries.

Second, the literature on financial development identifies a relationship between a country's development of financial institutions and aggregate volatility. Ajello (2016) estimates a DSGE model using data from the US and finds that permanent shocks to financial intermediation account for 25% of aggregate output volatility and 30% of aggregate investment volatility. With a focus on aggregate consumption, output, and investment volatility, Denizer et al. (2000) find that the presence of banks, measured by the ratio of deposit money bank assets to deposit money bank

assets plus central bank domestic assets, plays an important role in reducing investment volatility. They suggest these findings may be due to the reduction of informational asymmetries between savers and borrowers through banks. A strain in the broad literature on trade credit suggests that trade credit helps reduce informational asymmetries. Bias and Gollier (1997) for example argue that trade credit reduces informational asymmetries by sending a signal about the creditworthiness of the trade credit recipient. Gianetti et al. (2011) find empirical evidence that firms receiving trade credit borrow from more banks, cooperate with more distant banks and borrow at lower cost, supporting the former hypothesis. Following these arguments, higher access to international trade credit should lower industry investment volatility, especially in countries with less developed financial institutions by reducing informational asymmetries.

Third, a different strand of literature looks into the potential destabilizing effects of trade credit. This literature analyzes how shocks propagate through a network of firms lending to and borrowing from each other, leading to a chain reaction which then affects aggregate variables. Raddatz (2010) argues that supplier credit generates a network between firms (or credit chains), which then could result in a chain reaction if one firm faces a liquidity shock. He finds that higher levels of trade credit lead to higher output correlation of firms that are connected through trade relations as measured by an industry input-output matrix. Boissay (2006) further argues that trade credit suppliers tend to be badly diversified as they tend to have balances outstanding with only a few trading partners. Following these arguments, trade credit is a form of external finance generating a linkage between firms that can lead to an economy wide domino effect once one firm has liquidity problems. This negative network externality may amplify shocks and hence destabilize industry specific outcome variables.

The link between a country's level of financial and institutional development and volatility has already been analyzed by several researchers. Raddatz (2006) finds that financial development reduces the output volatility of industries with a higher need for external finance. The proposed channel here is that the additional access to external finance helps to smooth temporary liquidity shortages. In line with these results, Larraine (2006) finds in a cross sectional analysis of output volatility that higher average financial development dampens the idiosyncratic component of output volatility in industries with a greater dependence on external finance

Using aggregate industry data, Hoxha (2013) analyzes the impact of a country's banking structure on the volatility in growth in value added. The author finds that banking concentration dampens volatility whereas higher banking competition increases the volatility in growth in value added. Banking competition and banking concentration both affect a firm's credit access. Previous literature in this field concludes that more concentrated banks leads to higher access to credit, while greater banking competition leads to a lower access to credit (e.g. Petersen and Rajan (1997)). My approach uses financial development to measure firms' access to private credit from banks. Further, I assume international trade credit to be an additional source of finance available to firms in trade credit dependent industries. These measures could potentially affect the investment volatility for external finance dependent industries or for those that depend on trade credit by providing more financing opportunities.

Related to this literature, Dynan et al. (2005) analyze the role of financial development on the volatility of consumer spending, housing expenses, and business fixed investment (BFI) to explain the overall reduction in output volatility over the recent decades. The authors are able to identify a reduction in the volatility of BFI after the "democratization" of credit which was driven by several governmental financial market liberalization actions in the 1970's and 1980's. These

developments lead to increased access to external finance for BFI and working capital. Considering their results for the question of this paper, trade credit as an additional source of external finance for firms could affect industry investment volatility in a twofold way: First by providing liquidity to alleviate temporary working capital shortages as a substitute for financial development and hereby reducing the output volatility; second by providing a direct source of funding business fixed investment projects.

I explore whether higher use of trade credit by countries increases or reduces the volatility of the investment share of industries that are more or less trade-credit dependent. In order to identify how investment volatility responds to the availability of trade credit, I construct measures of volatility in industry investment shares across countries and test the potential effect of international trade credit based on the amount of trade credit at the country level. In particular, I consider average trade credit interacted with an industry specific trade credit dependency measure to analyze the potential effects on industry investment in more trade credit reliant industries. This interaction approach was first implemented by Rajan and Zingales (1998) and makes use of across industry variation in dependency to link cross country variables to industry variables. The dataset includes 23 manufacturing industries in 20 countries from 1999-2009. To preview, my results imply that average international trade credit in trade credit dependent industries increases the volatility in the investment share while financial development dampens the volatility. These results are robust to different lengths in the estimation intervals and also to shifting the sample across time.

Hypothesis and Approach

As discussed above, existing studies on the role of liquidity for corporate investment, the role of financial and institutional development for aggregate and industry volatility, and credit chain linkages imply a potential relationship between access to international trade credit and industry

investment volatility. To test this relationship between trade credit and investment volatility I use the following empirical specification:

$$VFI_{c,i,t} = \beta_0 + \beta_1\left(Industry\ size_{c,i,t}\right) + \beta_2\left(international\ trade\ credit_{c,t}\right) +$$
$$\beta_3\left(trade\ credit\ dependence_i *\ international\ trade\ credit_{c,t}\right) +$$
$$\beta_4\left(external\ finance\ dependence_i * international\ trade\ credit_{c,t}\right) + \quad (1)$$
$$\beta_5\left(trade\ credit\ dependence_i * financial\ market\ development_{c,t}\right) +$$
$$\beta_6(external\ finance\ dependence_i * financial\ market\ development_{c,t}) + \gamma_c + \gamma_i + \gamma_t + \varepsilon_{c,i,t}$$

where $VFI_{c,i,t}$ is volatility in industry fixed investment, measured as the standard deviation in the investment share at time t for country c in industry i. Industry size, international trade credit, and financial market development enter the equation as averages over the chosen period where c is the country, i the industry and t the year index, which indicates the end date of each period (e.g., the volatility calculated over 1999-2002 is denoted as t=2002 and similarly for the averages calculated over the same period). Similar to the previous chapter that examined the impact of the level of trade credit on the level of industry investment, this specification focuses on the impact of country level trade credit on industry investment volatility. The key measure in this specification is therefore the interaction term between an industry's trade credit dependency and a country's level of trade credit. Following the argument in Rajan and Zingales (1998), the interaction terms give estimates for the within country differences across industries. γ_c and γ_i are country and industry specific effects to control for unobservable industry and country specific factors influencing an industry's investment. γ_t are year specific dummies to control for effects that influence countries and industries the same way (e.g. a global crisis or global interest rate changes).

I consider various measures of volatility over different time periods, including 1, 2, 3, 4 and 10 year intervals. The benchmark results present volatility measured over 3 years, with corresponding

averages for the explanatory variables, most notably trade credit and financial development. This approach has the advantage that it smooths any potential shocks to any of the variables within a specific year (see Denizer et al. (2002)). The trade credit dependency and the external finance dependency measures do not vary across time or countries. These measures enter as industry values representing a ranking of industries. Using independently calculated standard deviations has the advantage that one does not have to control for the potential of correlated moving averages in the error terms imposed by a rolling sample regression. Further, as described in chapter II in the robustness section, the main variation in the data used for the empirical study comes from across-country variation rather than across-time variation, therefore shrinking the sample by calculating individual standard deviations and averages does not cause harm. The identification of the interacted coefficients as well as the individual effect coefficients on international trade credit results mainly from variation across countries.

The literature discussed in the previous section implies two potential directions in which trade credit could affect the volatility of industry investment in more trade credit dependent industries. If international trade credit stabilizes industry investment by providing a stable source of liquidity for trade credit dependent industries, then the sign of β_3 is expected to be negative. Similarly, if international trade credit helps overcome informational asymmetries in countries with a lack of development in financial institutions, then the sign on the coefficient β_3 is expected to be negative. Conversely, the sign of β_3 could be positive if the level of trade credit in a country indicates credit chains that destabilize investment. I also include an interaction between the industry external finance dependence measure and trade credit since reliance on external finance may also help explain the volatility investment share. The sign for β_4 could be positive or negative since greater

access to trade credit may reduce volatility for those industries that rely on external finance or increase the volatility if trade credit transmits shocks through credit chains.

I also include an interaction of both external finance dependence and trade credit dependence interacted with financial development in all three specifications to control for the potential explanatory value of those variables. Hoxha (2013) finds that higher banking concentration dampens the volatility of growth in value added whereas higher banking competition increases the volatility in value added in sectors with higher investment opportunities. Banking competition and banking concentration both affect a firm's credit access. Previous literature in this field concludes that more concentrated banks lead to higher access to credit, while greater banking competition leads to lower access to credit (e.g. Petersen and Rajan (1995)). Here, lower financial development means that firms have less access to private credit from banks. This could potentially also affect the investment volatility for external finance dependent industries or for those that depend on trade credit. Thus, β_6 would be expected to be negative, indicating a dampened volatility in investment once more external finance dependent industries get more access to credit.

The empirical analysis in Chapter II indicates that industries with a higher propensity to use trade credit facing less developed financial institutions outperform industries with a higher propensity to use trade credit in countries with more developed financial institutions in terms of the investment share. Thus, the interaction term between trade credit dependence and financial development would be expected to have no effect with β_5 remaining insignificant as financial development does not help more trade credit dependent industries. On the other hand, part of the role of banks is reducing informational asymmetries. If this effect also applies to trade credit dependent industries, financial development is expected to reduce industry investment volatility and β_5 is expected to be significantly negative.

