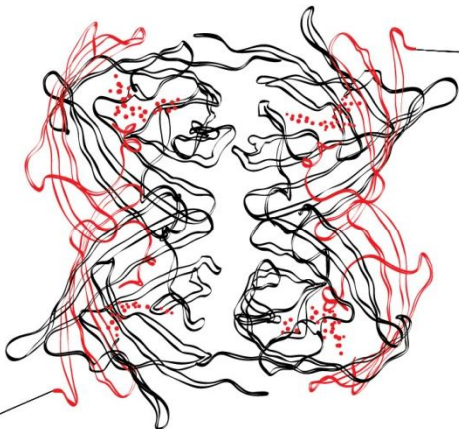Master thesis Business Administration,

Specialisation track: Financial Management

Trade credit as a shock absorber?

The effects of the financial crisis on the use of trade credit by Dutch manufacturing firms

By Thomas Grave

UNIVERSITEIT TWENTE.

Trade credit as a shock absorber?: The effects of the financial crisis on the use of trade credit by Dutch manufacturing firms.

by

Thomas Grave, BSc

E-mailadress: Tgrave85@gmail.com
Telephone: +31 6 28272621

Master Thesis,
Business Administration, specialisation track Financial Management

Deventer, 20th August 2011

UNIVERSITY OF TWENTE.

School of Management and Governance

Postbus 217

7500 AE Enschede, The Netherlands

Supervisors:

Kabir, R. Prof. Dr.   Department Finance and Accounting (F&A)

Roorda, B. Dr.   Department Finance and Accounting (F&A)

Abstract

The purpose of this study was to investigate the relation between the creditworthiness of a firm and its trade credit usage during the financial crisis, by using ANOVA-analysis and ordinary least square regressions. First by focusing on the aggregate pattern in the usage of trade credit by Dutch manufacturing firms. Secondly the study focused on creditworthiness indicators to see whether a creditworthy firm has different trade credit behaviour compared to less creditworthy firms during the financial crisis.

Many firms suffer from the reluctance to extend credit by the financial sector. The banking sector use more strict criteria for extending loans according to the Dutch Central Bank (2009). As a result of this shortage firms try to obtain finance through other sources. One of their options is trade credit.

A firm creates trade credit when it does not immediately pays its supplier for delivered goods. It is common to separate deliveries from payments. Petersen and Rajan (1997) introduce three explanations for the use of trade credit: suppliers have a financial advantage, trade credit is a way to price discriminate and trade credit lowers transaction costs.

In the context of the financial advantage and price discrimination theory, it was Meltzer in 1960 which was the first to introduce trade credit as a channel to redistribute obtained bank credit to less creditworthy customers. The objective of this research is to find evidence of the existence of a trade credit channel to offset the reluctance of the capital market during the current financial crisis.

In this study ANOVA-analysis and Ordinary Least Square regressions were conducted. The data were obtained from the balance sheets of 53 Dutch manufacturing firms. The period of analysis was 2005-2009, three years before the start of the crisis and two years during the crisis. The study proposed three regression models: trade receivables, trade payables and net trade credit.

The results of this study were contrary to the expected patterns. First, the aggregate pattern of trade credit usage was downward. Most firms reduced the amount of trade credit extended (trade receivables) and obtained (trade payables). Contrary theory suggested

an increase in trade credit usage during recessions of periods of monetary contraction. Probably the extreme and global impact of the financial crisis caused the opposite pattern. At some point in a crisis bank lending is cut to an extent that the redistribution of credit through the trade credit channel constipates.

Secondly, the heterogeneous firm responses (based on the creditworthiness of a firm) did not indicate that trade credit is able to offset the reduced availability of bank loans. This study presented no substantial prove that the creditworthiness of a firm to a crisis predicts heterogeneous responses in trade credit usage of firms.

This research illustrated the decrease in trade credit overall during the financial crisis. Theoretical it is illogical that the decrease in trade credit is demand-driven: i.e. a reduction in the supply of trade credit is the cause of the observed decrease in trade credit. Since the availability of external capital diminished in the financial crisis, it would be logical that the demand for an alternative like trade credit increases. Therefore it is interesting to investigate what causes the supply to dry up in a severe global financial crisis. Contrary to recessions and monetary contractions where net trade credit indeed increased. Moreover it would be interesting to see in the future how to trade credit recovers from this decline during the financial crisis.

Preface

Ever since the beginning of the financial crisis I am fascinated by its effects on the economy globally. Inevitably it was quite clear that the subject of my thesis had to be closely associated to the financial crisis. In September 2010 I read a newspaper article about trade credit. I started searching for academic articles and found an article which suggested that trade credit is able to temper the effects of reduced availability of bank credit. I wondered if this concept played any role during the current financial crisis. Because of this curiosity I started writing a research proposal, which led to this thesis.

I would really like to express my thanks to all the people who have devoted their precious time and support, with the intention to make this research a success. First of all I would like to thank my primary supervisor, Prof. Dr. R. Kabir, because of his valuable feedback and constructive criticism. Also, my thanks to my second supervisor, Dr. B. Roorda. I am deeply grateful for his suggestions how to improve the regression analysis. Additionally, I would like to thank Fred Koelen and Adriaan de Haan for reading critically my thesis. I have received in record time, useful grammatical suggestions and corrections. Above all I would like to thank my friends and family for their mental support during the last phase of my study.

I hope the reader enjoys reading this thesis. Please do not hesitate to contact me if you have any questions or remarks.

Thomas Grave, 20th August 2011

"Obstacles are those frightful things you see
when you take your eyes off your goal."
-- Henry Ford

Table of contents

List of tables and figures

Tables

Figures

Chapter 1:   Introduction

Currently the effects of the financial crisis become more and more clear and are subject of many news items. A major consequence of this crisis is the reluctance of financial institutions to supply credit to firms in the Netherlands. A publication of De Nederlandse Bank (the Dutch Central Bank (DNB)) indicates that already in 2007 banks in the Netherlands use more strict criteria for extending loans (DNB, 2009).

Next to the fact that firms suffer from a declining demand resulting in lower sales, the reduced availability of credit can lead to serious cash flow problems. Academic studies have indicated the importance of credit on firm growth and as a consequence the indirect effect on the employment and the gross domestic product (GDP) of a country (Rajan & Zingales, 1998). Therefore the contraction of credit provided by financial institutions can seriously harm employment and GDP, which ultimately result in more declining sales: a viscous circle is born.

In periods of financial contraction there are signals that firms in financial distress – due to reduced supply of (bank) credit – rely on their suppliers by means of trade credit. A qualitative investigation held among Dutch credit managers in 2010 conducted by the "Vereniging voor credit management" (VVCM, 2010) clearly illustrates this development. The average repayment period of trade credit in 2010 compared with 2005 is substantial longer. A longer period to pay suppliers for delivered goods/services provides the firm additional credit. The firm needs less funds from other financial sources to finance its operations.

Suppliers which have good access to the capital market can provide its customers with additional trade credit by extending the repayment period. These suppliers can partly *redistribute* funds from the capital market to its customers through trade credit. In the early 60s Meltzer (1960) wrote about this *redistribution* function of trade credit. This phenomenon is the main issue in this research: the connection between the financial crisis and the use of trade credit. The reason for writing this research is the fact that this subject is extremely relevant at the moment, because of the current global financial

crisis. Governments, central banks and firms are struggling to find solutions to overcome the financial crisis, is trade credit a tool to soften the effects of the financial crisis?

1.1　Background: the use of trade credit and financial crises

To overcome this financial contraction, various lending channel literature discuss the role of trade credit as a substitute for bank credit (Meltzer, 1960) and on the other hand as complementary for bank credit (Burkart & Ellingsen, 2004). Meltzer (1960) claims that trade credit (he calls it mercantile credit) in times of "*tight money*" functions as a substitute for bank credit. Meltzer explicitly mentions the redistribution function of non-financial firms. In times of financial downturn, the relatively creditworthy liquid firms extend paying terms (to consolidate future sales) of their customers and in that way redistribute their obtained bank credit towards the less creditworthy firms. On the other hand literature supporting the complementary perspective argues that bank credit is typical long term in origin, where trade credit mostly is short term (Burkart & Ellingsen, 2004). Since firms need short term and long term credit as well, both types of credit are complementary rather than substitutable. This statement is supported by an American research (Cole, 2010) that shows that two in five small U.S. firms constantly use credit of both types.

In the perspective of the substitutable role of trade credit, this research mainly focuses on the effects of the (current) financial crisis on the use of trade credit. The financial crisis obviously results in credit rationing for firms. The reduced availability of credit to these firms forces them to look for other sources to finance their working capital. Obtaining trade credit is one of their options. Narrowing the discussion on credit, and more specific trade credit. The next step is to discuss some academic analyses of previous crises regarding the role of trade credit.

1.1.1　Trade credit as a lending channel

Taketa and Udell (2007) discuss whether trade credit plays a significant role as a substitute for other '*lending channels*' during the Japanese banking crisis in the 1990s. This study basically approaches the subject through Berger and Udell's (2006) framework

on *lending technologies.* Berger and Udell (2006) distinguish nine different lending technologies, of which trade credit is one of the possible technologies[1].

Berger and Udell (2006) describe these lending technologies as static with respect to macro and business cycle effects. Taketa and Udell (2007) extend this concept by making it dynamic with respect to these cycles and introduce the concept of "lending channels". In their concept a lending channel can react in two ways in times of financial shocks: a lending channel can either expand or contract as a response to financial contraction. The manner in which these lending channels expand or contract, determines whether this channel softens the impact of a financial shock.

So trade credit could be seen as a lending channel. In this respect it is interesting to investigate if trade credit is able to neutralize the contraction of other *lending channels*, although Taketa and Udell (2007) show no significant evidence supporting this. In a suggestion for future research they nevertheless discuss the possibility that the financial condition of individual firms could play an important role. Let's therefore focus on an interesting article written by Love, Preve and Sarria-Allende (2007) which analyses the financial condition of individual firms.

1.1.2   *Use of trade credit and the financial condition of individual firms*

Love et al. (2007) analyzed the impact of financial crises and trade credit, taking the financial health of a firm into account. Their article is mainly based on the 'redistribution view' on trade credit (Meltzer, 1960). Financially strong firms redistribute their bank credit to financially weaker firms through trade credit. The authors signalled that directly after a financial shock, trade credit increases, but in the aftermath of a crisis trade credit shrinks heavily. Also Kohler et al. (2000) and Nilsen (2002) have investigated if trade credit can offset contraction in the bank lending channel. However none of these articles have focused on the current financial crisis. Since this phenomenon could play an important role in the current financial crisis, this research is written.

---

[1] Other lending technologies are: relation lending, financial statement lending, small business credit scoring, asset-based lending, equipment lending, factoring, and leasing.

1.2   Research question, sub-questions and hypotheses

The main objectives of this research are to identify aggregate patterns in the use of trade credit by non-financial Dutch manufacturing firms due to the effects of the financial crisis and secondly to test whether these firms react differently in their trade credit usage caused by the firm's vulnerability to a crisis (determined by the creditworthiness of a firm). Therefore relevant literature on this topic will be reviewed to develop two hypotheses. These hypotheses will be tested by analyzing the financial statements of Dutch firms. Two research questions will be answered through this research:

"What is the aggregate pattern in trade credit usage during the financial crisis?"

"Do less creditworthy firms use trade credit to overcome credit rationing caused by the financial crisis?"

To answer the previous research questions the sub research questions and objectives in table 1.1 will be used:

Table 1.1: Research questions and research objectives

Research questions:	Research objectives:
What is trade credit and which explanatory theories are available?	Composing a literature review of relevant theories concerning trade credit
What literature on the availability of trade credit, during financial crises is available?	Extending the literature review with relevant information about the impact of financial crises on trade credit
How does the trade credit literature define creditworthiness?	Identifying the definition of creditworthiness and how it is related to trade credit
How do the theories explain the relation between creditworthiness and the use of trade credit?	Comprehension about the relation between creditworthiness and the use of trade credit
What aggregate patterns in the use of trade credit are visible during times of financial crisis?	Identify aggregate patterns in the use of trade credit by Dutch firms: using descriptive statistics
To what extent does creditworthiness determines heterogeneous firm responses in the use of trade credit during the current financial crisis?	Evaluating redistribution view on trade credit during the recent financial crisis
To what extent can these results/explanations be generalized?	Elaborating on the generalizability of the explanations

Two hypotheses formulated based on relevant literature will be tested. The results are used to answer the research questions of this report. The hypotheses reflect expectations in the use of trade credit at two levels. The first hypothesis reflects the overall behaviour of firms during the financial crisis: aggregate patterns. The second hypothesis reflects firms-specific response in the use of trade credit during a financial crisis, based on creditworthiness indicators of firms: heterogeneous firm responses.

Aggregate patterns concerning the use of trade credit:

"During a financial crisis non-financial manufacturing firms provide more trade credit to their customers and obtain more trade credit from their suppliers compared to the period before the crisis"   (1)

Heterogeneous responses in the use of trade credit:

"Non-financial manufacturing firms with relatively low (high) creditworthiness will relatively use more (less) and extend less (more) trade credit during periods of financial contraction than high (low) creditworthy non-financial manufacturing firms."   (2)

The remainder of this thesis is structured as follows: in chapter two a review of academic literature is given on the theoretical background of trade credit in general, and trade credit usage during financial crises specifically. In chapter three the hypotheses are formulated as well as the rationale behind them. Chapter four discusses the methodology used to answer the hypotheses stated; also the variables and model specification is discussed in this chapter. Chapter five describes the data and resources of these data. Subsequently chapter six presents the results found in several statistical tests conducted. The thesis ends with a concluding chapter, in which the main results are explained and discussed and suggestions are made for additional scientific research.

Chapter 2:   Literature review

In this chapter relevant literature is reviewed to situate this research in a contextual setting based on academic literature. The literature review starts at a general level by investigating several explanatory theories about the use of trade credit. At the end of this chapter the literature review narrows down towards a more specific explanation of the use of trade credit in times of financial contraction: *the redistribution view on trade credit.*

After clarifying this specific concept it will be discussed in more detail by elaborating on the choice which distinction should be made to be able to test the explained concept of redistributing credit. Finally various academic articles, which try to find empirical evidence supporting/neglecting this redistribution view on trade credit, is discussed.

2.1   Theories explaining the use of trade credit

Petersen and Rajan (1997) are the first to make a comprehensive overview of the leading theories explaining the use of trade credit. This article is important because in this field almost every published academic article in leading journals refer to Petersen and Rajan (1997). This research uses the same categorization of the theories as proposed by Petersen and Rajan (1997). The categorization is extended by more recent articles and empirical evidence. But before explaining the diverse categories of explanatory theories, let's have a look at a graphical rendition of trade credit in figure 2.1.

Figure 2.1: Graphical rendition of trade credit
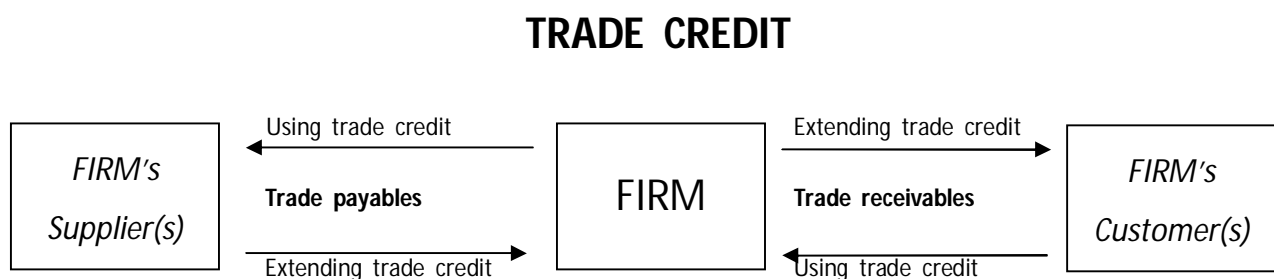
TRADE CREDIT

Note: If a firm obtains (or delivers) goods/services before paying (or getting paid) for it trade credit arises. The firm in the figure can use trade credit extended by its supplier(s); the amount of trade credit used is booked as trade payables on the Firm's balance sheet. Vice versa: if the firm extends trade credit to the firm's customer(s) the amount of trade credit extended is booked as trade receivables on the Firm's balance sheet.

Petersen and Rajan (1997) define three categories of explanations for the use of trade credit: The first category is *financial advantage. S*uppliers have an advantage over financial institution in monitoring and obtaining information from their customers. Besides the suppliers can easier repossess and sell delivered goods in case of default.

The second category is *price discrimination,* a supplier with relatively high profits has an incentive to make additional sales. If direct altering prices is not allowed (or not desirable), trade credit can be used to price discriminate.

Finally the third category is *transaction costs.* Trade credit can result in two transaction cost advantages. On the one hand separation of payment and delivery allows a firm to hold less cash balances. On the other hand in case of seasonality, stimulating sales in periods of low demand can reduce costs of managing the inventory.

In short these are the three main categories of explanations of the use of trade credit. The following part discusses the theories in more depth and additionally the theories are visualized in figure 2.2.

2.1.1　*Financial advantage*

The basic assumption behind this category is the fact that a supplier has a financial advantage over traditional financial institutions regarding supplying credit. The theory dates back to 1974 discussed in an article written by Robert A. Schwartz called ´*An Economic model of trade credit*`.

Financial advantages over traditional lenders occur in three different ways. First an *advantage in the acquisition of information* could be an explanation for suppliers to grant trade credit to their customers. The way financial institutions obtain information about their debtors is fundamentally different than suppliers. Suppliers in general visit their customers (debtors) more often. Moreover the size and timing of new orders contains more accurate information about the debtor's operational performance. The fact that a customer does not benefit from early paying discounts could implicitly indicate bad creditworthiness of the firm. The advantage comes from the fact that all mentioned information is gathered during normal operational business, in which financial institutions

would pay separately to obtain similar information (Petersen & Rajan, 1997; Schwartz, 1974).

Mian and Smith (1992) call this advantage in the acquisition of information a *by-product of selling*, since the regular visits of the supplier's sales representative provide information to evaluate the creditworthiness of the buyer. Additionally if a supplier makes use of retailers to bring their products to customers and this retailers provides important promotion and maintenance services which leads to demand, the supplier is interested in the quality of the retailer. To be sure of the quality of the retailer, regular evaluation sessions are held. These information gathering efforts can also be used to determine the creditworthiness of the retailer (Mian & Smith, 1992).

Trade credit also has a signalling effect to banks. The fact that a supplier extends trade credit to a customer is a signal to financial institutions that the supplier trusts the customer. In some cases financial institutions are not willing to extend working capital finance to firms because of information asymmetry. The fact that suppliers do extend trade credit to these firms can be a signal to the financial institutions. Consequently after the trust suppliers show by extending trade credit to the firm, financial institutions extend additional finance to the firm. Without the obtained trade credit these firms would not obtain credit from financial institutions. Trade credit acts as a 'good' signal to financial institutions (Biais & Gollier, 1997).

Secondly the supplier has an *advantage in controlling the buyer*. For example if a customer (debtor) has few alternative sources to buy materials, a supplier can threaten to cut off future deliveries in case of non-payment (Petersen & Rajan, 1997). This advantage is especially effective if the buyer is responsible for a small stake of the supplier's sales. Financial institutions, compared to suppliers, have relative weak power if they threat with cutting off future debts. Such a threat is not immediately affecting buyer's operational activities. Additionally financial institutions are often - due to bankruptcy laws – not allowed to withdraw the actually provision of finance of past granted debts.

The last financial advantage a supplier has over traditionally financial lenders is the *advantage in salvaging value from existing assets.* The supplier has a financial advantage in collecting credit if the collateral – goods delivered by the supplier – is of more value

to the supplier than to other parties. These parties show less effort in obtaining these goods (Mian & Smith, 1992). Furthermore the supplier can at relatively low costs - compared to financial institutions - repossess and resale delivered goods. This depends on which goods are sold and how much the customer has transformed them (Petersen & Rajan, 1997). Additionally, due to the fact that delivered goods cannot easily be diverted compared to cash (which is provided by financial institutions), a supplier suffers less from agency costs (Biais & Gollier, 1997).

2.1.2   Price discrimination

Next to the fact that suppliers have a financial advantage in granting trade credit, the second theory to explain the use of trade credit is price discrimination between customers. Trade credit gives an opportunity to price discriminate among different customers. Offering different trade credit terms to customers is the fundamental principle behind this explanation of the use of trade credit (Meltzer, 1960).

The concept of price discrimination can easily be understood when looking at a case in which the supplier has high margins over their products, and therefore has an incentive to make additional sales incurring extra costs. Assuming that anti-trust law would prohibit direct price discrimination, trade credit can be an ultimate tool to provide risky customers goods using high-priced trade credit. A customer suffering from credit rationing by financial institutions will use the trade credit as a way to finance their working capital. A creditworthy firm on the other hand finds the trade credit expensive and pays back quickly. In practice most firms give a discount for early payment, but the principle stays the same: trade credit provides a mean to alter the effective price of goods without changing the original price of the goods (Petersen & Rajan, 1997).

This phenomenon especially occurs if the demand of low-quality buyers is price-elastic. Since low-quality buyers inherently have problems in obtaining external finance, these buyers are sensitive to favourable trade credit terms. In other words, because of their inability to lend money it is interesting for them to buy goods from their suppliers and therefore be able to proceed their activities without having the need for additional finance (Brennan, Maksimovic, & Zechner, 1988).

Another reason for investing in risky customers otherwise than making additional sales on short term, is the fact that a customer can be a strategic partner for the future. Providing them favourable trade credit on short term could lead to extra sales by this particular customer in the future. Granting trade credit can therefore be seen as an investment in the customer. It secures an implicit equity stake in the customer (Petersen & Rajan, 1997).

2.1.3   Transactions costs theories

The last category of explanation of the use of trade credit is developed by Ferris (1981) and is the most practical reason for extending trade credit by suppliers. Separating deliveries and payment, by paying monthly or quarterly makes cash in- and outflows more predictable. Buyers are no longer obligated to hold high stakes of cash on their accounts to be able to pay for a particular delivery. Holding lower cash balances results in transaction cost benefits.

Other versions of the transactions costs theory examine how trade credit is used in a way to increase operational flexibility (Emery, 1987; Long, Malitz, & Ravid, 1994). This is especially relevant if a firm's business is cyclical. In these situations the terms of trade credit can be used to stimulate a-cyclical demand. Spreading the demand more equal during the entire year can result in more efficiently use of production facilities and reduction of inventory costs. A brief example from the bicycle industry, might clarify this concept. The bicycle industry is seasoned, demand starts in spring, when the weather begins to improve. Koninklijke Gazelle, a bicycle factory, alter a-cyclical demand by granting favourable paying terms if a retailer orders bicycles during autumn and winter. This results in a stable production during the year, which leads to a more efficient use of the production facilities and consequently less inventory building. Sales normally made in spring are now partly settled in winter. So the benefits are twofold: the firm does not incur the cost of changing their production levels and second trade credit reduces in this example the storage costs of excessive inventory. Emery (1987) suggests that the reduction of storage costs is especially relevant if the buyer has a cost advantage in carrying inventory. Long et al. (1994) show significant results that firms in sectors with variable demand extend relatively more trade credit.

2.1.4 Other theories

Finally another explanation - which Petersen and Rajan (1997) did not address - is *implicit (quality) guarantees.* Trade credit is a way for suppliers to offer implicit (quality) guarantees**.** According to (Smith, 1987)) the length of extended trade credit is used as time for the customers to evaluate the delivered goods. Especially young and small suppliers are expected to extend trade credit to convince customers of the quality of their products. Long et al. (1994) found empirical evidence for this explanation.

Figure 2.2 represents a visualization of the described theories of the use of trade credit, how these theories are connected to trade credit, and how some theories influence the relation between creditworthiness and trade credit. For instance, the financial advantage theory suggests that the better a firm is able to control its customer, the more wiling it is to extend trade credit to less creditworthy firms. Also the extent in which a firm is able to price discriminate stimulates a firm to extend trade credit to less creditworthy firms. Transaction costs and the necessity to offer quality guarantees does not influence the relation between creditworthiness of a firm and the use of trade credit. Instead these directly influence the use of trade credit. A firm which has a need to offer quality guarantees offers more trade credit to its customers regardless of the creditworthiness of its customers. Therefore these theories are directly linked to ´use of trade credit´ in figure 2.2.

On the right side the effects of the financial crisis are visualized as a cloud affecting a firm's creditworthiness at the one side, and the availability and price of credit on the capital market at the other side. The financial crisis directly influences the relation between creditworthiness of a firm and the use of trade credit through affecting the creditworthiness of firms. Secondly the effects of the financial crisis affect indirectly the relation between creditworthiness of a firm and the use of trade credit by influencing the price and availability of external funds[2].

---

[2] See for a discussion about how the effects of the financial crisis affect the relation between creditworthiness of a firm and the use of trade credit paragraph 2.2.1.

Figure 2.2: Explanatory theories of the use of trade credit, creditworthiness and the effects of the financial crisis
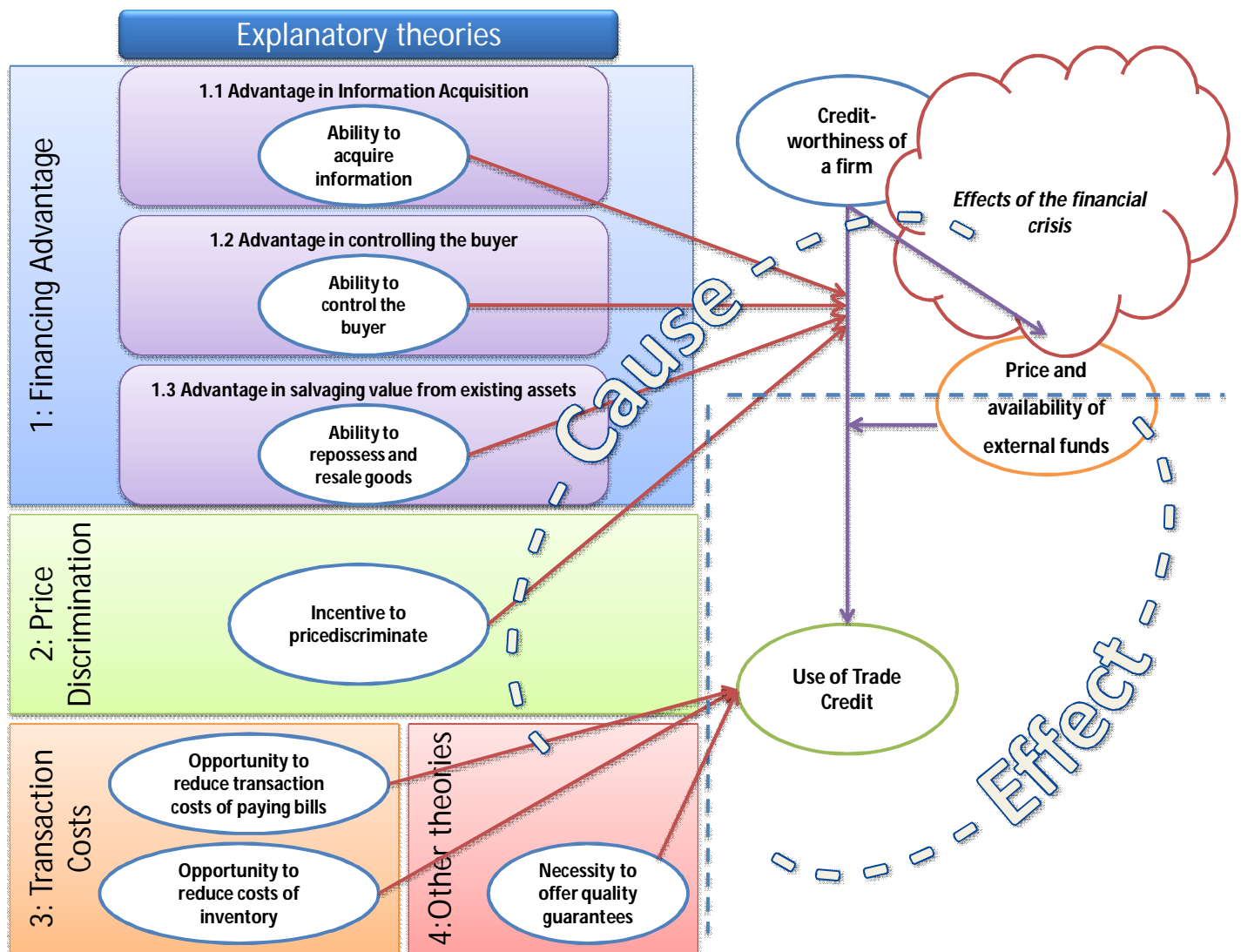
2.2 Trade credit theories and financial contraction: a redistribution view on trade credit

Central in this research is the presence of the financial crisis and its effect on the use of trade credit by non-financial manufacturing firms in the Netherlands. After having addressed the several trade credit theories as visualized in figure 2.2, this paragraph focuses on those theories which could (partly) explain/predict the use of trade credit in times of financial contraction.

The theory on implicit guarantees and the transaction costs theory play a minor role in explaining trade credit during times of financial contraction. Both theories describe the relation to trade credit as static towards financial tendency. As is visualized in figure 2.2 both theories directly influence the use of trade credit and do not affect the relation between creditworthiness of a firm and the use of trade credit. The transaction costs theory is irrelevant because it mainly explains ways for suppliers to manage cash holdings, inventory and operational aspects; largely independent to the financial atmosphere.

Secondly, granting trade credit as a quality guarantee is a matter of settling a firm's reputation. Probably these firms have a harder job in times of financial downturn, but still this theory is not relevant enough to be used as a starting point to formulate hypotheses about how firms react in terms of using trade credit as a result of the current financial crisis. Nevertheless these theories describe relevant factors which influence the use of trade credit in general. Therefore the model used in this research contains control variables reflecting these theories.

Consequently two explanatory theories remain as premises for the relation between creditworthiness and the use of trade credit. These are the *financial advantage theory* and its three subcategories and the *price discrimination theory*. Both theories should be seen as motives for firms to supply trade credit to less creditworthy customers which have therefore financing difficulties. The financial advantage theory basically summarizes the advantages a supplier has over financial institutions. These advantages make a supplier less reluctant to offer credit to less creditworthy firms compared to financial institutions. The price discrimination theory unfolds the reasons for a supplier to offer trade credit to less creditworthy firms as long as the suppliers has enough margin.

Following Petersen and Rajan (1997) these two theories predict that firms that are *more* creditworthy and have *better access* to institutional credit offer *more* trade credit.

Prior research on the effects of financial contraction on the use of trade credit regularly focuses on the previous mentioned (paragraph 2.1) *redistribution view* of Meltzer (1960) on the use of trade credit (Blasio, 2005; Choi & Kim, 2005; Kohler, Britton, & Yates, 2000; Love, Preve, & Sarria-Allende, 2007; Nilsen, 2002). Choi & Kim (2005) call it the "*financial assistance view*".

Meltzer's (1960) view on trade credit is associated with both the financial advantage theory and the price discrimination theory. Basically Meltzer (1960) states that the way suppliers act during times of financial tightening is twofold. First suppliers which have accumulated their cash flows before the crisis and have therefore relatively large cash balances use this to increase the average length of their trade receivables. Secondly these 'creditworthy' suppliers redistribute the credit they *still* can get to the relatively less 'creditworthy' firms. So the supplier creates extra trade credit with own liquid funds and/or by redistributing bank credit.

This concept automatically occurs because of the previous explained theory on *price discrimination*. Hence the credit rationed firms take the opportunity to finance their businesses by using the extended trade credit, since financial institutions do not extend credit or extend credit against excessive interest rates. The relatively liquid supplier is willing to extend (extra) trade credit, because of generating extra sales. As long as the liquidity level of the supplier is healthy this process of extending extra trade credit continues: a trade-off between profitability and liquidity.

At this stage the link between the redistribution view and price discrimination is made. The other category of explaining the use of trade credit is still left: *financial advantage.* This category has an important role in explaining *why* a supplier still would extend trade credit even if financial institutions are reluctant to extend loans.

The financial advantage theory explains clearly in threefold why it is possible that a supplier compared to financial institutions judges differently about the creditworthiness of a firm. Suppliers steer on different information: they can threaten to cut off future deliveries, and are better able to repossess and resell customer's inventory. Besides, non-financial firms try to obtain extra external financing to optimally exploit their financial advantages in making their borrowers to repay extended trade credit (Demigürc-Kunt & Maksimovic, 2001).

In short, Meltzer's contribution on explaining the use of trade credit is the insight that creditworthy firms extend additional trade credit with its liquid resources and/or by redistributing capital they can obtain to less creditworthy firms. Both theories – financial advantage and price discrimination – should be seen as the explanation why firms would

be willing to extend and use trade credit at all. The different trade credit usage in periods of financial shock is closely interrelated with the price and availability of external funding provided by financial intermediaries. This interrelation is explained in the next subchapter.