Data description

Industry level Data

I use Data for 23 manufacturing industries in 20 countries from 1999-2009. The industry level data on investment and output is drawn from the OECD Stan Database and varies by industry, country, and time. The dependent variable of interest is the standard deviation of the industry investment share, with the investment share calculated as industry investment formation relative to total investment formation in the economy. This indicator represents the investment composition in the economy. If an industry's investment share increases, it can be translated into an increase in investment in tangible assets in this industry relative to investment in tangible assets economy-wide. I consider multiple measures of volatility, by forming the standard deviation calculated over 1, 2, 3, 4 and 10-year periods. Therefore, several years of data are collapsed into one time period resulting in five time periods for the 1 year standard deviation, three time observation points for 2-year standard deviation, two time observations points for the standard deviation in the 3 and 4-year case and one time observation point in the 10-year case. I start each calculation using data from 1999. Thus, the 1-year standard deviations are calculated over 1999-2000, 2001-2002, 2003-2004, 2005-2006, and 2007-2008. The 2-year standard deviations are calculated over 1999-2001, 2002-2004, and 2005-2007. The 3-year standard deviations are calculated over 1999-2002 and 2003-2006 and the 4-year standard deviations are calculated over 1999-2003 and 2004-2008. These standard deviations represent short-term volatilities in the investment share. The 10-year standard deviation is calculated over the whole sample, from 1999-2009, and represent the long run volatility in the investment share. The baseline results presented are the results for the 3-year period, with the other specifications presented as sensitivity analysis.

The industry characteristics (trade credit dependence and external finance dependence) are taken from Fisman and Love (2003). The measure for an industry's propensity to use trade credit

is based on Compustat data that includes US firms in 37 manufacturing industries. I use the industry ranking by trade credit dependence as reported in their paper. They calculate the measure using the ratio of accounts payable, which is trade credit outstanding and equivalent to the term trade credit throughout the paper, to total assets for each firm in 1980, then take the median of all firm observations in 1980 for each industry as their final measure of this industry characteristic. Fisman and Love (2003) argue, in line with Rajan and Zingales (1998), that a dependency measure calculated from US data is the appropriate variable to use as the United States represents the "optimal capital market" and therefore firms' decisions on trade credit or external finance are likely to represent the desired level of trade credit or external finance. Further literature suggests that the propensity to use trade credit is related to several industry specific characteristics. As described in the literature review, properties of certain goods increase the regularity to use trade credit as a warranty for the quality or signal for the quality.[20] These properties do vary less within industries than across industries. Ng et al. (1999) provide empirical evidence for little variation in credit terms within industries but wide variation across industries drawn from a dataset on US firms. Using these arguments, I use this measure as a proxy for an industry's natural level of trade credit usage, excluding the United States from the sample. Importantly, it is the ranking of industries by this measure that matters, rather than the actual value of the measure. To also account for potential benefits from trade credit and financial development for more external finance dependent industry's investment volatility, I use the external finance dependence measure as reported in Fisman and Love (2007). A similar measure was first used by Rajan and Zingales (1998) and represents the portion of assets externally financed. It is calculated using the same US data as the trade credit dependence measure. External finance dependence is calculated as total assets minus

[20]See for example Lee and Stowe (1993). Cunat (2007) and Engemann et al. (2014) extend the idea to international trade.

retained earnings as a ratio to total assets for each firm in 1980. The industry median in 1980 for each industry is used as the industry characteristic. Like the trade credit dependence measure, I interact the external finance dependence measure with the country-level variables of interest (in this case domestic financial development and aggregate international trade credit).

To control for industry size, I include the average industry share, calculated as industry output relative to total output. Following Hoxha (2013) I argue that industries with a lower average output share should experience higher volatility in their investment share. Hoxha (2013) finds industry size lowers the volatility in growth in value added. A lower average output share implies low cash flow and hence low internal funds available to finance investment. Therefore, industries with a lower average output share are expected to have a higher volatility in investment since they have less sources available to keep investment at a stable level in the face of exogenous shocks. The average industry share is calculated over the same time frames as the other explanatory variables, to match the timing from the investment volatility measure.

Country level data

The main variable of interest is aggregate international trade credit used by the private sector in a country within a year. As previously described, trade credit could affect industry investment volatility in two ways. On the one hand, it could dampen the volatility if it acts as a stable source of financing investment and working capital for industries. On the other hand, it could increase investment volatility if it builds up credit chains through which liquidity shocks are transmitted between firms. I also control for a country's level of financial development.

The measure for trade credit used here is solely international trade credit and differs from previous papers that use aggregate trade credit, which might be domestic or international credit granted by suppliers. The measure for international trade credit is from the IMF balance of

payments statistics and represents the aggregate of trade credit liabilities used by both the private sector and the government within a year. Trade credit liabilities are of interest as my goal is to find whether the measure acts a source of additional finance to firms. As my goal is to examine private investment by firms, trade credit liabilities in the private sector would be a preferred measure. However, the data coverage for trade credit liabilities in the private sector is very limited. For those that do exist, the individual numbers show that there are rarely any differences between the private sector and the private sector plus government. Moreover, the correlation is close to one as will be shown in the data section. In the regression equation, I use averages of international trade credit as a percentage of GDP over the same above described periods of the standard deviation calculation to match the averages with the industry volatility measures that I use. For example, for the benchmark 3-year standard deviations I use average trade credit to GDP over the same 3-year period. I have explored leading the trade credit variables with similar results on investment volatility.

Following Denizer et al. (2002), I use the average financial development for each country, lagged by one period to get a measure for financial development in the beginning of the period. Denizer et al. (2002) analyze the role of different financial development indicators on aggregate investment volatility, aggregate consumption volatility and aggregate per capita output volatility. They find that private credit by deposit money banks relative to GDP lowers the aggregate investment volatility while the other measures do not significantly affect aggregate investment volatility. Denizer et al. (2002) argue that this measure represents the risk management and information processing ability of banks. Given these findings I focus on controlling for the ratio of private credit by deposit money banks to GDP. The data are drawn from the financial

development and structure dataset published by Beck et al. (2000) and updated by Čihák et al. (2012).

The averages in the explanatory variables are calculated over the corresponding time frames. As mentioned before, taking averages smooths out any temporary increases or decreases in trade credit or domestic banks' credit supply.

Descriptive Statistics

Table 1 reports summary statistics of the 3-year standard deviation in investment share and the corresponding averages in the explanatory variables as well as simple correlation analysis. The 3 year standard deviation is positively correlated with the average ratio of trade credit to GDP and with the average investment share. The correlation between the 3 year standard deviation and the average in financial development measured as average ratio of private credit to GDP is negative. The correlation between average trade credit to GDP and the average private credit to GDP is negative and higher than the correlation between the annual levels in both variables.

Table 3 1: Descriptive statistics and correlation analysis

Variable	Mean	Standard deviation	3-year average trade credit/GDP[b]	3-year average private credit /GDP[b]	3-year average industry output	Number of obs.
3-year standard deviation in Investment	0.161	0.376	0.199	-0.201	0.470	829
3-year average trade credit/GDP[b]	0.027	0.026	1	-0.440	0.050	851
3-year average private credit /GDP[b]	78.239	38.572		1	-0.141	805
3-year average industry output	.014	.014			1	871

a: calculated across all industries, countries and time.
b: calculated across all countries and time.

Results

Main findings

Table 2 reports the benchmark specification using a pooled ordinary least squares regression of the industry investment share volatility on the interaction terms with international trade credit where the calculations are made over 3-year periods. Table 3 reports the same analysis over alternative calculated periods. In Table 2, the coefficient on the interaction between trade credit dependence and the average aggregate trade credit (β_3) is positive and statistically significant in all 6 columns in Table 1. This suggests that the availability of aggregate trade credit in a country increases the investment volatility for those industries that depend more on trade credit relative to those industries that rely less on trade credit. Thus, there appears to be a credit chain effect for industries with a higher propensity to use trade credit from the availability of international trade credit at the aggregate level. Trade credit dependent industries in countries with higher average

levels of international trade credit experience higher volatility in their investment share. Including the interaction term between external finance dependence and average international trade credit (β_4, columns (2), (4), and (6)) does not add any explanatory power to the model and the interaction term is insignificant in all specifications.[21] Adding the interaction term between trade credit dependence and financial development (β_5, columns (3)-(6)) does not improve the model in terms of the model selection criteria, but lowers the coefficient on the interaction between trade credit dependence and average international trade credit. The coefficient on the interaction between trade credit dependence and average financial development is negative and significant in all 6 specifications, implying that domestic financial development dampens the investment volatility for industries with a higher propensity to use trade credit.

The coefficient on the interaction term between trade credit dependence and international trade credit in specification (3) is equal to 1.246. The magnitude of this coefficient can be interpreted in the following way:[22] An industry with the average trade credit dependence of 0.088 experiences an increase in investment volatility by 1.246*0.088*0.026 = 0.285% points if the size of average international trade credit is increased by 1 standard deviation (0.026). Compared to the average investment share volatility over all countries in 2005, which is 0.161 %, this is an increase by 177%.

[21]It is also insignificant in a specification where the standard deviation of investment share is regressed only on the average output share and interaction between external finance dependence and financial development.
[22] see for example Denizer et al. (2002) who conduct a country level analysis of the impact of financial development on investment volatility.

Table 3 2: Baseline regression.

Pooled OLS regression of volatility, defined as 3-year standard deviation in investment share, on the average of international trade credit interacted with trade credit dependence and external finance dependence and the average of financial development in t-1, defined as private credit/GDP, interacted with trade credit dependence and external finance dependence.