Figure 2.3: The effects of the financial crisis and the relation between creditworthiness and the use of trade credit
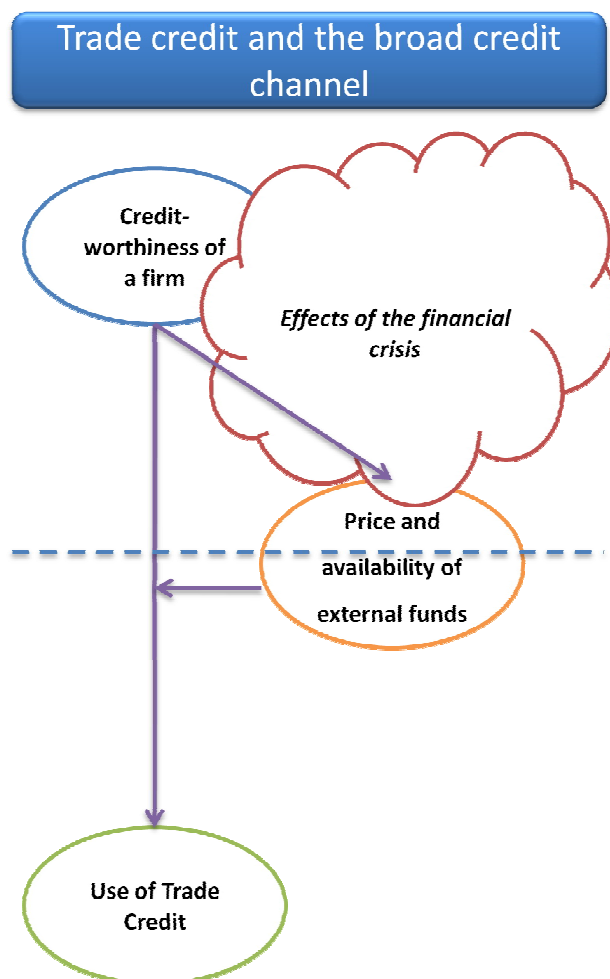
2.2.1 Trade credit and the broad credit channel view

Figure 2.3 visualizes how the effects of the financial crisis affect the relation between creditworthiness and use of trade credit. A financial shock both changes the creditworthiness of firms and the price and availability of external funds. In multiple ways a financial crisis can therefore influence the relation between the creditworthiness of a firm and the use of trade credit. The financial crisis either directly alters the

creditworthiness of firms: making them less attractive to investors, which results in an increase of trade credit demand. Secondly effects of the crisis can affect investors, making them reluctant to invest. This results in either an increased price or reduced availability of credit, consequently making more firms interested in obtaining credit through their suppliers, because no longer the price of external funds is cheaper than the price of trade credit. Therefore the effect of the financial crisis influences the relation between creditworthiness and the use of trade credit in two ways. Let's see in depth how this works.

The literature provides two sets of mechanisms to explain how the credit channel works during a financial shock. First of all the bank lending channel, which proposes that a financial shock (through an increase in the central bank interest rate) can lead to an increase of the costs to banks for making loans. This leads to an increase of the price of loans or banks decide to provide fewer/smaller loans, which results in a reduced availability of external funds to firms (this mechanism is visualized in figure 2.3 by letting *'the effects of the financial crisis'* overlay *'price and availability of external funds'*) (Kohler et al., 2000; Mateut, Bougheas, & Mizen, 2006).

The second mechanism works the other way around. A financial shock affects the aggregate creditworthiness of firms, this is called the *balance sheet channel.* Because the financial shock alters the financial position of borrowers, the shock affects their ability to obtain bank credit. A financial shock for instance reduces the aggregate demand, therefore the current cash flows of a firm could shrink. Consequently the firm has less internal resources to finance new projects and is forced to finance a greater portion externally. The reduced creditworthiness and the higher demand for bank finance leads to an increase of the price and a decrease of the availability of external funding. Next to the reduced current cash flow of the firm, it is also reasonable that because of a reduced demand, the value of the firm's assets is reduced. Since the assets act as collateral for bank loans the availability of external funds shrinks (this mechanism is visualized in figure 2.3 by letting *'the effects of the financial crisis'* overlay *'creditworthiness of a firm'*) (Kohler et al., 2000).

In this specific case, the current financial crisis, an extra dimension comes around. The increased average price and decreased availability of bank loans is caused by the extreme devaluation of bank's assets. Distrust of depositors and among banks made them restraint. The interbank funding completely dried, the so called "*credit crunch*". This resulted in a major shortage of liquid resources, consequently steering up the price of external capital for firms.

For the results of this report it is not important to explain the exact cause of a financial shock or a period of monetary tightening. It is not relevant to know whether the financial shock influences the creditworthiness of firms or if the financial shock affects the price and availability of external finance. Both influence either directly or indirectly the relation between creditworthiness and a firm's price and availability of external funding. To indicate the time period of the shock a country's GDP, the central bank interest rate can be used and other indicators can be used (see which method is used in this research in paragraph 4.4) (Kohler et al., 2000; Mateut et al., 2006; Nilsen, 2002).

Important to understand is that the usage of trade credit is affected by the price and availability of external funds. If a particular firm is unable to obtain (on concessional terms) external funding, it might decide to take up trade credit to finance their activities. Under normal conditions (in the absence of a financial crisis) trade credit would be (relatively) too expensive, but since normal funding channels are unavailable and the supplier's terms to extend trade credit stays constant over time, the firm takes up trade credit (Nilsen, 2002).

Those firms with relatively good access to external funding (favourable creditworthiness) will extend relatively more trade credit in these periods. An important question to answer at this moment is how to distinguish the creditworthiness of firms.

2.2.2 *How to distinguish creditworthiness: Small versus large?*
The Oxford English Dictionary gives the following definition of *creditworthy*:

"*(of a person or company) considered suitable to receive credit, especially because of being reliable in paying money back in the past.*"

A firm's creditworthiness is all about its ability (as perceived by the debtor) to repay debts. The creditworthiness of a firm is a broad label of various factors, which makes a firm creditworthy or not. Solvency (the ability of a firm to meet its long-term obligations), liquidity (the ability of a firm to convert assets into cash), profitability are all factors which determine a firm's creditworthiness. In this research the definition of creditworthiness is limited to mainly liquidity aspects of firms. The reason for limiting the definition is the short-term nature of trade credit. Trade credit is therefore can therefore only be a substitute to short-term debts. Besides the impact of the financial crisis is especially affecting liquidity aspects of a firm. Long-term financing issues of firms are not directly or at least less affected by the financial crisis. Several creditworthiness indicators like the Altman Z-score[3] are not discussed, because these indicators use a too broad definition of creditworthiness. The following part of this paragraph therefore discusses creditworthiness mainly in terms of liquidity and other short-term aspects of creditworthiness.

Originally Meltzer (1960) suggested that large firms would have easily access to external capital markets, especially large firms which are publicly traded. More recent literature suggests that this distinction should be more nuanced. Several recent studies suggests other factors which better determine the creditworthiness of a firm. The following paragraphs discuss several articles which make a more nuanced distinction.

Nilsen (2002) proved that over a longer period in the US the use of trade credit as a substitute for (not granted) bank credit was found at both small ánd large firms with low access to capital markets. Nilsen (2002) distinguishes firms on the ability to have access to external capital, firms with a bond rating; firms that are rich (based on cash flows); and the absence of colletaralizable assets. Nilsen (2002) finds evidence that these distinctions better explain the difference in use of trade credit than simple small-large distribution.

---

[3] Altman Z-score is a financial indicator to predict the default risk of a firm. It was introduced by Edward L. Altman in 1968. The indicator is the weighted average of a set of solvency and liquidity ratios (Altman, 1968).

Mateut et al. (2006) uses the degree of *wealth* a firm has. The initial wealth level of a firm determines its access to different sources of external funding. Besides this the authors also use an indicator to measure the firm´s risk, called the Quiscore produced by Qui Credit Assessment Ltd. The higher the risk the lower the access to sources of external funding is assumed.

Preve (2004) distinguished firms based on the degree of having short term debt (with its typically higher costs and difficulties in renewing it) and liquidity of a firm: cash stock/cash flow. Love et al. (2007) which have investigated Asian firms during the 1997 Asian crisis, uses similar variables as in the previous mentioned dissertation. Love et al. (2007) discusses a firm's financial vulnerability to a crisis and uses several indicators. The variables used in this article are the ratio of short-term debt to assets and the pre-crisis stock of cash holdings and the cash flow generating capacity of a firm.

An empirical confirmation of the work of Love et al. (2007) is an earlier research of Niskanen and Niskanen (2006). They concluded in their search for the determinants of trade credit that creditworthiness and access to capital markets are significantly positive correlated with the amount of trade credit extended by sellers.

These variables predict better whether or not the redistribution view plays a role in the use of trade credit during periods of financial contraction, because these variables are a better estimation of a firm's creditworthiness. High proportions of short term debt, probably results in higher cost of capital and complications in rolling these debts over during the crisis. This ultimately could lead to the fact that these firms reduce their extended trade credits and if available rely more on offered trade credit by suppliers. High stock cash holdings and great capacity to generate cash flows indicate that a firm has relatively high capacity to internally finance its business. These firms therefore would probably extend more and take less trade credit during crisis relatively to less liquid firms.

Table 2.1: Creditworthiness indicators used in academic trade credit literature

Author(s)	Indicator
Meltzer (1960)	Firm size
Nilsen (2002)	Bond rating
	Cash flows
	Absence of colletaralizable assets
Love et al. (2007)	Ratio of short-term debt to assets
	Pre-crisis cash stock
	Cash flow generating capacity of a firm
Mateut et al. (2006)	Wealth
	Quiscore
Preve (2004)	Degree of having short term debt
	Liquidity of a firm: cash stock/cash flow

Note: this table contains several creditworthiness indicators used in academic papers. All these indicators are discussed in paragraph 2.2.2

Concluding this part regarding the distinction Meltzer (1960) originally made – small versus large firms –, a distinction based on a firm's financial vulnerability to a crisis would be a more accurate distinction for this research. This can be either done by focusing on the proportion of short term debt or the liquidity of a firm. Moreover Mateut et al. (2006) discuss the variable risk and its influence on a firm's ability to access credit. Probably the credit rating of a firm could be used as an alternative for the Quiscore, since it is not available in the Netherlands. A simple small/large distinction is too simple, more sophisticated indicators of a firm's creditworthiness as suggested by Preve (2004) and Love et al. (2007) are used in this research.

2.3　Empirical evidence on trade credit and financial crises

It is important to evaluate the contributions of academic literature on the relation between trade credit and financial crises. After discussing the literature it becomes clear to what extent this research can provide additional contributions to the current literature.

An important and regular cited article about the use of trade credit during times of monetary crisis is written by Kohler et al. (2000). They used a panel of UK listed firms and proved that there is a 'trade credit channel' that off sets the bank credit channel. It seems like firms with direct access to capital (creditworthy firms) help out their customers

with less direct access, since these creditworthy firms both extend more and use less trade credit during recession. Also the previous mentioned article by Nilsen (2002) finds similar evidence. At the same time during a recession firms with good access to bank credit increase their debts and those which have not good access use more trade credit.

Love et al. (2007) investigated the use of trade credit during financial crises and found that at the peak of a financial crisis the use of trade credit increases and after the peak the use of trade credit collapses. The authors used the ratio of short term debt to sales and liquidity of firms as indicators for a firm's vulnerability to a financial crisis. The firms with relatively high short term debt cut their extended trade credit sharply and start relying more on trade credit extended by their suppliers. Also the more liquid firms extend relatively more trade credit to their customers and rely less on trade credit from their suppliers. The authors emphasize the importance of the availability of aggregate bank credit, since although firms rely on trade credit, in the aftermath of a crisis due to absence of bank credit also the trade credit channel 'dries up'.

A main criticism to these articles is the way the authors make the distinction between firms with good access to credit markets. Kohler et al. (2000) use quoted firms in their data, and because of these quotations the authors take good access for granted. Besides this they also presume that the net trade credit creation of the quoted firms result in a net supply of trade credit for unquoted firms, without investigating this.

Also Nilsen (2002) and Love et al. (2007) take only quoted firms in their sample. Nilsen (2002) makes a distinction in size, but still it is a sample of only quoted firms. A small firm in his article is therefore still a relative large firm taking the complete population into account (a population including small and medium-sized enterprises (SMEs)). Especially the medium and small sized firms, with their relative weak access to credit, are an interesting domain regarding the use of trade credit in times of financial contraction.

A solid fact about the research conducted by Love et al. (2007) is the fact that they studied the effects of a crisis on the use of trade credit in six different (emerging) countries and during two different crises, namely the Mexican devaluation of 1994 and

the south-east Asia currency crisis of mid 1997. This wide diversion of countries and crises makes the results more robust.

Recently Garcia-Teruel & Martinez-Solano (2010) focused on the use of trade credit by small and medium sized firms. Unfortunately the study was not conducted during a period of financial contraction. The authors found significant evidence that financially strong firms extend more trade credit to their customers. Greater access to short term financing resulted in an increase of extending trade credit to customers. Garcia-Teruel and Martinez-Solano (2010) conducted their study among small and medium sized firms in seven European countries. Interesting is the fact they found mixed results of the effect of cash generating ability of a firm and its use of trade credit. According to their data the effect seems country dependent, unfortunately the authors do not elaborate on any possible explanation for these mixed results.

Neither of these studies address the effects of the current financial crisis on the use of trade credit. This is the gap, which hopefully is reduced after reading this research. Therefore this research is especially a contribution to the academic literature on trade credit, because it focuses on the effects of the current financial crisis. The topic is extremely relevant since the crisis is still ongoing and if the economy in the future recovers, periods of financial contractions shall undoubtedly reoccur. Above all trade credit can function as a *lubricant* to stimulate the real economy of a nation and soften the negative effects of the financial crisis.

Chapter 3: Hypotheses

The objectives of this thesis is first to identify aggregate patterns in trade credit usage and secondly to evaluate whether differences in the use of trade credit during a period of restricted bank finance (credit rationing) can be explained by a firm's vulnerability to a crisis (in terms of creditworthiness of a firm). Before focusing on this distinction it is relevant to investigate the general pattern of the use of trade credit when the access to bank credit is limited. These results provide better insights whether or not trade credit – as predicted by Meltzer (1960) – works as a substitute for bank credit. The following hypotheses are formulated based on the discussed literature in the previous chapter.

3.1   Aggregate patterns of trade credit usage

Based on recent academic studies (Kohler et al., 2000; Nilsen, 2002 and Mateut et al., 2006), which test how the use of trade credit is affected by monetary contractions (comparable to the financial crisis), hypothesis one is formulated:

> *"During a financial crisis non-financial manufacturing firms provide more trade credit to their customers and obtain more trade credit from their suppliers compared to the period before the crisis"*   *(1)*

The rationale behind this hypothesis comes from the traditional trade credit channel concept. This concept predicts that restricted banking finance (in terms of price and availability of external funds) caused by a financial shock leads to an increase of the use of trade credit by firms. Firms still need resources to finance their activities, the financial sector is reluctant to keep financing and subsequently suppliers fulfil the new need for (short-term) financial resources. Unconstrained – having no problems in obtaining external finance – suppliers use their own liquid assets and/or the short-term finance they can obtain to *help out* their constrained customers. In other words for those constrained customers trade credit works as a substitute for bank credit (Kohler et al., 2000; Mateut et al., 2006; Meltzer, 1960; Nilsen, 2002).

A financial crisis results in a reduction of reserves of the financial sector (banks had to depreciate assets). The reduction of the reserves of the banking sector results in scaling back the amount of loans outstanding. The banking sector restricts the loan terms, either by not renewing current loans or increasing the interest rates firms have to pay for loans. To overcome the reduced availability of bank loans, firms will seek for alternative sources to finance its operations. Trade credit is an alternative. In times of stable conjuncture trade credit is more expensive than bank credit. However since banks restrict credit, trade credit becomes an attractive alternative to those firms which suffer from a reluctant financial sector. Those firms which have alternative credit sources will ignore the trade credit alternative. Since theoretically some firms will accept extra trade credit during the financial crisis the amount of trade credit will increase (Nilsen, 2002).

3.2   Heterogeneous responses: creditworthiness, financial contraction and trade credit

In addition to this general hypothesis – which basically predicts a general pattern of the use of trade credit by non-financial Dutch manufacturing firms – a more specific hypothesis is formulated using differences in firm's creditworthiness.

> *"Non-financial manufacturing firms with relatively low (high) creditworthiness will relatively use more (less) and extend less (more) trade credit during periods of financial contraction than high (low) creditworthy non-financial manufacturing firms."*   (2)

The previous discussed theory gives sufficient reason to assume that the creditworthiness of a firm determines how the redistribution view unfolds during a financial crisis (see paragraph 2.2.2). Following Meltzer (1960), Petersen and Rajan (1997) and Nilsen (2002) those firms which have still relatively easy access to external sources of external funding (based on their presumed creditworthiness) redistribute this to firms which have not. A liquid firm will prefer making additional sales - by extending additional trade credit - as long as the firm has enough cash balances and expected cash flows. At the same time less creditworthy firms have more interest in obtaining trade credit,

because of a reluctant credit market. The theory suggests that compared to banks, suppliers are relatively more lenient in case of default. Banks for instance hold more secure positions. Since financial institutions are in these times more reluctant to provide bank credit to weak creditworthy firms, I expect the previous statement to be stronger in periods of financial contraction. Therefore I expect firms with low creditworthiness will relatively use more trade credit during the financial crisis. These firms have difficulty in obtaining finance, therefore they cut the amount of receivables and increase the amount of payables relatively. Creditworthy firms extend on the other hand relatively more trade credit to their customers and use relatively less trade credit from their suppliers. This effect occurs because in times of a financial shock relatively more customers are willing to accept trade credit to overcome their inability to obtain finance from financial intermediaries.

An important assumption supporting the second hypothesis is that the premium of external capital for the less creditworthy firms which raises because of the effects of the financial crisis, does not raise for the creditworthy firms. At least the premium of external capital does not increase that much. Assuming this holds the financing advantage increases, it becomes more likely to provide trade credit to less creditworthy firms (Kohler et al., 2000).

Chapter 4: Methodology

4.1   Research strategy

The objective of this thesis is to investigate the influence of the financial crisis on trade credit usage and in what way trade credit is able to suppress these effects. The data comes from the financial statements of non-financial Dutch manufacturing firms. Based on these data three regression models are specified. Using these three basic regression models a regression analysis is conducted. This is a quantitative archival *explanatory* research. Explanatory because I want to investigate possible firm-specific factors which determine a firm's trade credit usage during the financial crisis. The study is archival, because the data in the financial statements are administrated and published by the firms in the past, I do not collect *new* data by myself. To investigate whether particular firm-specific factors determine the use of trade credit by firms in a crisis period *multiple regression analysis (OLS)* is conducted. First an *ANOVA-analysis* is conducted to see which trend in the use of trade credit occurs in the data set at forehand.

4.2   ANOVA analysis

The analysis of the data starts with an ANOVA-analysis. This analysis is the first indicator of differences in trade credit usage in the period before the crisis compared to the crisis period. A simple analysis of variances (ANOVA) is conducted to evaluate if there are any significant differences in the means of the trade credit variables. An ANOVA-analysis is a tool to compare the means of several groups. In this case the groups correspond with time periods. The analysis is able to calculate wheter variation in the mean is caused by variation within the group or variation between the groups. This method is a commonly used statistic method to estimate the variances in the means of a particular dependent variable between two or more groups. The method separates the variance in two components, a *"within group variance"* and a *"between group variance"*. The next step of an ANOVA is comparing these two variances in a quotation, by calculating F:

F = Between-group variability / Within-group variability

To calculate the *critical* F value, in other words which value of F must be exceeded to claim that a particular difference in mean is caused by group differences or within group differences, the *degrees of freedom* must be calculated. Degree of freedom is the amount of values, which can defer from the estimated mean (Baltagi, 1994). Degree of freedom of the between-group is the number of groups – 1). The "*within-group*" degree of freedom is calculated by the sum of (the number of values within a group – 1). There are tables available[4] in which the F-test critical values can be found for a particular significance level. If the calculated F is higher than the critical value, the between group variability is significant causing the differences in means between groups (Baltagi, 1994).

4.2.1   Time demeaning of trade credit variables

Every firm has its own natural level of trade credit. For instance firms operating in the retail industry extend low amounts of trade credit to their customers, because most customers pay directly. Because of these large differences in 'natural level' of trade credit between firms, the within-group variability is high. To undo this effect of different 'natural levels' of trade credit the input of the trade credit data is demeaned.

I corrected the trade credit amounts by the five year firm-specific average level of trade credit. This is commonly known as *time-demeaning* the data. It is now possible to see whether most firms had lower or higher trade credit usage during the crisis years in comparison with the pre-crisis period, regardless of their 'natural level' of trade credit.

4.3   Regression analysis: Ordinary least square

One of the goals of this research is to explain the trend in trade credit usage. The ANOVA analysis simply gives the trend of the values of the dependent variable over time. The analysis compares pre crisis values with crisis values. However the values of a dependent variable is determined by independent factors. Some factors have a negative

---

[4] See for instance http://www.itl.nist.gov/div898/handbook/eda/section3/eda3673.htm

influence and others have positive influence. To measure the effect of these variables on the independent variable regression analysis can be used.

An often used regression technique is ordinary least squares (OLS). It is a simple statistical method to estimate the unknown parameters in a linear regression model. However to make valid estimates with OLS the researcher has to make a set of assumptions. The following paragraphs show some important tests used in this research to verify if the assumptions of OLS hold. First I explain how the two models are specified (one regression model to explain trade receivables and one regression model to explain trade payables).

4.3.1 Model specification

To specify the model of dependent variables explaining the independent variable *stepwise regression* is used. Stepwise regression is a systematic method for adding or removing predictors in a multiple regression model based on their statistical significance. This systematic procedure contains three steps:

1. Identifying an *initial model*
2. Iteratively adding or removing a predictor based on their statistical significance
3. Terminating the search when no longer a predictor can be added or removed

The initial model always contains the regression intercept. Additionally the initial model includes those factors, which are *forced* into the model. These factors are not removed during the second step.

There are three methods to conduct the second step in stepwise regression:

- Forward selection
- Backward elimination
- Combinations of those two

The first method tries every potential predictor one by one if it is statistically significant. If it is statistically significant the variable is added to the model. The backward elimination method is the other way around. The initial model is estimated with all potential predictors in the model. The least significant predictor is removed and the (new)

model is estimated again. Until every predictor has a particular minimum significance level. The combination method tests at each stage the significance level in order to add or remove variables. The selection can be based on either critical *F* values or critical *p* values (Zellner, Keller, & Zellner, 2004).

4.3.1.1 OLS Regression models

In this study the backward elimination method is used. The procedure is conducted to specify the '*best fitting*' model to explain at one hand trade receivables and on the other hand trade payables. Three different models are specified.

First of all every potential dependent variable is selected out of the trade credit literature. These are taken together in a multiple regression model and the coefficients are estimated. After removing step-by-step the non-statistically significant variables the model one is build to explain trade receivables:

$$\text{RECASS}_{it} : \beta_0 + \beta_1 \times \text{CASH}_{it} + \beta_2 \times \text{CURRAS}_{it} + \beta_3 \times \text{LSIZE}_{it} + \beta_4 \times \text{LAGE}_{it}$$
$$+ \beta_5 \times \text{PGROWTH}_{it} + \beta_6 \times \text{NGROWTH}_{it} + \beta_7 \times \text{Y2008}_{it} + \beta_8 \times \text{Y2009}_{it} (+$$
$$\beta_9 \times \text{Y2008} \times \text{FIN}_{it} + \beta_{10} \times \text{Y2009} \times \text{FIN}_{it}) + \varepsilon_{it} \qquad (1)$$

In model one β_0 is the intercept, β_{1-10} are coefficients of the several independent variables. ε_{it} is the disturbance term or idiosyncratic error term. Dependent variable: RECASS stands for trade receivables divided by total assets. The independent variables: CASH represents the amount of cash stocked divided by total assets; LSIZE is the logarithm of total assets; LAGE is the logarithm of the number of years a firm exists; PGROWTH is the positive growth of sales compared to the previous year; NGROWTH is the negative growth of sales compared to the previous year; Y2008 and Y2009 are dummy variables to indicate the crisis period*; FIN* stands for one of the three independent creditworthiness indicators: Stfina: Ratio of short term finance to total assets; Ebitdaa: Earnings before interest tax and amortization to total assets; Cash: Cash stock to total assets.

$$PAYASS_{it} : \beta_0 + \beta_1 \times CASH_{it} + \beta_2 \times CURRAT_{it} + \beta_3 \times LTDEBT_{it} + \beta_4 \times CURRAS_{it} + \beta_5 \times LAGE_{it} + \beta_6 \times STFINA_{it} + \beta_7 \times FCOST_{it} + \beta_8 QUOTED_{it} + \beta_9 Y2008_{it} + \beta_{10} \times Y2009_{it} (+ \beta_{11} \times Y2008 \times FIN_{it} + \beta_{12} \times Y2009 \times FIN_{it}) + \varepsilon_{it} \qquad (2)$$

In model two β_0 is the intercept, $\beta_{1\text{-}10}$ are coefficients of the several independent variables. ε_{it} is the disturbance term or idiosyncratic error term. Dependent variable: *PAYASS* stands for trade payables divided by total assets. The independent variables: *CASH* represents the amount of cash stocked divided by total assets; *CURRAT* is the current ratio (current assets divided by current liabilities); *LTDEBT* is long-term debt divided by total assets; *CURRAS* is current assets divided by total assets; *LAGE* is the logarithm of the number of years a firm exists; *STFINA* is short term finance divided by total assets; *FCOST* is interest payments divided by total assets; QUOTED is a dummy for being stock listed; *Y2008 and Y2009* are dummy variables to indicate the crisis period; *FIN* stands for one of the three independent creditworthiness indicators: Stfina: Ratio of short term finance to total assets; Ebitdaa: Earnings before interest tax and amortization to total assets; Cash: Cash stock to total assets.

$$NETASS_{it} : \beta_0 + \beta_1 \times CURRAT_{it} + \beta_2 \times LSIZE_{it} + \beta_3 \times LAGE_{it} + \beta_4 \times STFINA_{it} + \beta_5 \times QUOTED_{it} + \beta_6 \times Y2008_{it} + \beta_7 \times Y2009_{it} (+ \beta_8 \times Y2008 \times FIN_{it} + \beta_9 \times Y2009 \times FIN_{it}) + \varepsilon_{it} \qquad (3)$$

In model three β_0 is the intercept, $\beta_{1\text{-}9}$ are coefficients of the several independent variables. ε_{it} is the disturbance term or idiosyncratic error term. Dependent variable: NET*ASS* stands for trade receivables minus trade payables divided by total assets. The independent variables: *CURRAT* is the current ratio (current assets divided by current liabilities); LSIZE is the logarithm of total assets; *LAGE* is the logarithm of the number of years a firm exists; *STFINA* is short term finance divided by total assets; QUOTED is a dummy for being stock listed; *Y2008 and Y2009* are dummy variables to indicate the crisis period; *FIN* stands for one of the three independent creditworthiness indicators:

Stfina: Ratio of short term finance to total assets; Ebitdaa: Earnings before interest tax and amortization to total assets; Cash: Cash stock to total assets.

4.4   Variables

Paragraph 4.3.1.1 introduces three OLS regression models to explain the use of trade credit during the financial crisis. These models contain several variables. This paragraph explains each variable and its expected effect separately.

4.4.1   *Dependent variables: Trade payables and receivables*

To identify the patterns of the use of trade credit by non-financial Dutch manufacturing firms, I use two dependent variables: trade payables and trade receivables. These variables are scaled by using total assets, what results in comparable ratios. Data for these variables are available in financial statements of the firms.

This results in two dependent variables:

- Recass: Trade receivables scaled by total assets
- Payass: Trade payables scaled by total assets
- Netass: Trade receivables minus trade payables scaled by total assets

4.4.2   *Independent variables: Short term debt and liquidity*

Paragraph 4.3.1.1 presents the three basic models to explain the use of trade receivables and trade payables. These models reflect the aggregate pattern of trade credit usage during the financial crisis. This aggregate pattern is represented by the two dummy variables Y2008 and Y2009. The other variables should be seen as relevant control variables, explained in the next paragraph.

After conducting these regressions the heterogeneous firm responses is investigated by adding *"(β_{11} x Y2008 x FIN $_{it}$ + β_{12} x Y2009 x FIN $_{it}$)"*. FIN stands for one of the three creditworthiness variables. The following indicators are used to determine a firm's creditworthiness (vector FIN in model 1 and 2):

- Stfina: Ratio of short term debt to assets (as measured one year before the crisis)

Standard proxies for the liquidity position of a firm:

- Ebitdaa: Cash flow to assets (as measured one year before the crisis)
- Cash: Cash stock to assets (as measured one year before the crisis)

A firm with a relatively large amount of short term debt before the start of the crisis has to refinance probably a part of their debt in times when it is hard and costly to do. Both firms with greater cash flows and larger stocks can probably fall back on these cushions in time of financial contraction. All these indicators determine a firm's creditworthiness.

The role of a firm's vulnerable position on the use of trade credit can be clarified by a supply effect. Firms that have trouble with accessing finance are probably more reluctant to provide trade credit to their customers.

To find possible explanation for the impact of a financial crisis on the use of trade credit, Love et al. (2007) investigate the vulnerability of a firm in case of financial contraction, i.e. a vulnerable financial position: creditworthiness. Love et al. (2007) argue that these firms are more likely to be negatively affected by a financial shock and therefore cut their supply of credit to their customers and try to increase their use of trade credit from suppliers.

Every creditworthiness variable is computed one year before the crisis. In that way the variables indicate how vulnerable a firm is towards the crisis. Subsequently this value is multiplied with a crisis year dummy. So the first predictor (β_{11} x Y2008 x FIN$_{it}$) shows how creditworthy firms reacted in the first year of the crisis. The second predictor (β_{12} x Y2009 x FIN$_{it}$) represents the use of trade credit in the second year of the crisis and its relation towards pre-crisis creditworthiness indicators. This method is conducted from an article of Love et al. (2007).

4.4.3 Independent variables: control variables

Each regression model in paragraph 4.3.1.1 contains several control variables. Table 4.1 presents the effects of these control variables.

Table 4.1: Calculations and expectations concerning determinants of trade credit

Abbr.	Description	Calculation	Theory	RECEIV	PAYAB
Lsize	ASSET assets (in thousand €)	Logarithm of the assets	Financial adv.	Positive	Negative
Lage	years company in operation	logarithm of (1+age)	Financial adv.	Positive	Negative
Ebitdaa	Earnings before interest and depreciation/ amortization	EBITDA divided by total assets	Financial adv.	Positive	Negative
Cash	Amount of cash stocked	Cash stocked to total assets		Positive	Negative
Stfina	Amount of short term finance	Amount of short term finance divided by total assets	Financial adv.	Negative	Positive
Ltdebt	long-term debt	ratio of long term debt to assets	Financial adv.	Not clear	Negative
Fcost	cost external financing	ratio of financial expenses over total debt minus accounts payable	Financial adv.	Negative	Positive
Pgrowth	positive sales growth	Yearly positive variations in sales	Price discrimination	Positive	Positive
Ngrowth	negative growth	Yearly negative variations in sales	Price discrimination	Negative	Not clear
Curras	investment in current assets	ratio of current assets to total assets	Transaction costs	Not clear	Positive
Currat	Current ratio	Current assets to current Liabilities		Positive	Negative

Notes: LSIZE the size of the firm; LAGE the age of the firm in years; EBITDAA cash flow generated by the firm; STFINA the amount of short term finance; LTDEBT the amount of long term debt; FCOST the amount of interest paid; PGROWTH positive sales growth; NGROWTH negative sales growth; CURRAS current assets divided by total assets; CURRAT is current ratio divided by current liabilities; CASH amount of cash stock divided by total sales. The fourth column shows the corresponding trade credit theory (see chapter two for more information on these theories)

Figure 4.1 represents all variables used in the three models to explain the use of trade credit during the financial crisis. The last three columns of the table show the expected sign to occur in the regression models. First of all *Lsize Lage*, these two variables represent a firm's credit capacity (large firms have more credit capacity) and reputation (old firms have a better reputation compared to start-ups). Larger firms are considered to be more creditworthy and have better access to the capital market than

smaller firms. As a consequence these firms will be better in acting as a financial intermediary towards smaller firms ((Schwartz, 1974). Larger firms will therefore take less trade credit from suppliers (negative influence on trade payables), since these firms can easily access cheaper sources of external funds. The effect of Lsize on trade receivables is positive. According to Petersen and Rajan (1997) the size of a firm is a proxy for creditworthiness. Creditworthy firms are expected to extend more trade credit. Lage can be interpreted in the same way as Lsize (Petersen & Rajan, 1997).

Ebitdaa and Cash are proxies to measure the creditworthiness of a firm. Ebitdaa represents the amount of cash flow which a firm is able to generate and Cash the amount of cash balance a firm has. Both represent how liquid a firm is. These firms enjoy a larger *liquidity cushion* and are therefore better able to finance profitable commercial operations (by extending trade credit to customers) and have an incentive to reduce the amount of trade credit they take (since internal funds are cheaper than trade credit). Therefore the effect of these variables in positive on trade receivables and negative on trade payables (Love et al., 2007).

Stfina represents the amount of short term finance. A firm able to obtain short term finance is expected to grant more trade credit than firms which are not able to obtain short-term finance. Since short-term finance can be seen as a (cheaper) substitute of trade credit (Garcia-Teruel & Martinez-Solano, 2010). Important to realize is the difference with the amount of short-term finance *before* the crisis as an indicator of a firm's creditworthiness *during* the financial crisis. A reverse effect of short-term finance on trade credit is then expected.

Ltdebt represents the amount of long term debt of a firm. Ltdebt is only an explanatory variable for trade payables. The variable is added to the regression to test whether there is a substitutional effect towards the amount of credit obtained from suppliers (trade payables). Therefore the expected sign of Ltdebt on trade payables is negative (Deloof & Jergers, 1999).

Fcost is calculated by dividing interest by the amount of debts. The higher the cost of financing the less willing a firm is to extend trade credit to their customers, and the more the firm has an incentive to obtain trade credit from its suppliers. So therefore

Fcost is expected to be negatively related to trade receivables and positive to trade payables (Garcia-Teruel & Martinez-Solano, 2010).

Pgrowth and Ngrowth are indicators which capture the impact of shocks in the amount of sales made in a year. The first variable indicates the positive growth in sales and the second one the negative growth. A growing firm is expected to extend relatively more trade credit. A firm with declining sales however does not automatically extend less trade credit. Firms with declining sales can try to counter this by extending more trade credit to stimulate its sales (Petersen & Rajan, 1997). Additionally it can be interesting for firms to alter the declining sales trend because of accompanying costs of growing stocks and changes in the production level (Emery, 1987).