	(1)	(2)	(3)	(4)	(5)	(6)
Industry output	16.073*** (4.037)	16.089*** (4.030)	16.153*** (4.053)	16.169*** (4.043)	16.163*** (4.045)	16.170*** (4.043)
Trade credit	-.141*** (.058)	-.119 (.085)	-.116* (.056)	-.098 (.082)	-.116 (.056)	-.098 (.080)
Financial development			.002 (.002)	.002 (.002)	.0011 (.003)	.002 (.002)
Trade credit*Trade credit dependence	1.562*** (.704)	1.525*** (.732)	1.246* (.660)	1.219* (.685)	1.244* (.664)	1.220* (.683)
Trade credit*external finance dependence		-.027 (.057)		-.022 (.056)		-.021 (.054)
Financial development*Trade credit dependence			-.044*** (.013)	-.043*** (.013)	-.043** (.014)	-.043*** (.014)
Financial development*External finance dependence					.001 (.002)	.001 (.002)
Number of observations	696	696	696	696	696	685
F-test	7.61***	7.96***	6.23***	6.49***	6.20***	6.36***
R^2	0.432	0.432	0.440	0.441	0.440	0.440
Root mean squared error	.303	.303	.314	.315	.315	.315
Bayesian Information Criterion	592.582	598.968	623.033	629.437	629.543	635.982
Akaike Information Citerion	383.964	385.714	409.402	411.260	411.366	413.260
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Overall, the positive significant coefficient on the primary interaction term (β_3) implies that greater average international trade credit increases industry investment volatility in more trade credit dependent industries rather than dampening it. The effect of a higher level of trade credit as a share of GDP makes industry investment more unstable and therefore, the previously described chain effect and negative network externalities potentially induced by financial linkages between firms through trade credit seem to be the driving force.

On the other hand, financial development has a dampening effect on industry investment volatility for more trade credit dependent industries as indicated by a negative sign of the coefficient β_5. This indicates an important role of financial development for industry investment. The result complements the results in Denizer et al. (2002) who find financial development measured as private credit to GDP dampen aggregate investment volatility. While more access to international trade credit increases industry investment volatility, a higher level of financial market development and hence better access to domestic credit helps stabilize industry investment. This effect is in particular stronger for industries with a higher dependence on trade credit, therefore working through a trade credit dependency channel.

Alternative specifications and sample periods

The main results suggest that the short-term volatility (measured over a 3 year period) of trade credit dependent industries' investment increases in an economy's average access to international trade credit but declines with an economy's domestic financial development. These findings could be sensitive to the length of the period over which the standard deviation is calculated as calculating non-overlapping standard deviations shrinks the sample in the time dimension. To test whether the results are robust with regard

to the chosen sample length and also the number of time data points available, I re-estimate the results from column (3) using 1-year, 2-year, 4-year and 10-year standard deviations in the investment share and the corresponding averages in trade credit as a ratio to GDP, private credit as a ratio to GDP, and output share. The results are reported in Table 3. The results are robust for the 1-year, 2-year and 4-year standard deviations. The sign of the coefficient on the interaction term between trade credit dependence and international trade credit is positive and the coefficient on the interaction term trade credit dependence and financial development is negative in all 6 specifications with an increasing magnitude in the length of the time interval over which the standard deviation is calculated. The coefficient on the interaction term between trade credit dependence and international trade credit is significant and negative for the 10-year period (column 6) but becomes insignificant once the interaction term between trade credit dependence and financial development is included in the regression (column 5). Akaike and Bayesian information criterion imply that the model without the interaction term between trade credit and financial development is a better fitted version for the 10-year specification.

Table 3 3: Robustness test: Alternative volatility measures.

Pooled OLS regression of volatility in investment share on the average of international trade credit interacted with trade credit dependence and the average of financial development in t-1 interacted with trade credit dependence.

	Baseline: 3-year standard deviation	1 year-standard deviation	2-year standard deviation	4-year standard deviation	10-year standard deviation	10-year standard deviation
Industry output	16.152***	7.002***	12.002***	17.085**	15.252***	15.711***
	(4.053)	(1.066)	(2.423)	(5.855)	(3.257)	(3.388)
Trade credit	-0.117*	-0.043*	-0.076*	-0.211*	-0.123*	-1.256*
	(0.056)	(0.019)	(0.034)	(0.085)	(0.056)	(0.059)
Financial development	0.002	0.004***	0.002*	-0.002	0.003	
	(0.002)	(0.001)	(0.001)	(0.005)	(0.003)	
Trade credit*Trade credit dependence	1.246*	0.469*	0.910*	1.489*	0.860	1.135*
	(0.660)	(0.211)	(0.392)	(0.669)	(0.543)	(0.613)
Financial development*Trade credit dependence	-0.044**	-0.037***	-0.027**	-0.145*	-0.046*	
	(0.014)	(0.009)	(0.009)	(0.073)	(0.019)	
Number of observations	696	1,671	1,090	234	417	417
F-test	7.96***	8.43***	8.49***	6.49***	8.12***	8.65***
R^2	0.432	0.308	0.409	0.504	0.562	0.557
Root mean squared error	.303	.213	.251	.394	.229	.23
Bayesian Information Criterion	598.968	-101.534	368.719	379.443	177.740	176.66
Akaike Information Citerion	385.714	-378.013	124.016	258.507	-3.749	-.800
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

I further calculate the 1-, 2- and 3-year standard deviations one period ahead to rule out the possibility that the results depend on the choice of the sample period. The results are reported in table 4. The calculation for the 1-, 2- and 3-year standard deviations are each shifted one year ahead, hence the 3-year standard deviation is calculated over 2000-2003 and 2004-2007. The last 2 columns of table 4 report the results shifting the 3-year standard deviation 2 and 3 periods ahead. The 3-year standard deviation is in those 2 samples calculated from 2001-2004 and 2005-2008, and from 2002-2005 and 2006-2009. The averages in the explanatory variables are correspondingly shifted 1, 2 or 3 periods ahead. Using the same approach for the 4-year standard deviation is not feasible as it would reduce the sample size to a single data point. The sign on the interaction between trade credit and trade credit dependence, (β_3), remains positive. The coefficients for β_3 are slightly higher in magnitude and still significant, ruling out the possibility that the previous results are dependent on the choice of the sample period. Also, the coefficient on the interaction term between financial development and trade credit dependence (β_5) remains negative and significant.

Table 3 4: Robustness test: Alternative sample periods.

Pooled OLS regression of volatility in investment share on the average of international trade credit interacted trade credit dependence and the average of financial development in t-1 interacted trade credit dependence and the average of international trade credit interacted trade credit dependence.

	1-year standard deviation	2-year standard deviation	3-year standard deviation	3-year standard deviation	3-year standard deviation
Industry output	12.193*** (2.793)	14.666*** (3.257)	14.848*** (3.372)	16.047*** (3.645)	14.282*** (3.319)
Trade credit	-0.094** (0.033)	-0.121** (0.040)	-0.116* (0.049)	-0.139 (0.089)	-0.196 (0.136)
Financial development	0.004** (0.002)	0.005** (0.002)	0.002 (0.002)	0.003 (0.003)	0.001 (0.004)
Trade credit*Trade credit dependence	1.182** (0.416)	1.353** (0.463)	1.315* (0.573)	1.000** (0.418)	1.436*** (0.394)
Financial development*Trade credit dependence	-0.040** (0.015)	-0.065*** (0.019)	-0.036* (0.014)	-0.048*** (0.017)	-0.036** (0.015)
Number of observations	1606	1,012	746	816	800
F-test	5.04***	5.65***	6.26***	6.76***	6.26***
R^2	0.290	0.391	0.446	0.471	0.474
Root mean squared error	.358	.328	.299	.302	.267
Bayesian Information Criterion	1581.640	660.360	359.615	624.332	416.104
Akaike Information Citerion	1307.183	901.425	576.507	407.929	200.612
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.
Columns 1-3 show results with the 1-, 2- and 3-year standard deviations each shifted one year ahead. Columns 4-5 report results shifting the 3 year standard deviation 2 and 3 periods ahead.

Different forms of financial development

As described in the introduction, a large literature on firm level investment concludes that financing constraints are an important determinant for firms' fixed investment decisions. Hubbard (1998) provides a detailed survey and analysis of this literature. More recently, researchers started analyzing the role of international capital flows for firms' investment decision and a firms' access to external finance. Harrison and McMillan (2003) make use firm level data from the Ivory Coast and find that domestic private firms face more stringent financial constraints than domestic public and foreign firms. They find that on the one hand, foreign investors bring in capital to domestic firms hereby reducing credit constraints but on the other hand, they find a crowding out effect with regard to the availability of bank loans for domes firms induced by foreign owned firms.

Harrison et al. (2004) expand this analysis for different foreign capital inflows and a larger set of countries. For the extended data set, they find that only foreign direct investment flows (FDI) help firms to alleviate financial constraints. This even affects firms in the economy that are not subject to foreign direct investment inflows. They argue that this spillover effect on firms without access to international direct investment results from an increase in the availability of capital in the whole economy as a result of FDI. These results imply that firms use FDI inflows as an additional source of external finance. Considering these results, there might be a substitutability between domestic access to external finance and international access to external finance.

To test the above described implications of international financial flows for my results, I re-estimate the baseline regression replacing the domestic financial development variable with different foreign capital flows, namely total foreign assets, total foreign liabilities, foreign direct investment, foreign portfolio equity and foreign portfolio debt.