Finally Curras and Currat are variables to measure the influence of the amount of current assets a firm has. Curras is calculated by dividing current assets with total assets. Firms which have made a large investment in short term assets will use more short term finance in general and trade credit in particular. Therefore Curras has a positive relation with trade payables. There is no expected relation between Curras and trade receivables. Currat (current ratio) is calculated by dividing current assets by current liabilities. A firm which has a high current ratio is relatively liquid. A liquid firm is willing to finance profitable commercial operations and has less incentive to take trade credit from suppliers, since it is more expensive than financing its operations by themselves.

To conduct the OLS regressions the literature suggests several control variables. Table 4.1 helps to understand the way these variables are calculated. All variables are suggested by the literature to be important determinants of trade credit (Garcia-Teruel & Martinez-Solano, 2010; Petersen & Rajan, 1997) (see chapter two for an extended discussion of trade credit theories).

4.5   OLS assumptions

Before conducting the OLS regressions it is important to check whether some specific OLS-assumptions apply to the data and sample used in this research. The following

paragraphs deals with these important OLS-assumptions and present the tests used in this research to verify if the assumptions apply in this research.

The following assumptions and aspects of OLS are discussed in the next paragraphs:

- Normality of residuals
- Homoskedaticity
- Absence of multicollinearity
- Bootstrapping
- Robustness of results: observations clustered by firm

4.5.1 Checking normality of residuals

Hypothesis testing using OLS assumes the data to be normally distributed. The skewness and kurtosis of the data are important indicators of normality. Skewness is a measure which indicates the asymmetry of the distribution of the data, OLS assumes the data to be normally distributed (bell curve). Both tails should be of similar length. Skewness is zero. A negative measure indicates relatively few low values and therefore the left tail will be longer. A positive measure indicates relatively few high values and consequently the right tail will be longer. For OLS the skewness indicator of a variable should be zero.

Kurtosis represents how big the tails are. It measures to what extent the observation peak in the middle of the distribution. A positive measure indicates most of the observations are central around the mean. A negative measure indicates more distributed observations and therefore have a wider peak around the mean.

Another important assumption for hypothesis testing in regression analysis is the assumption that the distribution of the error term is normal and has a mean of zero. The value of the error term is assumed to be purely determined by chance (Studenmund, 2010). The distribution of the error term for the total population should look like the chart in figure 4.1. For a small sample - as in this research – it is not likely that the mean of the error term is exactly zero and that the distribution of the error term is perfectly normal. However it is important in terms of hypothesis testing to know the

distribution of the error term. Only if the error term is normal distributed the found results can be claimed to be significant for the entire population.

Tests

Skewness and kurtosis of the data can be easily observed by inspecting the curve and comparing it with a normal distributed virtual curve (for example figure 4.1). The normality of the residuals can be tested by a graphical plot and/or calculate a numerical test. A perfectly normal distributed error term should look like figure 4.1. In this research plots and numerical tests are conducted for both models of trade credit. One of the numerical tests for normality of the residuals in Stata is the Shapiro-Wilk W-test for normality. It tests the null hypothesis that the residuals of the error term are normally distributed. If the p-value is close to zero (lower than an alpha of 0,05) the hypothesis that the residuals are normally distributed have to be rejected (Shapiro & Wilk, 1965).

Figure 4.1: Normal distribution of the error term
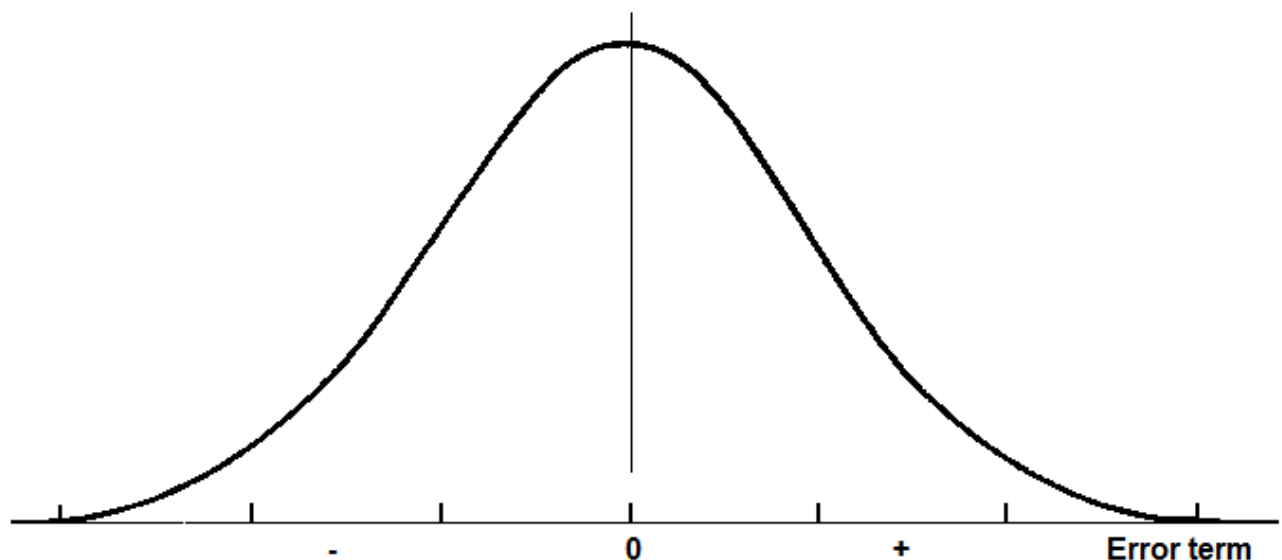
4.5.2 Checking for heteroskedaticity

An important assumption of OLS regressions is the homogeneity of the variance of the residuals. In other words all variables of every observation should have a constant variance. Sometimes this assumption is violated due to the effect of a particular

dependent variable of the observed firms. For instance it is possible that larger firms (dependent variable size) have a higher variance of residuals.

There are graphical and non-graphical methods to check whether there is heteroskedaticity. A common used graphical method is plotting the residuals and the fitted values. Figure 4.2 is an example of heteroskedastic residuals and homoskedastic residuals.

Figure 4.2: Example of heteroskedastic residuals and homoskedastic residuals
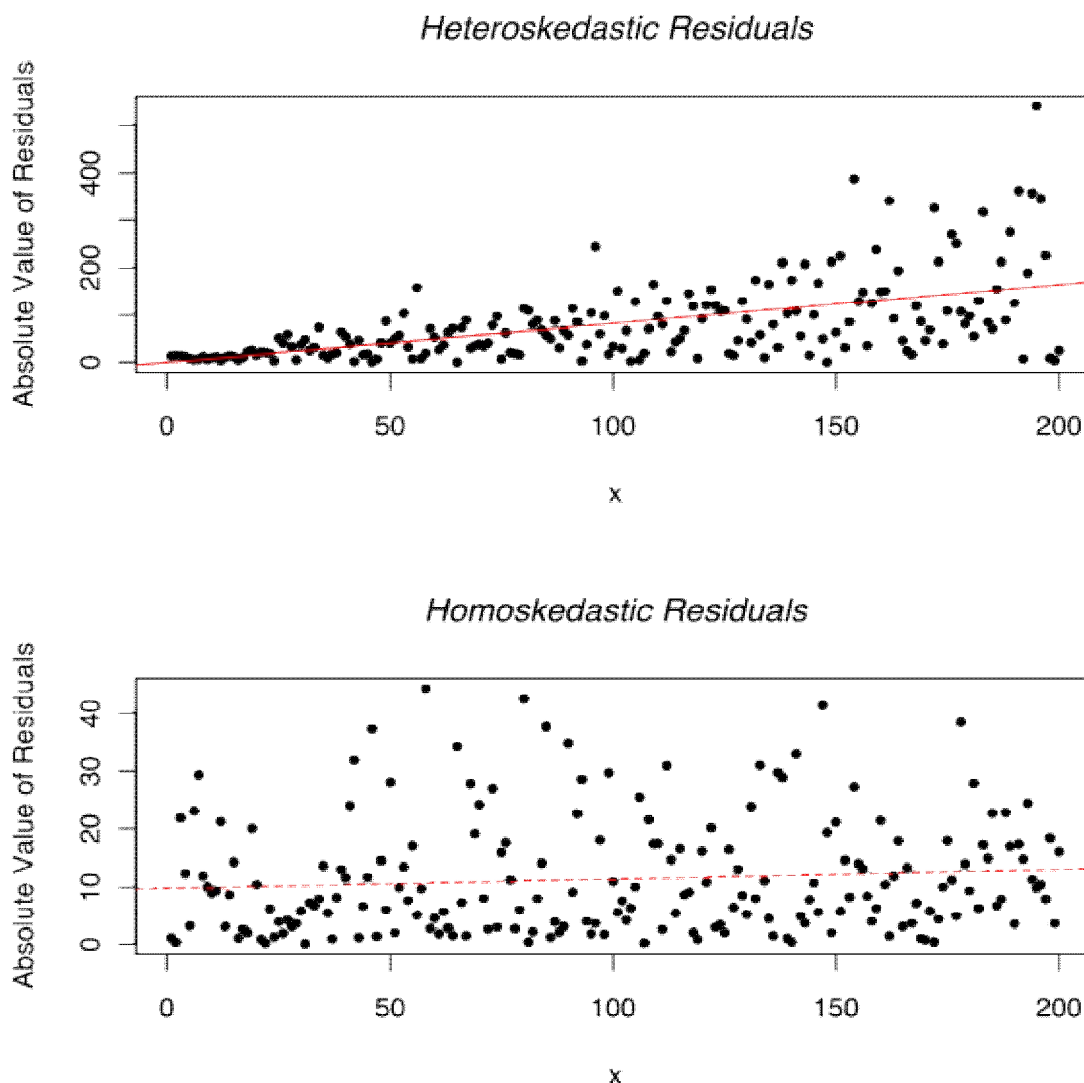
Commonly non-graphical methods are Breusch-Pagan test and White's test. Both test the null hypothesis that the variance of the error are all equal. A P value near zero indicates heteroskedaticity. Both tests give similar results. In this study the Breuch-Pagan test is used. The Breusch-Pagan test the null hypothesis that the variance of the residuals is homogeneous. A very small p-value therefore forces to reject the null-hypotheses. In

practice the test is combined with a plot to see the severity of the potential heteroscedasticity.

4.5.3 Checking for multicollinearity

A major threat in regression analysis is multicollinearity. Collinearity occurs when two independent variables in the model correlate with each other. The variables more or less indicate the same phenomenon. Ordinary least square is unable to estimate the coefficients of the correlating variables. Perfect collinearity between two independent variables is rare, but severe imperfect multicollinearty can cause serious problems (Studenmund, 2010).

Consequences

The principal consequence of multicollinearity is that the variance and standard errors of the estimates will increase. Because both variables are correlated it becomes hard to identify the separate effects of the single variables. If it is difficult to identify the individual effects of a variable it is likely to make large errors in estimating the βs. The estimated coefficients now come from distributions with large variances. This increases the likelihood of estimating an unexpected sign.

Also the computed t-score falls. The t-score is calculated with the standard error of the estimated coefficient as the denominator. Since multicollinearity increases the standard error the t-score decreases.

At last the estimates become very sensitive to changes in the specification. OLS estimation is in case of multicollinearity forced to emphasize on observation which differ. Since most observations are similar in case of multicollinearity, the effect of a few observations determine the OLS estimation. If you delete or add some observations can dramatically affect the estimation of coefficients (Studenmund, 2010).

Detection of multicollinearity

Because of these consequences it is important to test for multicollinearity. An often used method to detect multicollianearity is calculating the variance inflation factor. After calculating the VIF's a rule of thumb to detect collinearity is a VIF greater than 10.

4.5.4   Model validation: bootstrapping

To validate the models I used bootstrapping. Bootstrapping is a statistical method to estimate robust standard errors and standard intervals of the regression coefficients. A basic assumption of OLS is that the sample data have a normal distribution. With bootstrapping this is no longer needed. Bootstrapping is a method based on resampling. A regression is conducted multiple times on smaller subsamples. Each subsample is a random sample of the original sample. In this research for every regression model 2000 bootstrap samples are taken (Freedman, 1981).

4.5.5   Improving robustness: cluster robust-VCE estimator

A cluster estimator is added to the regressions to improve the robustness of the results. It is commonly referred as cluster-robust-VCE estimator (where VCE stands for variance covariance matrix of estimates). To undo the effect of the heteroskedastic errors the function *vce (cluster i)* is used. Where i stands for a particular firm. It is reasonable to expect that observations of the same firm over different years create similar errors. Therefore cluster-robust-vce estimator corrects the results of the regression. It allows within-cluster correlation of errors and this consequently results in more conservative standard errors (Baum, 2006).

4.6   Timing of a financial crisis

The start of the financial crisis is somewhat arbitrary. Most media speak of the start/peak of the crisis when Lehman brothers fell. However to make a more scientific decision about the start of the financial crisis with respect to trade credit issues a more objective identification method of the starting moment of the financial crisis is needed.

The underlying cause of the beginning of the financial crisis was a problematic US mortgage sector. An increased number of people had payment problems. This became a seriously threat to the US banking sector in 2007. Banks lend bundles of problematic mortgages to other financial institutions and/or take securisations for problematic

mortgages on their balance sheet, the so called credit default swaps (CDS).[5] The entire global financial sector becomes affected. Additionally because of these complex constructions the impact of the devaluating mortgage activa becomes unclear. Because of the uncertainty about the risks of these activa the trust of financial institutions in each other frozens. Interbancaire lending dried and financial institutions started to write off the value of their suspicious assets (Fratianni & Marchionne, 2009).

In most newspapers this is treated as the starting moment of the financial crisis: the summer of 2007. However concerning the topic of this particular research, the use of trade credit, the real effects of the crisis on firms is timed later. The central concept of this research is the connection between the shrinkage in the provision of financial institution's credit and the way trade credit is used to absorb this effect. Therefore information about changes in the acceptation policies of banks is a better indicator for the starting point of the crisis. Additionally changes in the GDP reflect the moment when the crisis seriously affected the Dutch economy.

More specifically for the Dutch situation the fourth quarter of 2008 is considered as the 'peak' of the financial crisis in the Netherlands, since at this moment the crisis physically affected the Dutch economy. Other articles on this topic use different methods to identify, Choi and Kim (2005) for instance look at the federal fund rate to time financial shocks. Taketa and Udell (2007) just mention the period, the US credit crunch of 1990-1992. In this case looking at growth/shrinkage of GDP to indicate the crisis-year seems most valid, because this indicates that the crisis physically affected firms in the Netherlands.

---

[5] CDS: a credit default swap is a financial instrument, which more or less function as an *insurance-like contract*. It guarantees to pay possible losses in case of a default in exchange the insured pays a premium. For a more extensive discussion see a Time article 'Credit Default Swaps: The Next Crisis?'. http://www.time.com/time/business/article/0,8599,1723152,00.html