All measures are relative to GDP and the data are obtained from the Lane and Milesi-Ferretti "The External Wealth of Nations Dataset" (2007).

The coefficient on the interaction term between trade credit dependence and international capital flows could be either positive or negative for investment share volatility. If access to international capital flows crowds out access to bank loans this would be expected to increase the volatility of industry investment as access to bank loans becomes more uncertain to domestically owned firms. Therefore, β_5 would be expected to be positive. In case access to international trade credit would alleviate this effect, the sign on the coefficient on the interaction term between trade credit dependence and international trade credit (β_3) would be expected to switch from positive, as in combination with domestic financial development, to negative. If, on the other hand, the findings of Harrison et al. (2004) hold for my sample, then the sign on the coefficient on the interaction term between trade credit dependence and international capital flow (β_5) would be expected to be negative, implying a similar dampening effect for industry investment volatility from both, domestic and international financial development.

The results are reported in table 5. The coefficient on the interaction term between trade credit dependence and international trade credit remains positive and significant and slightly higher for the specifications with accumulated international capital flows compared to measures for domestic financial development. Total assets and total liabilities do not seem to have a statistically significant influence on industry investment, neither for all industries nor for trade credit dependent industries in particular. Foreign direct investment (FDI) has a dampening effect on industry investment volatility in more trade credit dependent industries as indicated by a negative significant coefficient on the

interaction term between the trade credit dependency measure and FDI as ratio to GDP.[23] These findings are in line with Harrison et al. (2004) who find a loosening of credit constraints for firms once the economy has more access to FDI inflows. FDI may substitute private credit and hereby reduce credit constraints. This may then reduce the volatility in investment share. The coefficient on the interaction term between average trade credit and trade credit dependence (β_3) remains positive and significant and increases slightly in magnitude.

These empirical findings do not support the hypothesis that FDI might be crowding out access to bank loans hereby increasing the uncertainty for firms' external finance access and therefore increasing the industry investment volatility. Also, trade credit access does not serve as a stabilizing source of finance for trade credit dependent industries.

The results for portfolio equity and portfolio debt are in a similar vein supporting a benefit from additional external financing sources.

[23] Splitting FDI into its external assets and liability components does not change the sign or the significance of the coefficients.

Table 3 5: Equation (1): Baseline results

Pooled OLS regression of volatility in investment share over 3 years on the average of international capital flows interacted with trade credit dependence and the average of international trade credit interacted with trade credit dependence.

	Baseline	Total assets	Total liabilities	FDI	Portfolio equity	Portfolio debt
Industry output	16.152***	16.047***	16.047***	15.893***	15.814***	15.832***
	(4.053)	(4.033)	(4.033)	(3.957)	(3.910)	(3.922)
Trade credit	-0.117*	-0.140*	-0.140*	-0.168*	-0.168*	-0.168*
	(0.056)	(0.061)	(0.061)	(0.069)	(0.068)	(0.068)
Financial development	0.002	0.000	0.000	0.061	-0.156	-0.090
	(0.002)	(0.000)	(0.000)	(0.067)	(0.155)	(0.099)
Trade credit*Trade credit dependence	1.246*	1.525*	1.525*	1.841*	1.817*	1.812*
	(0.660)	(0.720)	(0.720)	(0.816)	(0.799)	(0.799)
Financial development*Trade credit dependence	-0.044**	-0.000	-0.000	-0.263*	-0.505*	-0.382*
	(0.014)	(0.000)	(0.000)	(0.124)	(0.229)	(0.177)
Number of observations	696	762	762	762	762	762
F-test	6.23***	7.18***	7.19***	7.16***	6.88***	6.92***
R^2	0.440	0.432	0.432	0.436	0.437	0.437
Root mean squared error	.314	.303	.303	.302	.302	.302
Bayesian Information Criterion	592.582	387.702	387.703	383.137	380.959	381.814
Akaike Information Citerion	623.033	605.592	605.592	601.027	598.849	599.703
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Clustering the standard errors

Ignoring potential correlation of observations within a group might lead to underestimated standard errors and therefore an over rejection of the null hypothesis that any of the estimated coefficients is statistically significant different from zero. To avoid this potential problem, I re-estimate the baseline specification for the 1-year, 2-year, 3-year, 4-year and 10-year standard deviations using country-industry level clustering of the standard errors. A detailed discussion on the appropriate level of clustering can be found in the previous chapter II of this dissertation. Important for the appropriate level of clustering is (i) that enough clusters are available and, (ii) clustering is at the level at which intra-class correlation is present. The variance analyses of the standard deviation in investment share and the average trade credit as a ratio to GDP show that there is intra-class correlation on both the country and country-industry level but the intra-class correlation on the country-industry level exceeds the intra-class correlation on the country level. There is almost no intra-class correlation on the year level. Therefore, the standard errors are clustered on the country-industry level.

The results for the baseline specifications are reported in table 5. The results are robust for the interaction term between trade credit dependence and international trade credit. The same is true for the most part for the interaction between trade credit dependence and financial development, only the specification over the 1-year standard deviation loses significance in the latter interaction term (p-value 13.4%).

Table 3 6: Robustness test: Alternative specifications

Pooled OLS regression of volatility in investment share over 1, 2, 3, 4 and 10-years on the average of financial development in t-1 the trade credit dependence and the average of international trade credit interacted with trade credit dependence.

	1-year standard deviation in Investment share	2-year standard deviation in Investment share	3-year standard deviation in Investment share	4-year standard deviation in Investment share	10-year standard deviation in Investment share	10-year standard deviation in Investment share
Industry output	8.415***	12.002***	16.152***	17.539***	15.252***	15.711***
	(1.217)	(2.650)	(4.400)	(6.371)	(3.257)	(3.388)
Trade credit	-0.059*	-0.076*	-0.117*	-0.214**	-0.123**	-0.126**
	(0.033)	(0.041)	(0.065)	(0.088)	(0.056)	(0.059)
Financial development	0.004***	0.002**	0.002	-0.001	0.003	
	(0.001)	(0.001)	(0.002)	(0.007)	(0.003)	
Trade credit*Trade credit dependence	0.559	0.910*	1.246*	1.557**	0.860	1.135*
	(0.372)	(0.474)	(0.767)	(0.723)	(0.543)	(0.613)
Financial development*Trade credit dependence	-0.036***	-0.027**	-0.044***	-0.170*	-0.046**	
	(0.011)	(0.011)	(0.016)	(0.099)	(0.019)	
Number of observations	1671	1,090	696	183	417	417
F-test	6.41***	6.71***	7.09***	3.96***	8.12***	8.65***
R^2	0.336	0.409	0.440	0.512	0.562	0.557
Root mean squared error	.217	.251	.314	.444	.229	0.23
Bayesian Information Citerion	-9.356	368.719	623.033	356.558	177.740	176.656
Akaike Information Criterion	-273.972	124.016	409.402	250.645	-3.749	-0.800
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry	Country, Industry

The standard errors are clustered on the country-industry level, country, industry and year fixed effects are included in all specifications except for the 10-year standard deviation. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Financial Crisis

Firms experienced greater uncertainty about their future cash flows and access to external capital during the 2008/2009 financial crisis.[24] Furthermore, international trade broke down and led to an aggravation of this uncertainty.[25] Firms were suddenly cut off from access to working capital as credit markets tightened and international orders decreased. Further, the lack in national and international purchases led to a sudden breakdown in cash flow. Hence, essentially all external and internal sources of financing investment in fixed capital broke down and also future expectations about cash flows and profits were negative. This could have increased the volatility in industry investment for the crisis period and could bias the main results.

To account for this possibility, I re-estimate the baseline sensitivity results for the 1-year standard deviation. This is the only specification including 2008. I cannot re-estimate the 10 year baseline specification excluding 2008 and 2009 due to a limitation in data availability. The results are reported in table 7. The coefficients are robust in significance and sign. The magnitude is even higher when leaving 2008 out indicating that excluding the crisis even increases the effect of the average in trade credit to GDP on the volatility in investment share. Further empirical evidence for the robustness of the results with regard to the financial crisis can be found in table 4. The benchmark results for the 3-year investment volatility are shown to be robust even when including the financial crisis in the data used for the estimation.

[24] BIS (2010)
[25] See Bems et al. (2012) for a detailed review of the literature linking the financial crisis to a breakdown in international trade.

Table 3 7: Robustness test: Excluding financial crisis.

Pooled OLS regression of volatility in investment share over 1 year on the average of international capital flows interacted with trade credit dependence and the average of international trade credit interacted with trade credit dependence.

	1-year standard deviation	1-year standard deviation excluding 2008
Industry output	8.415***	12.193***
	(1.279)	(2.793)
Trade credit	-0.059**	-0.094**
	(0.024)	(0.033)
Financial development	0.004***	0.004**
	(0.001)	(0.002)
Trade credit*Trade credit dependence	0.559**	1.182**
	(0.267)	(0.416)
Financial development*Trade credit dependence	-0.036***	-0.040**
	(0.009)	(0.015)
Number of observations	1469	1606
F test	7.84***	5.04***
R^2	0.336	0.290
Root mean squared error	.217	.358
Bayesian Information Criterion	-273.972	1581.640
Akaike Information Citerion	-9.356	1307.183
Fixed effects	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Conclusions

This chapter focuses on the relationship between international trade credit and investment volatility. The positive relationship between the industries' standard deviation in investment share and the country's international trade credit usage interacted with the industries' trade credit dependency imply that trade credit dependent industries located in a country with a higher average trade credit usage experience higher investment volatility. These results might suggest that trade credit as a form of inter-firm finance creates linkages between firms' which then translate potential shocks through the firms' network. These results are in line with the findings of Raddatz (2010) who argues supplier credit generates a network between firms, leading to credit chains that form chain reactions once one firm is affected by a negative shock.

The findings further suggest that financial development has a dampening effect on industry investment volatility for more trade credit dependent industries. The findings in the previous chapter indicate that trade credit might serve as a substitute for financial development in more trade credit dependent industries. This is reflected by a negative sign of the coefficient on an interaction term between an industry's trade credit dependency and a country's level of financial development regressed on the level of the investment share in the previous chapter. The analysis of this chapter suggests that financial development might lower the volatility in industry investment while trade credit increases the volatility. The important role of financial development for volatility in aggregate consumption, aggregate investment and aggregate output is already mentioned by Denizer et al. (2002) who find that private credit dampens aggregate investment volatility. Further analysis could shed light on the role of different measures for financial development for industry investment under consideration of the industries' different propensities to use trade credit or to depend on external finance.

The specification used here focuses on the averages in the explanatory variables as determinates of the volatility in the industry investment share. Another important question to take into consideration is the stability of the trade credit inflow. The growth in trade credit inflows over time and the stability of the flow might affect industry investment volatility differently. A stable growth in access to international trade credit might dampen the volatility in industry investment if it gives firms a stable source of financing. The approach using averages has the advantage that it smooths out any temporary shocks to trade credit inflows, but in order to capture the stability of the flow, a volatility in trade credit and the growth rate of trade credit might be better suited. Previous literature supplies arguments for the latter argument: Fisman and Love (2003) find that relatively young firms are restricted from access to trade credit as they have not established bonds with

suppliers. Cunat (2007) finds that young firms' trade credit increases in the first years as they develop stronger bonds with their trading partners. Thus, future research might focus on the growth in trade credit, the volatility in the growth in trade credit as a measure for the stability of the inflow, and the effects on the investment volatility of young firms.

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Chapter IV: "The link between International Trade Credit and Industry value added"

Abstract: In this paper, I aim to examine the role of international trade credit on industry value added. Rajan and Zingales (1998) and many other authors suggest that well developed financial institutions play a crucial role for growth in value added. Fisman and Love (2003) expand this idea to the usage of trade credit and show that more trade credit dependent industries have higher industry growth in value added in countries with weak financial institutions. These findings suggest that firms in countries with a lack of access to external finance substitute trade credit for bank credit. In this paper, I examine explicitly the impact of international trade credit. While Fisman and Love (2003) use a cross sectional dataset and regress a 10 year compounding growth rate in industry value added on interactions between financial development and external finance dependence and trade credit dependence, I make use of a panel dataset using the value added share as the dependent variable. The dataset includes 23 manufacturing industries in 30 countries from 1986-2010. Controlling for the different countries' levels of overall development along with access to and dependence on domestic external finance, I show that industries with a higher propensity to use trade credit exhibit a higher value added share when international trade credit is less available, consistent with Fisman and Love's finding on financial development and suggestive that international trade credit is a poor substitute for domestic financial development.

Introduction

This Chapter addresses a potential link between a country's stock in international trade credit within a year and an industry's share in total value added while accounting for the industries' different propensities to use trade credit and to depend on external finance. The results in Chapter II indicate a positive relationship between international trade credit inflows and industry investment, particularly for those industries that rely more on trade credit. This gives implications for an analysis of industry output as previous literature has identified investment as a channel that positively affects economic growth. I examine industry output as measured by industry value added to explore the direct effect of international trade credit. Taking account of industry investment as one driver of industry value added, I ask whether the availability of international trade credit interacted with industry usage of trade credit has a direct impact on value added. I also account for industries' need for external finance and the level of financial development.

An influential empirical paper by King and Levine (1993) shows a link between financial development and long run GDP growth using different measures for banking sector development. They identify growth in capital accumulation and more efficient capital accumulation as channels through which financial development translates into higher future growth. Levine and Zervos (1998) expand this analysis to a broader dataset and include stock market development as an additional source of external finance. Their findings suggest that both, bank sector development and stock market development promote current and future growth, again through a capital accumulation and efficiency channel. Further literature followed this idea by taking it to an industry level. This literature on industry growth has in common that it focuses on different forms of external financing opportunities for firms in a specific country and links it to industry growth, making use of industry varying characteristics. Rajan and Zingales (1998) set a cornerstone in this literature by analyzing the role of a country's financial development for industries' growth in value

added while differentiating among industries based on their dependence on external finance. They find that industries with a higher dependence on external finance experience relatively higher growth in value added in countries with a higher level of financial development. Other authors followed this approach to establish links between different measures of a country's development in banking structure, ownership structure, or accounting standards and industry growth. Cetorelli and Gambera (2001) find that while the availability of credit improves industry growth, banking concentration on average dampens industry growth. The authors attribute this to a dead-weight loss created from a monopoly structure in the banking sector that lowers the availability of loans. On the other hand, Cetorelli and Gambera (2001) also show that industries relatively more dependent on external finance actually experience higher growth under more concentrated banking regimes, potentially due to better lending relationships. Carlin and Mayer (2003) find that higher accounting standards and higher ownership concentration are associated with more growth in industries that depend more on equity financing, whereas higher banking concentration is associated with a lower growth in industries that depend more on equity finance. The authors argue that the synergy arising from the interaction between accounting standards and an industry's dependence on equity finance on growth has its source in the fact that better disclosure standards might be important for a firm's access to stock market finance, an important source of equity for firms. Similarly, a more diffuse ownership structure appears to support outside finance, which, interacted with industries' equity finance, promotes growth. On the other hand, less competition in the banking sector dampens industry growth as the induced monopolistic banking structure increases loan rates, especially for those who depend more on banking finance.

More recently, supplier credit has become a topic of interest with regard to its effects on the economy and its potential substitutionary role for financial development. Ge and Qiu (2007)

analyze the role of trade credit for private firm growth in value added in China, where financial institutions tend to be strongly biased towards public firms in their loan supply, whereas private firms only have limited or no access to bank finance. They find that private firms have higher levels of supplier credit outstanding than public firms and at the same time outperform public firms in terms of their growth in value added. This finding suggests that trade credit can act as a substitute for bank finance for private firms in China. Building on the analysis in Rajan and Zingales (1998), Fisman and Love (2003) show that more external finance dependent industries experience higher growth in value added in countries with a higher level of financial development. As additional support for this effect, Fisman and Love (2003) show empirically that more trade credit reliant industries have higher growth in value added than less reliant industries if both industries are located in a country with less-developed financial institutions. This finding suggests that trade credit might be able to substitute for financial development, in particular for bank credit (or private credit), and benefit industry growth through this channel.

I explore this idea here by examining not only financial development but also a country's use of international trade credit. I focus first on industry output as measured by industry value added as a share of total value added. The choice of a level measure rather than a growth measure is related to the work in Chapter II, where I use the investment share as measure in order to identify relative differences across industries with different propensities to use trade credit. The share sets each industry relative to the total economy and allows to focus on relative industry benefits.

Chapter II provides empirical results indicating that industries with a higher propensity to use trade credit experience a relatively higher investment share in countries with greater availability of international trade credit. The empirical analysis in Chapter II further indicates a higher investment share for those industries depending more on trade credit when there is less domestic

financial development, suggesting trade credit might also substitute for financial development with regard to industry investment. King and Levine (1993) suggest that physical capital accumulation acts as a channel through which financial development fosters economic growth. Trade credit, in particular international trade credit, may provide a potential substitute for access to institutional finance that might also promote growth in value added through an increased level in fixed capital accumulation in more trade credit reliant industries. Further, the World Bank reports that trade credit also acts as an additional source of financing day to day transactions in firms. According to a worldwide survey including 125,000 firms, 10.9 % of working capital is financed by supplier credit. Hence, if this is a crucial source of financing production in firms, it might also translate into a higher relative value added in more trade credit reliant industries.

In this paper, I aim to identify whether trade credit and, in particular international trade credit benefits industries in generating value added. This effect could be either through the investment channel or through offering additional financing opportunities for working capital as a substitute for other forms of finance. If the positive effect that a country's level of international trade credit has on more trade credit dependent industries' investment passes through into value added, then more trade credit dependent industries should also have a higher share in value added once a country has a higher inflow in international trade credit. Similarly, if international trade credit can serve as an additional source of financing working capital, this should be reflected in a higher value added share in more trade credit dependent industries located in countries with a higher trade credit inflow. On the other hand, the effect could also move in the opposite direction. The additional investment generated through international trade credit might not be efficient in the sense that there might be an overinvestment from this additional finance which does not lead to an improvement in the productivity. Then, this could be reflected in negative relationship between

trade credit and value added in industries with a higher propensity to use trade credit. The effect could also offset a potential positive relationship between trade credit and value added through the working capital channel.