Figure 4.3: Fluctuations in Dutch GDP growth rate during the period 2005 to 2009
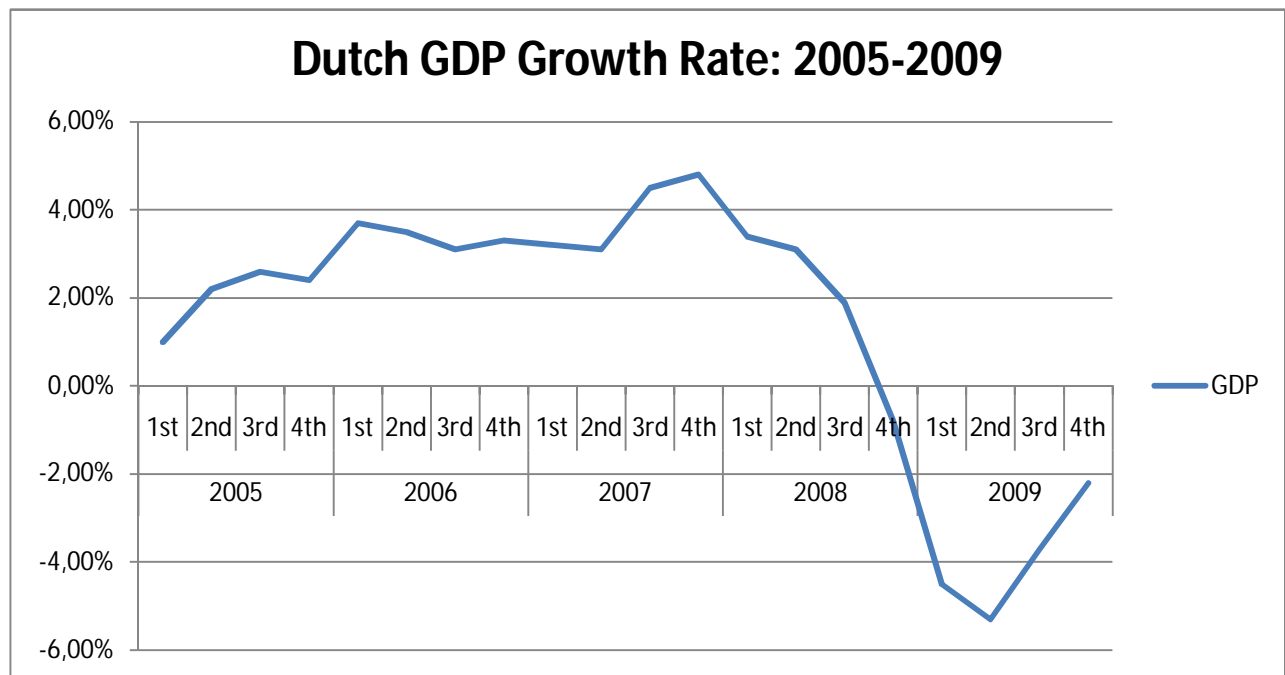
Figure 4.4: Fluctuations in the acceptance criteria of the Dutch banking sector (Source: DNB)[6]
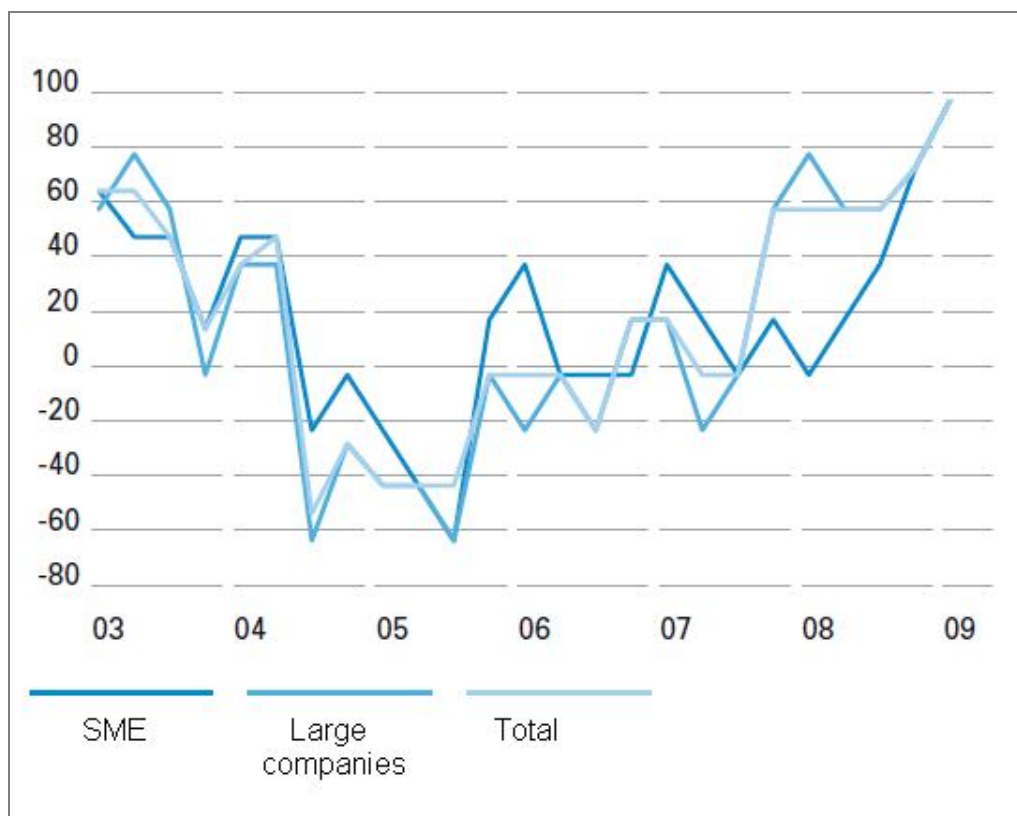
6   http://www.dnb.nl/binaries/Kredietverlening%2520aan%2520Nederlandse%2520bedrijven%2520loopt%2520terug_tcm46-214397.pdf

Figure 4.3 shows that the growth of Dutch economy decreased since the ending of 2007 and eventually shrinked since the last quarter of 2008. The second source to identify the crisis period is the tightening of acceptation criteria banks set for granting credit. The central bank of the Netherlands (DNB) conducts periodically a Bank Lending Survey (BLS) among Dutch Banks. Part of this BLS is an investigation of changes in the acceptation criteria banks apply to their clients. Since I expect trade credit to be a substitute to tightening of the bank lending channel, this is a relevant indicator to identify the crisis period.

As figure 4.4 visualizes, the acceptation criteria for granting credit to large firms have become more tightened since the last quarter of 2007 and since the beginning of 2008 also small and medium sized firms suffered from stricter acceptation criteria.

Taking both the GDP and the acceptation criteria of the Dutch banking sector, the years 2008 and 2009 are labelled as financial crisis years.

4.7   Hypothesis testing

To test the hypothesis three models are specified to explain the use of trade credit (one model to explain trade receivables and one model to explain trade payables). Dummy variables in the models represent the effect of the crisis years. To test hypothesis one both the regression models are estimated twice. First with two dummy variables representing crisis year one and secondly a model with one dummy variable representing both years combined: a dummy variable labelled 'crisis'.

Table 4.2: Expected relation hypothesis one

	Hypothesis one		
Crisis dummies	**Trade receivables**	**Trade payables**	**Net trade credit**
Cri Year 1	Positive relation	Positive relation	Positive relation
Cri Year 2	Positive relation	Positive relation	Positive relation
Crisis	Positive relation	Positive relation	Positive relation

After estimating the regressions test statistics and probability values are known. To accept the null hypothesis the sign of the test statistics should be equal to the expected relation showed by table 4.2. I accept the null hypothesis if the probability value is lower

than 0,05. Therefore the T-statistics should be (if a positive relation is expected) larger than 1,960 (Moore & McCabe, 1999).

To test the hypothesis three creditworthiness indicators are added to the models. Every indicator represents the pre-crisis value of this indicator. This value is multiplied with the crisis dummy. In that way these predictors in the model represent how the pre-crisis creditworthiness value of a particular firm influence the use of trade credit during the crisis year.

In the same way as with hypothesis one, the crisis years are represented in two ways. First by two different dummies representing crisis year one and crisis year two. Secondly by one dummy representing both crisis years, labelled 'crisis'.

Table 4.3: Expected relation hypothesis two

	Hypothesis two		
Creditworthiness variable	**Trade receivables**	**Trade payables**	**Net trade credit**
High proportion of short-term debt	Positive relation	Negative relation	Positive relation
High cash flow generation capacity	Negative relation	Positive relation	Negative relation
High cash stock	Negative relation	Positive relation	Negative relation

After estimating the regressions test statistics and probability values are known. To accept the null hypothesis the sign of the test statistics should be equal to the expected relation showed by table 4.3. I accept the hypothesis if the probability value is lower than 0,05. Therefore the T-statistics should be (if a positive relation is expected) larger than 1,960 (Moore & McCabe, 1999).

Chapter 5:   Data

To investigate the change in use of trade credit by Dutch firms during the financial crisis, the data is two dimensional. The data needed is both cross-sectional (multiple firms) and time-series (different time points). These data are pooled together and create a single data set, this type of data creation is called *panel data* (also known as *longitudinal* or *cross-sectional time-series data)* (Studenmund, 2010).

The population central of this research are all non-financial Dutch manufacturing firms. Their financial statements are publicly available. These statements are available on http://company.info. To make a comparison between pre-crisis and crisis behaviour of the firms, the selected data are distilled from annual accounts for the years 2005, 2006, 2007, 2008 and 2009. Before starting collecting and analyzing the data several trade-offs need to be handled. The following typical topics in this perspective is discussed in this chapter:

- Observation interval (quarterly or annually)
- Book year and crisis timing
- Characteristics of the firms to include: non financial manufacturing firms
- Sample frame/size

5.1   Observation interval (quarterly or annually)

Comparable literature on trade credit study firms varying in size and representing all sectors (except financial firms) (Garcia-Teruel & Martinez-Solano, 2010; Kohler et al., 2000; Love et al., 2007; Nilsen, 2002). Main source of data are annual accounts of the selected firms. Ideally to study trade credit behaviour would be quarterly data. First of all trends in trade credit behaviour is better visible and secondly matching of the timing of a crisis and subsequently the reaction of behaviour to this event is more applicable. On the other hand quarterly data would make seasonal effects visible, which are not visible in annual accounts. Since this is an interesting phenomenon in trade credit (see price differentiation theory in the second chapter), trade credit could be used to act contra-cyclical:

stimulating sales in off-season. These typical seasonal effects of a sector could blur the overall effects of a crisis and therefore the particular reaction of firms.

Concerning quarterly data (so called QFR), only Nilsen (2002) did research at a quarterly level. The study conquers the threat of seasonality by detrending the data using a 5-quarter weighted moving average. There are possibilities to overcome seasonality of quarterly data, unfortunately only annual data are available within this research. Therefore the annual reports of selected firms form the basic source of data.

5.2   Book year and crisis timing

Paragraph 4.3.1 discusses the rationale behind determining the crisis period. The crisis period is selected based on quarterly data of Centraal Bureau van de Statistiek (CBS) and based on the Bank Lending S conducted by DNB among Dutch Banks and is set for the second half of 2008. The timing of the crisis does not occur parallel with the publishing of firm's financial statements. The book year of most firms end at 31st of December.

To time this crisis being visible in the financial records of the individual firm, this report follows the definition given by Love et al. (2007). The fiscal year ending within a 12 month interval beginning in July 2008 is labelled as the crisis year of an individual firm. So firms which fiscal year end in July until December have crisis year 2008 and firms which fiscal year end in January until July have crisis year 2009.

The years of analysis are three years before the crisis year of a firm, the crisis year and one year after the start of the crisis. The crisis year and the year after the start of the crisis are labelled ´CriYr 1´ and ´CriYr 2´. Those firms which have a book year ending between January the first and 31st of June have crisis 2009 and 2010 labelled respectively ´CriYr 1´ and ´CriYr 2´.. The other firms have crisis years 2008 and 2009.[7]

---

[7] To improve comprehension crisis years will be named ´CriYr 1´ and ´CriYr 2´. However in some cases it will actually be data over 2008 and 2009 and in other cases 2009 and 2010 respectively.

5.3   Non-financial Dutch manufacturing firms

The analysis is conducted only on the non-financial firms, because the financial firms (e.g. banks and insurance firms) differ significantly from the non-financial firms in terms of capital structure. It is common in corporate finance to exclude financial firms because of their high leverage. According to (Fama & French, 1992)), the leverage "may not indicate the 'distress' associated with high leverage of non-financial firms which could bias the results from the analysis".

Besides the previous more general argument for not including financials in the data set, using data from financial firms in this topic is for another reason problematic. Trade credit is typically extended and used by firms, which produce goods or deliver services. The main business of financial institutions is reinvesting savings from customers and capital from investors, these firms act as financial intermediaries and earn their money with it. Taking these firms into account would severely affect the measures of trade payables and receivable, and are therefore left out.

Besides not selecting financial firms, only manufacturing firms are selected. As mentioned before especially manufacturing firms use trade credit actively. However the main argument for selecting manufacturing firms is a pragmatic one. Data collection using company.info has to be done completely manually, therefore a limited number of firms can be selected. To improve the representativeness for the entire population only manufacturing firms determine the sample. The characteristics of manufacturing firms are more comparable (in terms of investments in long and short term active and the use of trade credit), this would make the limited number of selected firms less problematic.

5.4   Sample frame/size/selection method

The source for the data gathered in this research is http://company.info. This is a Dutch database, which contains the financial statements of approximately two million Dutch firms (however the University of Twente have a licensee for only the top 50.000 firms in the Netherlands. Collecting data from this database has to be done manually. To categorize firms can be selected on SBI code and on sector (categories developed by

company.info). SBI codes are a hierarchical classification of economic activities of a firm. The coding is based on the European Union's classification: NACE (Nomenclature statistique des activités économiques dans la Communauté Européenne) and the United Nation's classification: ISIC (International Standard Industrial Classification of All Economic Activities). Using the SBI classification all non-financial manufacturing firms are selected (SBI coding: 10-33)[8].

5.4.1 Improving robustness and reasons for excluding firms

During the process of data collecting it became clear that small firms (total sales and total assets below 10 million) register too little information in their annual accounts to conduct the analyses needed for this research. For instance small firms are not obliged to register trade credit separately in their balance sheet. Instead these firms are allowed to allocate trade receivables to an aggregate post of all receivables. Therefore the sample frame only contains medium and large firms.

Secondly firms which are for a majority owned by other firms are excluded from the sample. These firms lack independent financing and are therefore differently affected by the effects of the financial crisis. For instance, although severe creditworthiness these firms might get financial support from their mother-companies and would therefore differently use trade credit in comparison with independent firms.

Thirdly firms which did not exist in 2004 and/or 2009 are not included in the sample. This is due to a lack of available time and resources. To maximize the number of observations collected I only selected those firms which existed in 2004 and in 2009 as well. Nevertheless I realize this could result in problematic attrition bias, this is discussed in the discussion part of this report.

At last firms which do not collect extended trade credit themselves are left out. This is so called factoring. The firm sells its trade receivables to a third party and in return the firm receives a certain percentage of the value of its trade receivables directly. The

---

[8] The sbi index can be found at the CBS website: http://www.cbs.nl/nl-NL/menu/methoden/classificaties/overzicht/sbi/default.htm

risk of fault of the debts lies at the factored and is no longer a risk of the firm. Since it sold its trade credit debtors at a discount to the factored. The problem for this research lies within the fact that these firms no longer have trade debtors on their year accounts and are therefore unsuitable to participate in this research.

To improve the robustness of the results it is common in the literature about trade credit to exclude the outliers of the variable (Love et al., 2007). Because of the limited number of included firms this is partly done in this research. Only unlikely values of variables are excluded (ratio of trade credit values of >1). Additionally the figures in the financial statements which appear to be misreported are removed (such as negative numbers for sales, trade credit etc). Also extreme values of cash, cash flows, sales growth and short term debt ratio are manually checked and corrected. Love et al. (2007) made similar adjustments to their data. In this research I excluded one observation, because of trade credit values above 1. Besides several suspicious observations are checked and corrected.

Besides the robustness is also improved by using three different indicators to calculate a firm's creditworthiness, which is explained in the variables section of this report (see paragraph 4.4.2).

5.4.2 Sample

The total sample frame contains 764 non-financial Dutch manufacturing firms (including forty stock listed firms). The database which is available lacks the functionality to describe the firms preceding the selection process. This resulted in deselecting (based on arguments discussed in the previous paragraph) some firms after the selection process.

All relevant literature on the use of trade credit during crisis periods take all firms available in their database (Kohler et al., 2000; Love et al., 2007; Mateut et al., 2006; Nilsen, 2002; Taketa & Udell, 2007). Due to limited time and resources I am forced to analyze the trade credit behaviour of a limited number of firms (the data can only be collected manually out of the annual reports available in the database). Therefore approximately 10% of the firms in the sample frame were selected.

Initially 70 firms were randomly selected (taking every 10th company starting at a random point in the list. If the first (2005) or last (2009) year did not contain trade payables and receivables the next company in the list was taken). This type of random sampling is called *systematic sampling*, taking every *k*th firm in the sampling frame. (Babbie, 2004)

Several firms were deselected, because they were a subsidiary of a foreign mother-company. Additionally some firms were deselected because of a severe lack of data. Ultimately the sample contains 53 firms (including 15 stock listed firms). See additional information about the data in the descriptive statistics part (paragraph 5.5).

After deselecting several firms initially selected, roughly 75% of the selected firms are still part of the sample. Since probably 25% of the firms in the sample frame would also not meet the criteria set in paragraph 5.4.1, the ultimately selected firms represent 10% of the proper sample frame. A proper description of the sample frame should be all *independent* non-financial Dutch manufacturing firms.

5.4.3   Selection method

There are two categories of methods to draw a sample of firms: probability sampling and non-probability sampling. Since the total number of firms is limited (originally 10% of the sample frame) in this research direct probability sampling is risky. To make sure the limited sample size contains variation, stratified systematic random sampling method is conducted (Babbie, 2004).

In the trade credit literature the size of a firm is an important determinant of trade credit usage (Petersen & Rajan, 1997). To improve the variation of the selected firms the sample frame is therefore divided in size categories. Secondly the trade credit literature has proven the importance of being stock listed (and the improved access to financial capital) and the way firms use trade credit (Nilsen, 2002). Therefore an additional category is created: *quoted*.

As mentioned before to increase the representativeness of the sample the firms are categorized. The firms in the sample frame are divided in three categories: two based on size (*medium* and *large*) and a separate group for quoted firms. There are three

commonly used alternatives to calculate size: based on turnover, headcount or balance sheet total. These three measures are suggested by the European Commission in 2005. Following Mateut et al. (2006) firms are assigned to a specific size category if they satisfy two of the three criteria.

In 2005 the European Commission made the categories presented in table 5.1 to define small and medium-sized firms (SMEs). Logically the large firms have a turnover greater than € 50 million, balance sheet total greater than € 43 million and a headcount of 250 or more.