The approach I use is closely related to Fisman and Love (2003) who focus on the role of trade credit dependence for growth in value added, making use of an approach first implemented by Rajan and Zingales (1998), where industries are ranked according to their dependence on trade credit. This approach makes use of across industry variation and links country specific variables to industry characteristics, distinguishing between differently ranked industries. The effect can therefore be interpreted as a differential effect influencing industries dependent on their ranking in the cross-industry varying variable of interest in different country settings. For example, Rajan and Zingales (1998) link industries' different dependence on external finance interacted with a countries financial development to industry growth in value added. While Fisman and Love (2003) use a cross sectional dataset to analyze the role of financial development and trade credit for industry's 10-year growth in value added, I make use of a panel data set and focus on the share of industry value added, which is calculated as value added of an industry relative to the value added in the economy. Further, I aim to explore the effect of international trade credit on industry value added in more trade credit dependent industries through the above described channels.

My findings suggest that access to international trade credit is linked to industries' value added share. The results indicate a lower value added share in more trade credit reliant industries once a country has a higher access to international trade credit. These results are robust with respect to different sensitivity tests and alternative specifications. The results further indicate that there might be a substitutionary relationship between financial development and trade credit regarding the industry value added share. This result complements a finding by Fisman and Love (2003) who

find a substitutionary relationship between trade credit and financial development with respect to industry growth in value added.

The remainder of the paper is structured as followed: Section II introduces the methodology and the main hypotheses. Section III describes the data used with results in Section IV. Finally, Section V concludes and gives some suggestions for further research.

Hypothesis and Approach

As discussed above, there might be different channels through which industry value added could be positively or negatively affected by higher trade credit inflows. In either case, the effect should be more pronounced in industries with a higher propensity to use trade credit. To test this theoretical idea empirically, I use the following regression equation:

$$\begin{aligned} VA_{c,i,t} = {} & \beta_0 + \beta_1\left(country\ development_{c,i,t}\right) + \beta_2\left(international\ trade\ credit_{c,t}\right) \\ & + \beta_3\left(financial\ development_{c,t}\right) \\ & + \beta_4\left(trade\ credit\ dependence_i * international\ trade\ credit_{c,t}\right) \\ & + \beta_5\left(external\ finance\ dependence_i * international\ trade\ credit_{c,t}\right) \\ & + \beta_6\left(trade\ credit\ dependence_i * financial\ market\ development_{c,t}\right) \\ & + \beta_7\left(external\ finance\ dependence_i * financial\ market\ development_{c,t}\right) \\ & + \gamma_c + \gamma_i + \gamma_t + \varepsilon_{c,i,t} \end{aligned} \quad (1)$$

where c is the country, i the industry and t the year index. VA is industry value added relative to total value added and varies by country, industry and time. Following the argument in Rajan and Zingales (1998), the interaction terms give estimates for the within country differences across industries. The main explanatory variables of interest are trade credit dependence, measured as an industry feature using U.S. data, and international trade credit, measured across countries and time. I also control for external finance dependence, which is the propensity of an industry to rely on external finance, and domestic financial development at the country level. γ_c and γ_i are country

and industry specific effects to control for unobservable industry and country specific factors influencing an industry's investment. γ_t are year specific dummies to control for effects that influence countries and industries the same way (e.g. a global crisis or global interest rate changes).

The idea discussed in the previous section implies that international trade credit could affect industry value added through two different channels. First, it could affect industry value added through an investment channel. King and Levine (1993) empirically show this channel for GDP growth. Second, in a World Bank survey on average about 10% of the about 125,000 worldwide surveyed firms state to use trade credit as a source of working capital. If international trade credit plays a role for financing day to day production processes, this might then feed into a higher value added share in industries with a higher propensity to use trade credit. If these predictions hold, the coefficient on the interaction term between trade credit dependence and international trade credit (β_4) will be positive.

The empirical results in Chapter II suggest that more trade credit dependent industries experience a relatively higher investment share in countries with a lower financial development, suggesting a substitutionary relationship between trade credit and financial development. This might either affect industry value added through the investment financing channel or directly. If trade credit works as a substitute for financial development for industry investment only, the coefficient on the interaction term between trade credit dependence and financial development (β_6) is expected to be insignificant. This would imply that trade credit dependent industries do not have a relatively higher value added in countries with less financial development. If trade credit works as a substitute for financial development for industry value added in industries with a higher propensity to use trade credit, then the coefficient on the interaction term between trade credit and financial development (β_6) would be expected to be negative. Fisman and Love (2003) find a

negative relationship between trade credit dependency interacted with financial development and growth in value added, indicating that more trade credit dependent industries experience a higher growth in value added in coutries with a lower financial development. They argue this results might indicate a substitutionary relationship between trade credit and financial development.

There might also be a beneficial effect for value added from financial development for those industries that rely more on external finance. This is captured by the coefficient β_7 . The coefficient would be expected to be positive if the beneficial effect of financial development increases in an industry's dependence on external finance.

Following the literature on determinants of growth in value added I control for country development by including the log of GDP per capita. While the literature on growth in value added argues that more developed countries experience lower growth, the effect of higher overall development on industries' value added share is expected to be positive. Better developed countries should experience higher levels in value added as they have better developed infrastructure, higher skilled labor and access to better technologies, giving them a comparative advantage over less developed economies. Therefore, the expected sign of β_1 is expected to be positive.

Data description

Industry level data

I use Data for 23 manufacturing industries in 30 countries from 1986-2010. The industry level data on the dependent variable of interest, value added share, is drawn from the OECD Stan Database and varies by industry, country, and time. The industry share in value added is calculated

as industry value added relative to total value added in the economy.[26] The indicator represents a measure for an individual industry's importance for the economy in generating additional output value. I also consider industry output as an alternative dependent variable.

The industry characteristics, trade credit dependence and external finance dependence, are taken from Fisman and Love (2003). The measure for an industry's propensity to use trade credit is based on Compustat data that includes US firms in 37 manufacturing industries. I use the industry ranking by trade credit dependence as reported in their paper. They calculate the industry dependence on trade credit using the ratio of accounts payable, which is trade credit outstanding and equivalent to the term trade credit throughout the paper, to total assets for each firm in 1980, then take the median of all firm observations in 1980 for each industry as their final measure of this industry characteristic. I use this measure to characterize the propensity of each specific industry to use trade credit, which is then interacted with country-level measures of international trade credit or financial development. Fisman and Love (2003) argue, in line with Rajan and Zingales (1998), that a dependency measure calculated from US data is the appropriate variable to use as the United States represents the "optimal capital market" and therefore firms' decisions on trade credit or external finance are likely to represent the desired level of trade credit or external finance. Further literature on trade credit suggests that the propensity to use trade credit is related to several industry specific characteristics. As described in the literature review in Chapter I, properties of certain goods increase the regularity to use trade credit as a warranty for the quality or as a signal for the quality.[27] These properties do vary less within industries than across industries. Ng et al. (1999) provide empirical evidence that there is little variation in credit terms within

[26] As the sample includes solely manufacturing industries, I consider using the industry value added share relative to manufacturing industries instead which yields similar regression results.
[27] See for example Lee and Stowe (1993). Cunat (2007) and Engemann et al. (2014) extend the idea to international trade.

industries but wide variation across industries drawn from a dataset on US firms. Using these arguments, I use this measure as a proxy for an industry's natural level of trade credit usage, and exclude the United States from the sample to minimize any feedback effects. Importantly, it is the ranking of industries by this measure that matters, rather than the actual value of the measure. To compare my results to previous literature and to show whether my proposed interactions provide additional explanatory value, I also use the external finance dependence measure as reported in Fisman and Love (2003). A similar measure was first used by Rajan and Zingales (1998) and represents the portion of assets externally financed. It is calculated using the same US data as the trade credit dependence measure. External finance dependence is calculated as total assets minus retained earnings as a ratio to total assets for each firm in 1980. The industry median in 1980 for each industry is used as the industry characteristic. Like the trade credit dependence measure, I interact the external finance dependence measure with the country-level variables of interest (in this case domestic financial development and aggregate international trade credit).

Country level Data

The main variable of interest is aggregate international trade credit used by the private sector in a country within a year. As previously described, trade credit could affect industry value added through two different channels. First, a higher level of trade credit in a country might increase the value added share in industries that depend relatively more on the use of trade credit by providing an additional source of financing working capital. Second, a higher level of trade credit might foster industry value added through an investment channel. On the other hand, the additional investment generated through international trade credit might not be efficient in the sense that there might be an overinvestment from this additional finance which does not lead to an improvement in the productivity. Then, this could be reflected in negative relationship between trade credit and

value added in industries with a higher propensity to use trade credit. The effect could also offset a potential positive relationship between trade credit and value added through the working capital channel.

The empirical findings in Chapter II suggest that industries with a higher propensity to use trade credit experience a higher investment share in countries with higher trade credit inflows. Following King and Levine (1993) who empirically show a channel though which GDP growth is increasing in investment, I argue the same channel might also apply for industry value added in manufacturing industries.

The measure for trade credit used here is solely international trade credit and differs from previous papers that use aggregate trade credit, which might be domestic or international credit granted by suppliers. The measure for international trade credit is from the IMF balance of payments statistics and represents the aggregate of trade credit liabilities used by both the private sector and the government within a year. Trade credit liabilities are of interest as a potential source of additional finance to firms. As my goal is to examine private investment by firms, trade credit liabilities in the private sector would be a preferred measure. However the data coverage for trade credit liabilities solely in the private sector is very limited and much of the data are reported as an aggregate of private sector plus government usage. For those that do exist, the individual numbers show that there are rarely any differences between the private sector and the private sector plus government. Moreover, the correlation is close to one. International trade credit enters the equation as a ratio to GDP to account for country size and to make the measure comparable to the financial development measures used.

To control for potential effects of financial development on industry value added in industries with different propensities to use trade credit and in industries with different levels of external

finance dependence, I use the ratio of private credit by deposit money banks to GDP as the main measure. This measure represents access to credit for the private sector within a country and is expected to affect industry value added positively as frictionless access to loans allows firms to obtain better access to external finance for working capital and investment. The effect is expected to be more pronounced for industries that depend more on external finance. The data are drawn from the financial development and structure dataset published by Beck et al. (2000) and updated by Čihák et al. (2012).

Descriptive Statistics

The data set used in the analysis comprises observations on the above described measures for 23 manufacturing industries in 30 countries from 1986 to 2010.[28] Table 1 presents some descriptive statistics.

Table 4 1: Descriptive Statistics

Variable	Mean	Standard deviation	Minimum	Maximum	25th percentile	50th percentile	75th percentile	Number of obs.
Value added share[a]	.879%	.851%	-.149%	11.487%	.277%	.648%	1.188%	12,369
Trade credit/GDP[b]	2.635%	2.509%	0.00006%	12.783%	0.482%	2.130%	3.819%	10,120
Private credit by deposit banks/GDP[b]	78.754	47.549	8.694	272.809	39.79	73.81	105.59	14,697
Investment share[a]	.732%	.947	-.283%	14.503%	.147%	.442%	.959%	4,260
Log GDP per Capita[b]	10.186	.652	8.615	11.608	9.782	10.378	10.623	15,824

a: calculated across all industries, countries and time.
b: calculated across all countries and time.

[28] namely Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom.

Table 2 provides a correlation analysis between the industry specific characteristics and the main country specific variables.

Table 4 2: Correlation analysis

	Value added share	Trade credit	Private credit by deposit banks/GDP	Trade credit dependence	External finance dependence
Trade credit	0.0289	1			
Private credit by deposit banks/GDP	-0.1056	-0.1866	1		
Trade credit dependence	0.1751	0.0179	0.0003	1	
External Finance dependence	-0.1172	-0.0017	0.0042	-0.1836	1
Investment share	0.7296	0.1153	-0.2480	0.2332	-0.0307

The correlation analysis shows that an industry's value added share is positively related to trade credit and an industry's investment share while it is negatively related to private credit. Aggregate trade credit is negatively related to the measure of external finance dependence but positively related to the measure of trade credit dependence. The trade credit dependence measure and external finance dependence measure are negatively correlated. Thus, these industry measures are picking up different industry characteristics. The industry's value added share is negatively related to external finance dependence but positively related to trade credit dependence.

While industry value added is positively related to trade credit dependence and to trade credit usage, the correlations are less than 0.5. What may matter, however, is how the trade credit dependence interacted with aggregate trade credit affects the industry investment share.

Results

Main findings

Table 3 shows the results from equation (1) using a pooled ordinary least squares regression of industry value added share on the interaction terms with international trade credit, the main measure through which the suggested financing channels are suggested to work. The coefficient on the interaction between trade credit dependence and aggregate trade credit (β_4) is negative and statistically significant in all 6 columns in Table 3. This is contrary to the above stated hypothesis that industries with a higher propensity to use trade credit benefit from the availability of trade credit at the aggregate level. The result suggests that trade credit dependent industries experience a lower value added share in countries with greater usage of trade credit, indicating that neither the proposed investment channel nor the working capital channel work, or, one of the channels offsets the other.

Including the interaction term between trade credit and external finance dependence, β_5, results in a negative coefficient once the industry value added is regressed on the interaction term. This result suggests that external finance dependent industries also do not benefit from being located in a country with a higher level of trade credit. The result is not robust across different specification and the significance vanishes once interaction terms with financial development are included.

Adding the interaction term between trade credit dependence and financial development, β_6, improves the model slightly in terms of the model selection criteria. The coefficient on this additional interaction term (between trade credit dependence and financial development) is significant and negative, which is similar to the finding in Fisman and Love (2003) for their regressions on the industry growth in value added. Here, industries that are more reliant on trade credit do not benefit from financial development in terms of value added. In other words, more

trade credit dependent industries have higher value added shares in countries with lower financial development relative to countries with higher financial development, perhaps indicating that trade credit in general (nationally and internationally granted) substitutes for other forms of credit and this then feeds into a higher share in value added through the proposed channels.

The different model selection criteria do not lead to the same conclusion with respect to which specification should be chosen. In general, Schwartz criterion is usually the more preferred selection criterion as it penalizes for including additional explanatory variables and is minimized for specification (3). However, as the coefficient on the interaction term between financial development and external finance (β_7) enters the model significantly, adding to a significant individual effect of financial development, specification (5), where the Akaike Information Criterion is minimized, is chosen here as the baseline result. The link between financial development interacted with external finance dependence is positive. It is important to note, however, that the sign and size of the coefficients are similar across all specifications.

The coefficient on the main interaction term between trade credit dependence and international trade credit in specification (5) is equal to -1.114. The magnitude of this coefficient can be interpreted in the following way:[29] An industry with the average trade credit dependence of 0.088 responds to an increase in the inflow of international trade credit by 1 standard deviation (2.509%) (or approximately increasing trade credit from the level of the Netherlands in 2005 to the level of the Slovak Republic in 2005) by a decline in value added share by -1.114*0.088*2.509%=0.25% points. Compared to the average value added share over all countries, which is 0.879%, this effect is also economically significant.

[29] see for example Hu and Png (2013) who analyze the effect of patent rights on economic growth.

Overall, the negative significant coefficient on the primary interaction term (β_4) implies that international trade credit plays a role for value added of trade credit dependent industries. Trade credit dependent industries respond with a lower share in value added once they are located in a country that has a higher share of trade credit liabilities in the Balance of Payments statistics within a year. This contradicts the expected effect of international trade credit inflows on trade credit dependent industries. Further, the negative coefficient on the interaction term between trade credit dependence and financial development suggest that trade credit dependent industries have a higher value added share in countries with a lower financial development. This finding suggests that the availability of trade credit in general might substitute for domestic financial development. An industry with a relatively high trade credit dependency outperforms an industry with a relatively low trade credit dependency in terms of their value added share in a country with a relatively financial development. The differential effect is approximately 0.3% points and therefore economically significant.

Table 4 3: Equation (1): Benchmark Results

Pooled OLS regression of value added share on international trade credit interacted with trade credit dependence and external finance dependence, and financial development interacted with trade credit dependence and external finance dependence.

	(1)	(2)	(3)	(4)	(5)	(6)
Country development	0.341**	0.341**	0.279**	0.279**	0.278**	0.279**
	(0.134)	(0.134)	(0.134)	(0.134)	(0.133)	(0.133)
Trade credit	0.087***	0.154***	0.095***	0.100***	0.096***	0.091***
	(0.018)	(0.025)	(0.019)	(0.024)	(0.019)	(0.025)
Financial development			0.006***	0.006***	0.004***	0.004***
			(0.001)	(0.001)	(0.001)	(0.001)
Trade credit*Trade credit dependence	-1.044***	-1.128***	-1.106***	-1.112***	-1.114***	-1.108***
	(0.195)	(0.191)	(0.199)	(0.193)	(0.200)	(0.193)
Trade credit*external finance dependence		-0.082***		-0.006		0.006
		(0.027)		(0.027)		(0.027)
Financial development*Trade credit dependence			-0.084***	-0.084***	-0.081***	-0.081***
			(0.010)	(0.010)	(0.010)	(0.010)
Financial development*External finance dependence					0.003**	0.003**
					(0.001)	(0.001)
Number of observations	8283	8283	7555	7555	7555	7555
F-test	173.15***	173.31***	169.72***	167.72***	168.74***	166.79***
R^2	0.531	0.531	0.548	0.548	0.548	0.548
Root mean squared error	.613	.613	.588	.588	.588	.588
Bayesian Information Criterion	15975.756	15979.615	13990.367	13999.266	13996.643	14005.546
Akaike Information Citerion	15470.174	15467.012	13484.479	13486.448	13483.825	13485.799
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Other Specifications

In this section, I include the industries' investment share as an explanatory variable for the value-added share. Industry investment may be one of the factors that can be linked to the level of output in an industry. Consequently, there may be a link between an industry's value added share and its investment share. The relationship is expected to be positive, with industries that have a higher relative investment also having a relatively higher value added share. Table 4 reports the results for this specification, where the industry investment share is included as an additional explanatory variable. Including this measure limits the dataset to 23 manufacturing industries in 20 countries from 1999-2009.[30] The range of data is restricted by OECD data availability. The OECD stopped reporting the investment shares in 2009 and switched to a different classification system. Further, the country coverage before 1999 is limited, therefore 1999 is chosen as a cutoff point.

The result indicates a positive and significant relationship between an industry's investment share and an industry's value added. The coefficient on the interaction term between trade credit and trade credit dependence remains negative and significant in all 6 specifications. The magnitude of the coefficient decreases slightly. The coefficients on the other interaction terms remain similar in magnitude and sign but lose significance, perhaps due to the limited sample size.

Importantly, this result may help explain the negative coefficient on the interaction between trade credit dependence and international trade credit. As Chapter II shows, trade credit plays a positive role for the investment share, particularly for those industries that depend more heavily on trade credit. Controlling for the investment share shows that it has a positive impact on value added.

[30] namely Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom.

Thus, the direct impact of international trade credit on the value added share being negative may indicate that these industries do not see an additional benefit from access to international trade credit. That is, trade credit dependent industries are benefitting from international trade credit for investment but they do not see an additional gain for value added.