Table 5.1: Size classification

Enterprise category	Headcount	Turnover	or	Balance sheet Total
Medium	< 250	≤ € 50 million		≤ € 43 million
Small	< 50	≤ € 10 million		≤ € 10 million
Micro	< 10	≤ € 2 million		≤ € 2 million

Note: see for additional info: http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm

In every size category the 10th firm was selected (except quoted firms, to give this category a meaningful size fifteen firms were selected, equally divided over the different indexes, i.e. taking 10%, only four firms would represent the quoted firms). After deselecting several firms (see previous paragraph) the variation of the selected firms over the categories is as follows:

Table 5.2: Size variation of firms

Category	Stock index	Number of firms
Quoted		15
	AEX	5
	AMX	5
	AScX and local	5
Large		22
Medium		16
Total number of firms		**53**

5.5   Descriptive statistics

5.5.1   Data cleaning

Particular extreme observations can highly affect the results of a regression analysis. Therefore it is important to inspect the collected data and if necessary clean the data set. There are two categories of observations which affect the results of a regression:

- Outliers: in linear regression an outlier is an observation with a large residual. The particular observation of the dependent variable is unusual given the values of the independent (predictor) variables.
- Leverage: an observation has high leverage when one of the independent (predictor) variables has an extreme value. Leverage is a measure of deviation from the mean. Consequently these leveraged values can have an influence on the estimates of the regression coefficients.

Not all outliers and leverage observation have severe impact on a regression. An observation is called *influential* if removing it substantially changes the estimates of the regression coefficients. This can be a result of leverage and outlierness of an observation.

After inspecting the initial summary statistics I corrected some unusual and strange observations, like negative observations for trade credit or extreme values for particular variables. Additionally there are systematic methods to calculate and identify influential observations.

There are two common used methods to identify influential observation: Cook's D and DFITS. Both methods give similar results, except they use different scales. In this research Cook's D is used to identify influential observation. The lowest value of Cook's D is zero, the higher the value the more influential the observation. A conventional cut off point for Cook's D is 4/n.

I made the following manual adjustment based on the results of Cook's D:

- Firm 41 'Heupink & Bloemtabak': correction of ebitdaa, because of irregular cost in 2007 of 18 million euro.

Tables 5.2 and 5.3 show that the selected firms contain a lot of variation in terms of age, size, sector and levels of trade credit. Additionally it contains extremely liquid firms and there is variation in the amount of short term finance available. These variables are used in the regressions presented in chapter six.

Table 5.3: Summary statistics

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
Dependent variables						
Recass	265	0,26	0,244	0,127	0,034	0,702
Payass	265	0,174	0,142	0,113	0,011	0,628
Independent variables						
Stfina	265	0,08	0,045	0,106	0	0,632
Ebitdaa	265	0,156	0,133	0,116	-0,174	0,571
Cash	265	0,081	0,036	0,129	0	0,805
Currat	265	1,654	1,51	0,699	0,428	4,88
Fcost	265	0,015	0,014	0,01	0	0,052
Pgrowth	265	0,705	1,028	0,656	0	4,163
Ngrowth	265	0,355	0	0,436	0	0,999
Ltdebt	265	0,145	0,143	0,13	0	0,513
Curras	265	0,582	0,55	0,187	0,173	0,992
Age	265	43,17	26	47,93	1	291
Size	265	2.278	71	7.196	5	39.000

Note: Dependent variables: Recass is measured as trade receivables divided by total assets. Payass is trade payables divided by total assets.
Independent variables: STFINA the amount of short term finance; EBITDAA earnings before interest, tax, depreciation and amortization divided by total assets; CASH amount of cash stock divided by total assets; CURRAT is current ratio divided by current liabilities; FCOST the amount of interest paid; PGROWTH positive sales growth; NGROWTH negative sales growth; LTDEBT the amount of long term debt; CURRAS current assets divided by total assets;. Age describes the number of years the firm exists. Size is defined as total assets of a firm (in millions)

Now let's see what the trade credit usage looks like in charts following a time line. Figure 5.1 visualizes the trade credit usage of the selected firms during the financial crisis and the years preceding.

Figure 5.1: Graphical analysis of the use of trade credit by year

Figure 5.1 presents the use of trade credit by non-financial Dutch manufacturing firms. In the first three charts three different size categories are presented to see if firm size result in different patterns of trade credit usage. The original size categories (medium; large and quoted) were not applicable because the quoted companies were varying in size. The size categories in figure 5.1 represent each 33,3% of the firms in the sample size. Since small (total assets ≤ € 10 million) and micro (total assets ≤ € 2 million) are not represented in the sample size, therefore the smallest 33,3% firms are labelled medium. To be able to compare the firms the amount of trade credit is scaled by total assets. The last chart represents both the pattern of trade receivables and payables.

These charts clearly visualize a decline in the use of trade credit during the financial crisis. This declining pattern is visible in every size category, however the size categories differ in their average trade credit level. Especially the third chart about net trade credit shows the fact that the very large firms in the sample size are high suppliers of trade credit. Medium and large firms provide slightly more trade credit than they obtain. On the other hand the very large firms provide (around 30%) almost twice as much trade credit than they obtain (around 15%). This picture corresponds with trade credit literature, larger firms have more possibilities to obtain short term credit from other (cheaper) sources and therefore act as a gateway in redistributing these financial resources to their customers in the form of trade credit. Resulting in a high amount of net trade credit.

To be able to conclude if the above presented data are of any statistical meaning I present and evaluate in the next chapter results of several statistical tests.

Chapter 6:   Results

The results part of this research contains two sections. The first section presents the results of an analysis of the variances in trade credit usage during the crisis period compared with the pre-crisis period. The last part contains the result of several ordinary least square regressions. The last part is divided in two subsections. It starts with focusing on the aggregate patterns and ends with the heterogeneous responses of firms in terms of their trade credit usage. Three models are used to calculate the ordinary least squares regressions. The three models represent trade receivables, trade payables and net trade credit.

6.1   Analysis of variances (ANOVA) in trade credit usage

As discussed in the methodology part of this research, the first step in analysing the panel data is conducting an analysis of variances (ANOVA) of the dependent variables. This test provides information in the differences of the average usage of trade credit in a particular period compared to another period. In this case pre crisis is compared with crisis. The results must be seen as a first signal of the trend in trade credit usage. However anova does not take several important control variables into account. Therefore to make statistical claims and to test the hypotheses paragraph 6.2 show the results of the ordinary least squares regressions.

6.1.1   Anova analysis test results

The anova is conducted on demeaned data. All trade credit data of a particular firm is corrected by the average trade credit level of the particular firm. Only deviations from the firm-specific trade credit level is left over to analyze. This is already explained in paragraph 4.2.1, but is important to realize when analyzing the test results.

Table 6.1 presents the mean, the differences of the mean of crisis years in comparison with the pre-crisis mean and the significance level of these differences. The last two columns represent the F-statistic and the probability that the F-statistics would have a different estimate for the entire population. To claim that the differences in

means are caused by between group variability the following critical F-statistic values should be used:

Critical F-statistic at 5% significance level: 3,030248

Critical F-statistic at 1% significance level: 4,687072

The ANOVA is six times conduted, respectively for the amount of receivables, payables and net trade credit (receivables – payables). First the crisis year 2008 en 2009 are seperately compared to the mean of the pre crisis years. The last three columns reflect a comparison between both crisis years and all pre crisis years. Interpreting the F-statistic both the differences in means of trade receivables as trade payables is at a 1% significance level caused by between-group variablility. In other words the differences in mean is not caused by a few firms which had extreme trade credit values, but the majority of the firms had the same pattern of trade credit usage. However the F-statistic belonging to the ANOVA conducted on net trade credit is not significant.

If we focus on the differences in means in particular years, concerning trade receivables both in 2008 and 2009 the means significantly decreased comparing with the pre-crisis period. Refering to the graphical picture (figure 5.1) shown of trade credit usage in the previous chapter, the decreasing trend visualised in those charts is significantly a trend at the majority of the firms in the manufacturing industry.

The means of trade payables was only significantly lower compared to the precrisis period in crisis year 2009. Crisis year 2008 had a lower mean compared to the pre-crisis period, but this was not significantly caused by between-group variability. Instead probably for this period the difference of some particular firms caused the decrease.

Additionally both crisis years together compared to the pre crisis years (last three columns) show the similar significant results for all three trade credit indicators (trade receivables, trade payables and net trade credit).

Concerning the last rows in the table representing differences in means of net trade credit usage no significant results were found. Most variability was caused by within group variability.

Table 6.1: ANOVA-analysis (computed using Bonferroni) result

	pre	cri08	cri09	F-stat	Prob > F	crisis	F-stat	Prob > F
Trade receivables/Total assets				8,42	0,000		15,62	0,000
Mean	0,010	−0,010	−0,020			−0,015		
Difference in mean crisis period vs pre-crisis		−0,020	−0,030			−0,025		
Significance level		0,044**	0,001***			0,000***		
Trade payables/Total assets				5,50	0,005		9,30	0,003
Mean	0,007	−0,005	−0,016			−0,011		
Difference in mean crisis period vs pre-crisis		−0,012	−0,023			−0,018		
Significance level		0,318	0,005***			0,003***		
Net trade credit/Total assets				0,77	0,463		0,55	0,459
Mean	0,002	0,000	−0,005			−0,002		
Difference in mean crisis period vs pre-crisis		−0,001	−0,007			−0,004		
Significance level		1,000	1,000			0,459		
Obs	159	53	53			106		

*Note: see for variable definition table 5.3. ***,**,* marks significance at 1% 5% and 10% respectively*

Concluding, table 6.1 show significant statistical evidence that the graphical charts (figure 5.1) are correct. Both trade receivables (year 2008 and 2009) and trade payables (year 2009 and the crisis years taken together) were significantly lower in the crisis year(s).

Comparing to Love et al. (2007) which investigated the same pattern during two different crises in Mexico in 1994 and Southeast Asia in mid-1997 there are some important differences. In the first crisis year they found an increase of both receivables and payables and in the following two years they only found a decrease of trade receivables, trade payables showed no significant difference with the mean of the pre-crisis period. Kohler et al. (2000) see two different patterns in their analyses of trade credit behaviour of UK quoted firms. Depending on the cause of the crisis quoted firms react differently. In case of a recession they observe that quoted firms extend more trade credit and obtain less trade credit. In case of monetary tightening quoted firms extend and obtain less trade credit. However in the latter, the net trade credit of quoted firms increases in periods of monetary downturn. So the decrease in trade receivables is

smaller compared to the decrease in trade payables. Neither of these trends is visible in the ANOVA results, table 6.1. In the observed crisis in this research both causes (economic recession ánd monetary tightening (or at least a contraction in bank lending)). I observe both trade receivables and payables to decrease and also a decrease of net trade credit.

Important differences of this study compared to studies like Choi and Kim (2005) Kohler et al. (2000), Love et al. (2007) and Nilsen (2002) are the type and impact of the crisis. These authors studied national or at least region-specific crises, the current financial crisis has a far more global impact. Perhaps firms in these studies had connections with foreign firms and/or investors, which were not affected by monetary contraction. This could lead to different patterns in the use of trade credit. Secondly the difference of this research and the article of Kohler et al. (2000) is that I also analyze medium-sized firms.

The results of ANOVA present the opposite trend as expected from the literature. To make statistical claims and to test the hypotheses it is important to take the effect of relevant independent variables into account. Paragraph 6.2 presents the results of the regression models. First the aggregate pattern of trade credit and secondly the heterogeneous responses of the firms based on their creditworthiness at the start of the crisis.

6.2   Results regression analysis

This part is divided into two sections. First of all the aggregate effects of the crisis on the use of trade credit by all firms is calculated. In the second part creditworthiness of particular firms is linked and evaluated whether differences in creditworthiness result in heterogeneous responses in the usage of trade credit in crisis years. In other words do creditworthy firms react differently in a crisis period than less creditworthy firms? Therefore the regression model includes additionally variables indicating the creditworthiness of a firm. This subchapter starts with some basic tests to verify if the assumptions of OLS apply.

6.2.1 Checking normality of residuals

In paragraph whether skewness and kurtosis of the data is normal. Skewness and kurtosis of the data can be checked by observing the graphs (figure 6.1, 6.2 and 6.3).

The first assumption of OLS is the normal distribution of the residuals. To test this assumption a numerical test and a graphical plot are used. The Shapiro-Wilk W test for normality is the numerical test. In this test the null-hypothesis claims the population to be normally distributed. This hypothesis is rejected if the P-value is close to zero (lower than a alpha level of 0,05) (Shapiro & Wilk, 1965).

The graphical analysis of the residuals is based on a comparison between the distribution of the residuals of the model (blue line) and a line representing a perfectly distributed population (red line). The blue line in the graph should be close to the red line to claim a normally distributed population.

Test-results

Table 6.2 are the test results of the Shapiro-Wilk W test. The residuals of all three regression models have P-values of nearly zero. Therefore the null-hypothesis of a normally distributed population should be rejected. These regression models with this data set is not suitable for valid hypothesis testing.

Table 6.2: Shapiro-Wilk W test for normal data

Model	Obs	W	V	Z	Prob > z
Residuals trade receivables	265	0,949	9,786	5,322	0,000
Residuals trade payables	265	0,959	7,849	4,807	0,000
Residuals net trade credit	265	0,953	8,898	5,100	0,000

Note: W is the Shapiro-Wilk test statistic. V is the covariance matrix. Z is the test result expressed in standard deviations. Prob > z is the p-value. A low P-value forces to reject the null-hypothesis that the population is normally distributed.

Figure 6.1: Plotted residuals trade receivables regression model
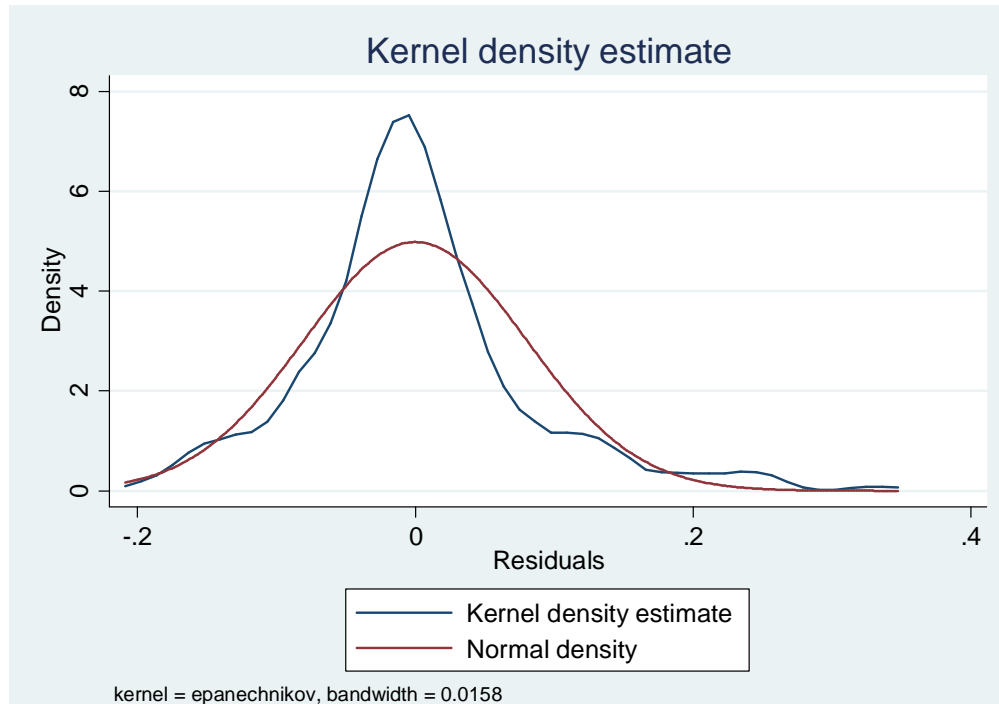
Note: the blue curve represents the residuals of the trade receivables model. The red curve represents a normally distributed population. To see if the residuals are normally distributed the blue curve should be alike the red curve.

Figure 6.2: Plotted residuals trade payables regression model
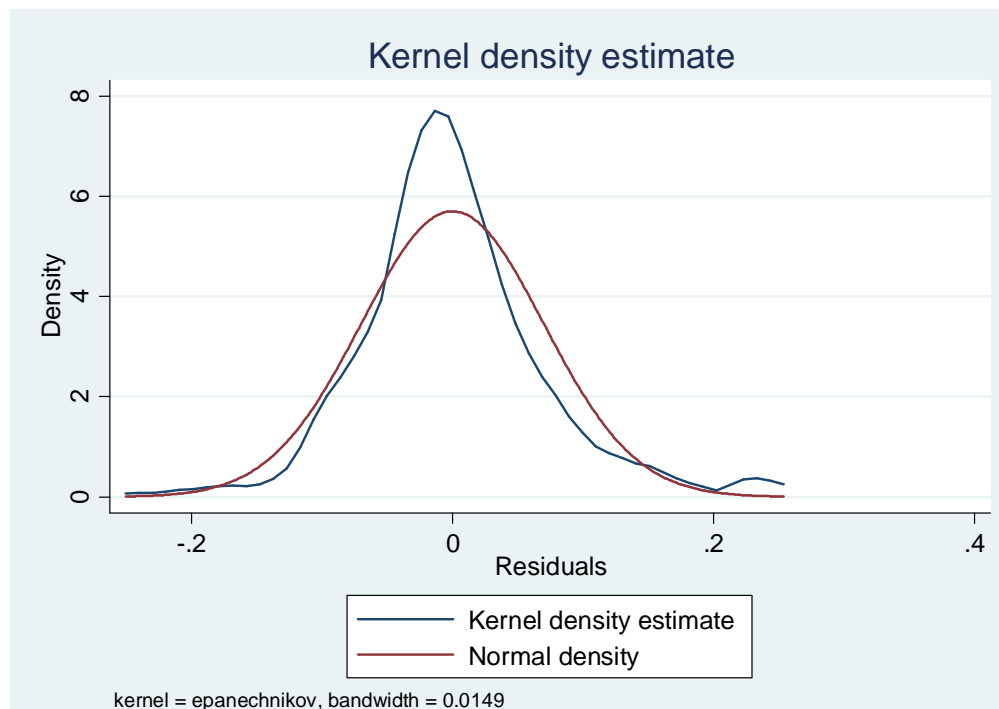
Note: the blue curve represents the residuals of the trade receivables model. The red curve represents a normally distributed population. To see if the residuals are normally distributed the blue curve should be alike the red curve.