Table 4 4: Equation (1): Including investment share

Pooled OLS regression of value added share on international trade credit interacted with trade credit dependence and external finance dependence, and financial development interacted with trade credit dependence and external finance dependence.

	(1)	(2)	(3)	(4)	(5)	(6)
Investment share	0.457***	0.457***	0.450***	0.450***	0.450***	0.450***
	(0.055)	(0.055)	(0.056)	(0.056)	(0.056)	(0.056)
Country development	0.360**	0.360**	0.332**	0.332**	0.332**	0.332**
	(0.148)	(0.148)	(0.156)	(0.156)	(0.156)	(0.156)
Trade credit	0.073***	0.085***	0.078***	0.089***	0.078***	0.086***
	(0.018)	(0.027)	(0.019)	(0.027)	(0.019)	(0.027)
Financial development			0.001	0.001	0.000	0.001
			(0.001)	(0.001)	(0.002)	(0.002)
Trade credit*Trade credit dependence	-0.844***	-0.859***	-0.904***	-0.917***	-0.909***	-0.916***
	(0.199)	(0.201)	(0.213)	(0.214)	(0.214)	(0.214)
Trade credit*external finance dependence		-0.015		-0.013		-0.009
		(0.025)		(0.025)		(0.027)
Financial development*Trade credit dependence			-0.016	-0.016	-0.015	-0.015
			(0.013)	(0.013)	(0.013)	(0.013)
Financial development*External finance dependence					0.001	0.001
					(0.001)	(0.002)
Number of observations	3297	3297	3211	3211	3211	3211
F-test	253.68***	248.64***	235.63***	231.15***	231.61***	227.33***
R^2	0.740	0.740	0.737	0.737	0.737	0.737
Root mean squared error	.427	.427	.429	.429	.429	.429
Bayesian Information Criterion	4116.789	4124.715	4063.911	4071.850	4071.747	4079.760
Akaike Information Citerion	3793.448	3795.273	3729.823	3731.687	3731.584	3733.522
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Robust Standard errors in parentheses. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Sensitivity Analysis

In this section, I examine the sensitivity of the benchmark regression result to the specification chosen. One issue is whether and how the standard errors should be clustered. Potential correlation of observations within a group can lead to overestimated standard errors and hence an over-rejection of the null hypothesis that the coefficients of interest are actually statistically significantly different from zero. While Tables 3 and 4 include robust standard errors, some previous literature suggests clustering the errors to ensure correct statistical inference.[31]

The cluster robust results for equation (1) specification (5) in Table 3 are reported in Table 5. Column (1) reports the benchmark results from Table 3. Column (2) provides results when errors are clustered on the country level and column (3) provides results when errors are clustered on the country-industry level. The results are generally robust to clustering the errors using either method. While the interaction between financial development and external finance dependence and the individual effect of financial development lose significance, the former drops to 33% and the latter to 24% in p-value (in column (3)).

[31] For example: Moulton (1986); Cameron and Miller (2008)

Table 4 5: Robustness test: Cluster robust standard errors

Pooled OLS regression of value added share on international trade credit interacted with trade credit dependence and external finance dependence, and financial development interacted with trade credit dependence and external finance dependence.

	(1)	(2)	(3)
Country development	0.278**	0.278***	0.278*
	(0.133)	(0.037)	(0.156)
Trade credit	0.096***	0.096***	0.096*
	(0.019)	(0.010)	(0.054)
Financial development	0.004***	0.004*	0.004
	(0.001)	(0.002)	(0.003)
Trade credit*Trade credit dependence	-1.114***	-1.114***	-1.114*
	(0.200)	(0.121)	(0.602)
Financial development*Trade credit dependence	-0.081***	-0.081***	-0.081***
	(0.010)	(0.011)	(0.023)
Financial development*External finance dependence	0.003**	0.003*	0.003
	(0.001)	(0.002)	(0.003)
Number of observations	7555	7555	7555
F-test	168.74***	18.55***	18.55***
R^2	0.548	0.548	0.548
Root mean squared error	.588	.588	.588
Bayesian Information Criterion	13996.643	13541.215	13996.643
Akaike Information Citerion	13483.825	13381.825	13483.825
Fixed effects	Country, Industry, Year	Country, Industry, Year	Country, Industry, Year

Clustered Standard errors in parentheses. (1) robust errors, (2) errors clustered by country, (3) errors clustered by country-industry. *significant at 10% level; **significant at 5% level; ***significant at 1% level.

Discussion

This chapter focuses on the relationship between international trade credit and the industry value added share. The negative relationship between international trade credit inflows and an industries' value added once the industry's different propensity to use trade credit is accounted for, implies that international trade credit does not provide an additional benefit to industry value added for those industries that rely on trade credit. The proposed channels where an investment channel through which a higher investment share in more trade credit dependent industries was thought to benefit industry value added in those industries and, a working capital channel, through which international trade credit was suggested to help firms to increase their value added by getting access to an additional source of financing working capital. The results suggest that either both channels fail to benefit industries in the case of international trade credit, or one channel offsets the other.

An explanation for an international trade credit to benefit industry value added share could have its ground in investment efficiency considerations. The additional investment generated through international trade credit might not be efficient in the sense that there might be an overinvestment from this additional finance and not lead to an improvement in the productivity. This idea could be tested with an approach to test the improvement of efficiency of investment similar to the approach in King and Levine (1993), who tested the efficiency of private investment in countries with different stages of financial development. Important here is also to distinguish between trade credit in general and international trade credit. The results on the negative relationship between trade credit and value added share in this chapter are grounded solely on international trade credit. The dampening effect comes from the interaction between trade credit dependency and international trade credit whereas the overall effect of international trade credit on the value added share is positive but small (0.007% points for the mean dependent industry). So, the relationship

between international trade credit and industry value added is positive for less trade credit dependent industries (below average dependency), while it is negative for more trade credit dependent industries. At the same time, the results also indicate that industries with a higher trade credit dependency experience a higher value added share in countries with lower financial development, suggesting there might be a substitutionary relationship between trade credit in general (internationally and nationally granted) and financial development.

Another idea to explain the negative relationship between international trade credit and value added share in trade credit dependent industries might come from a further analysis of the output share. The source of supplier credit is through some sort of purchase, more trade credit dependent industries might purchase input factors at relatively high prices compared to their sale prices and might therefore not generate too much additional value added. An analysis of the output share as measure for an industry's output relative to the total economy might therefore give deeper insight.

At this point, the policy implications from the findings in Chapter II and here indicate that the availability of international trade credit benefits investment directly, which then has feed-on effects to industry value added. There appears to be an additional negative channel for international trade credit availability to impact value added differently for those industries that rely on trade credit. Hence, industries that rely less on trade credit may actually see a benefit from greater availability of trade credit in terms of their value added share. Further research on the potential channels can be undertaken by considering the output share as an alternative dependent variable. In addition, considering how growth in value added responds compared to the value added share may provide additional insight on the channels by which international trade credit can impact industry output and growth.

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Chapter V: Conclusion

This dissertation focusses on the link between international trade credit as an additional source of finance on industry performance variables. The underlying idea is to identify whether international trade credit might be suitable source of finance for firms and affects their operating decisions and whether this effect is strong enough to feed into differences in industry performance when comparing industries relying more on trade credit with industries relying less on trade credit. The findings suggest that international trade credit and trade credit as a general measure can be linked to industry performance measures.

The first chapter gives an overview of the literature on trade credit, including different theoretical and empirical approaches to explain why (i) individuals may have an incentive to provide trade credit, (ii) how trade credit might substitute or complement for other forms of external finance and, (ii) the role of trade credit in international transactions.

The second chapter focusses on the relationship between trade credit and industry investment. Applying an approach first implemented by Rajan and Zingales (1998) on a dataset on international trade credit, I am able to show that international trade credit and trade flows, both relative to GDP, have a significant positive effect on industry investment for those industries with a higher propensity to use trade credit. The effect is even more pronounced for industries with relatively higher imports. While a large literature focuses on financial openness as a source of financing for firms and hence on output and investment, I am able to show that trade also plays an important role.

The third chapter focuses on the relationship between international trade credit and industry investment volatility taking industry specific differences in the propensity to use trade credit into account. I find a positive relationship between industry investment volatility and international trade credit for industries with a dependency above median and a negative relationship for industries

with an dependency below median. The positive relationship between the industries' standard deviation in investment share and the country's international trade credit usage interacted with the industries' trade credit dependency implies that trade credit dependent industries located in a country with a higher average trade credit usage experience higher investment volatility. These results might suggest that trade credit as a form of inter-firm finance creates linkages between firms which then translate potential shocks through the firms' network.

The third chapter focusses on a channel through which international trade credit might affect industry growth in value added. Accounting for an industry's propensity to make use of trade credit, I find a negative relationship between international trade credit and industry value added and a positive relationship between trade credit as a general and industry value added. The proposed channels where an investment channel through which a higher investment share in more trade credit dependent industries was thought to benefit industry value added in those industries and, a working capital channel, through which international trade credit was suggested to help firms to increase their value added by getting access to an additional source of financing working capital. The results suggest that either both channels fail to benefit industries in the case of international trade credit, or one channel offsets the other.

Overall concluding, I am able to show an empirical link between industry performance measures and international trade credit. This link gives rise to potential policy implications: trade openness not only benefits a country in the sense of comparative advantage and broader markets but it also may open a channel for industry finance. Thus, import restricting policies may harm a country by cutting off a form of finance, not only by eliminating gains from international trade.

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