Figure 6.3: Plotted residuals net trade credit regression model
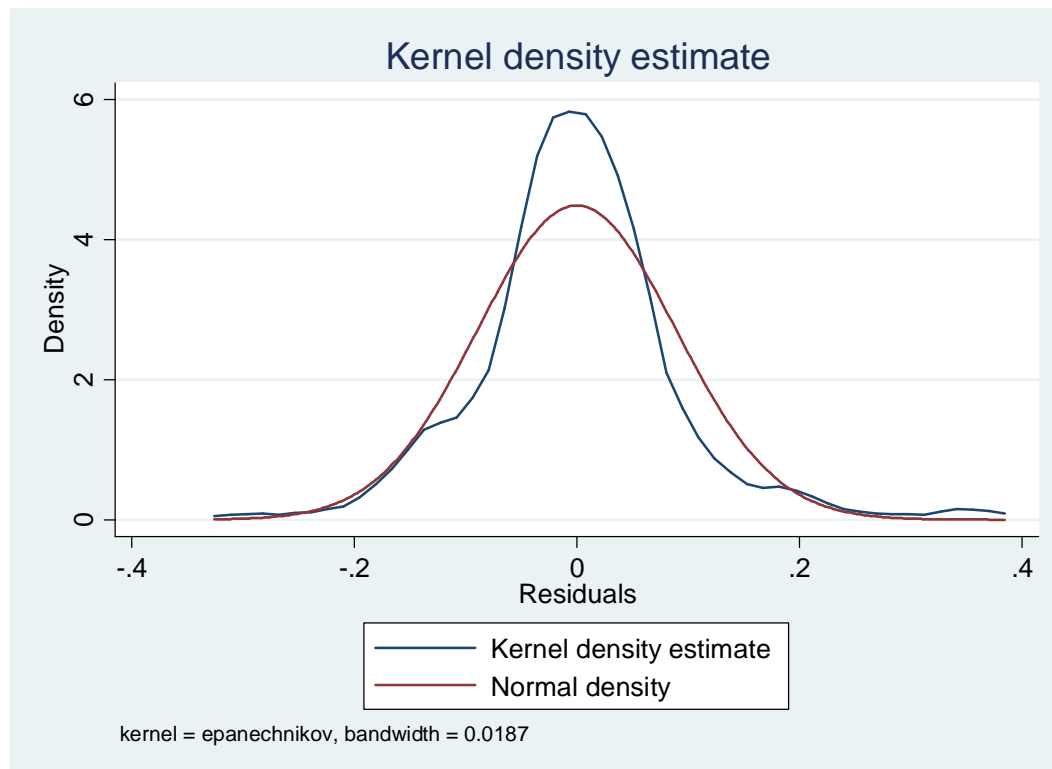
Note: the blue curve represents the residuals of the trade receivables model. The red curve represents a normally distributed population. To see if the residuals are normally distributed the blue curve should be alike the red curve.

Concerning skewness, all three graphs indicate a distribution which is around the middle/zero. There is no strong bias to the right or left, all three curves peak around zero. The skewness of the data is similar as a normally distributed curve. Concerning kurtosis, I observe strong peaks around the mean. This indicates positive kurtosis, also called *leptokurtic* (Lepto is Greek for thin or small). This causes different probabilities compared to a normal distributed curve. Since more observation occur around the mean. Significance level in hypothesis testing is based on a certain percentage which is represented in the tails of the curve. Since the number of observations in the tails is not similar to a normal distributed curve it is not possible to test hypothesis in terms of significance.

All three plots (figures 6.1, 6.2 and 6.3) show different patterns of the distribution of the residuals of the error term. The blue lines differ from the red line. The blue line

exceeds in both cases the line of normal distribution around the mean. The graphs do not show any signs of a normal distribution of the residuals.

Based upon the p-values close to zero in table 6.2 and the plot in figures 6.1 and 6.2 the assumption that the error term is normally distributed should be rejected for both regression models. An important consequence of these test results is the fact that hypothesis testing on these data is problematic since the data set does not represent a normal distributed population. The results of this research therefore cannot accept or reject formulated hypotheses. The results are only suggestions of possible relations.

6.2.2   Checking for heteroskedaticity

This paragraph contains test results from checks for heterskedasticity. Similar as the previous paragraph heteroscedasticity is checked by performing a numerical test and a graphical plot. The Breusch-Pagan / Cook-Weisberg test is the numerical test. It tests the null hypothesis that the variance of the error term is constant: homoscedasticity. Let's see the test result of the numerical test.

Table 6.3: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Regression model:	chi2(1)	Prob > chi2
Trade receivables	60,93	0,000
Trade payables	102,72	0,000
Net trade credit	1,25	0,264

Note: the table represents test result of both trade credit models. Chi2 is the Chi Square statistic and Prob > chi2 is the P-value to decide to accept or reject the null hypothesis that the variance of the error term is constant.

Table 6.3 represents the test results of the Breusch-Pagan / Cook-Weisberg test. The null hypothesis has to be rejected in both cases (alpha close to zero). The variance of the error term is not constant, which indicates heteroscedasticity in the observations. Since the data set contains multiple observations from the same firm heteroscedasticity is likely. Probably the observations of the same firm have similar error terms. Let see how this looks in a graphical form.

Figure 6.4: Variance of the error term in the trade receivables regression model
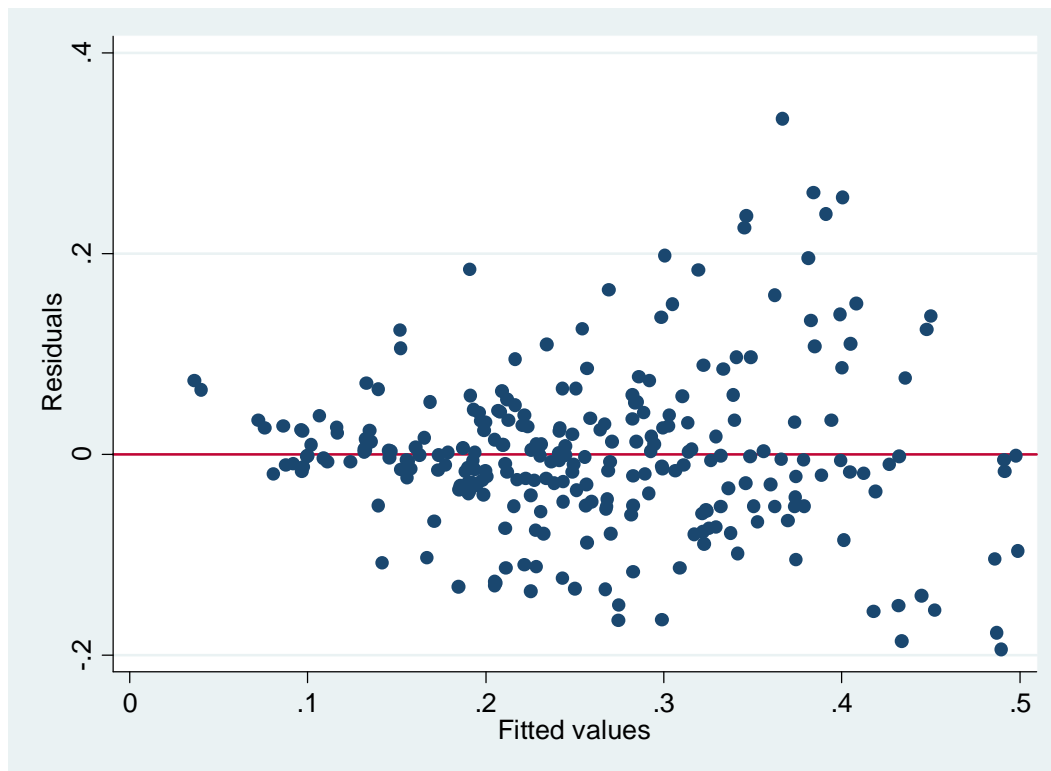
Figure 6.5: Variance of the error term in the trade payables regression model
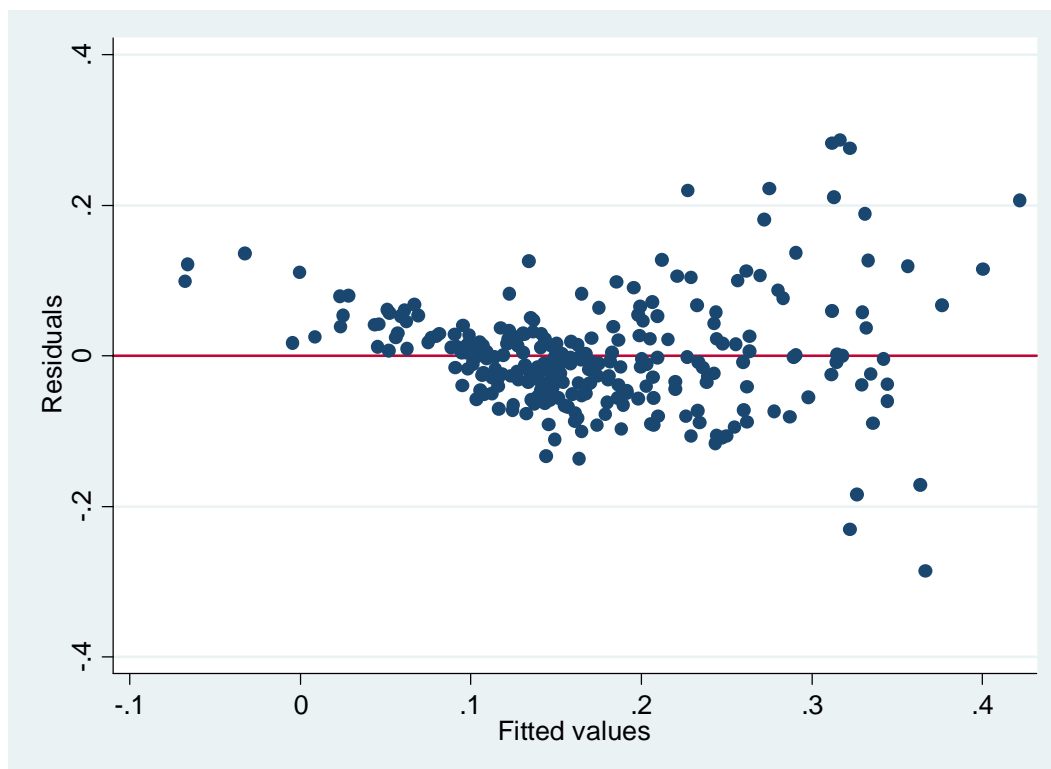
Figure 6.6: Variance of the error term in the net trade credit regression model
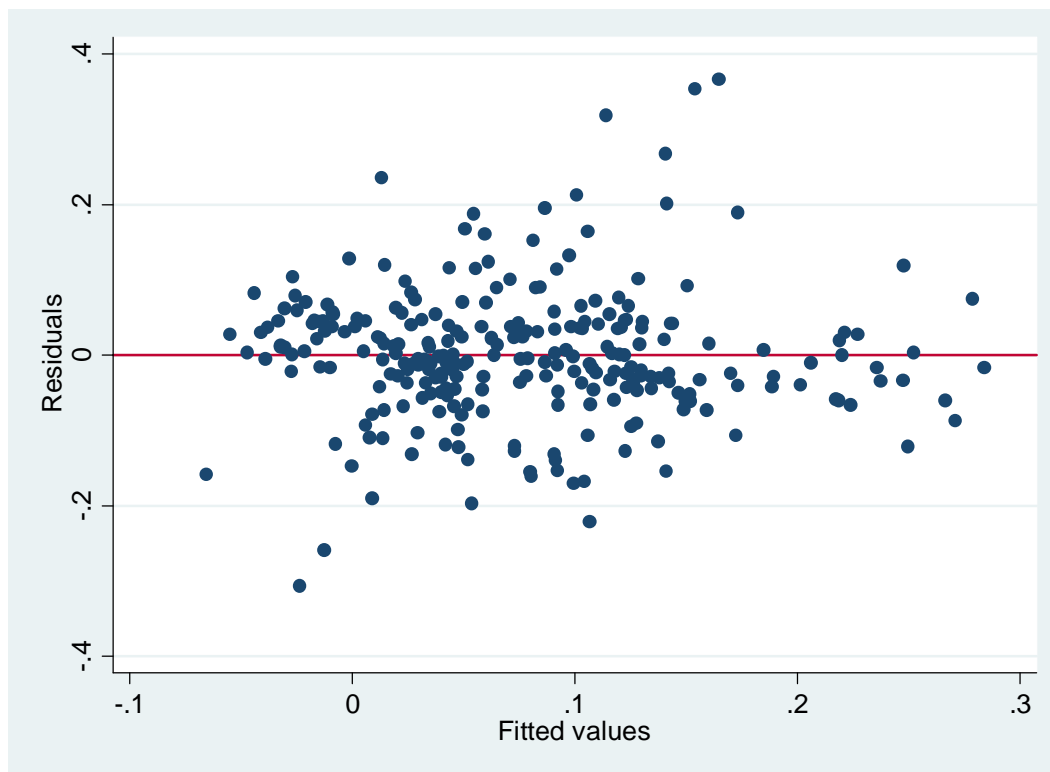
Figures 6.3 and 6.4 show no constant variance in the residuals. The variance should look like the second plot in figure 4.2. Since the results in figure 6.3 and 6.4 do not look like the second plot in figure 4.2 the variance of residuals seem heteroscedastic.

Both the numerical test and the figures suggest to reject the null-hypotheses. In other words the variance of the residuals is heteroscedastic. To correct for this effect the firms are clustered in the regression and the error terms are estimated more conservatively, using the VCE cluster ID functionality in Stata. See paragraph 4.2.5 for more information on VCE.

6.2.3 Checking for multicollinearity

The third important assumption of OLS handled is the absence of multicollinearity among the independent variables in the models. The independent variables in the model should not correlate with each other. To control whether the regression model suffers from multicollinearity the variance inflation factor (VIF) is calculated for each variable in

the model. VIF should not exceed 10 or should be higher than 0,10 if you look in the third row of tables 6.4 and 6.5 (1/VIF).

Table 6.4: Variance inflation factor trade receivables regression model

Variable	VIF	1/VIF
Cash	1,42	0,703
Curras	1,68	0,596
Lsize	1,35	0,738
Lage	1,03	0,966
Pgrowth	4,8	0,208
Ngrowth	4,77	0,210
CriYr 1	1,11	0,899
CriYr 2	1,37	0,727
Mean VIF	2,19	

Table 6,5: Variance inflation factor trade payables regression model

Variable	VIF	1/VIF
Cash	1,42	0,703
Currat	1,43	0,701
Ltdebt	1,93	0,519
Curras	1,99	0,502
Lage	1,22	0,823
Stfina	1,52	0,659
Fcost	1,71	0,586
Quoted	1,25	0,797
CriYr 1	1,09	0,914
CriYr 2	1,09	0,917
Mean VIF	1,47	

Table 6,6: Variance inflation factor net trade credit regression model

Variable	VIF	1/VIF
Currat	1,2	0,833
Lsize	2,23	0,449
Lage	1,32	0,759
Stfina	1,26	0,795
Quoted	2,32	0,431
CriYr 1	1,08	0,929
CriYr 2	1,07	0,934
Mean VIF	1,5	

All VIFs corresponding to the independent variables in tables 6.4 and 6.5 look fine. No value exceeds a value of ten in the second row. And no values lower than 0,10 occur in the third row. Based upon the results of VIF test I can conclude that all independent variables in the model do not severely correlate with other independent variables in the model. There is no multicollinearity in the models. Additional information on multicollinearity is presented in appendix A. The appendix contains three correlation tables corresponding to the three regression models used in this research.

6.2.4 OLS regression results: Aggregate patterns

Table 6.7, 6.8 and 6.9 represents the results of the OLS regression analysis of the data. The coefficients of the crisis dummies *(CriYr 1, CriYr 2* and *Crisis)* show the difference in trade credit between the crisis years and the pre-crisis period. These results are similar to the graphical representation of the use of trade credit earlier discussed in this research (figure 5.1).

Crisis dummies

Table 6.7 contains two versions of the trade receivables regression model. Model 1 distinguished the crisis period in two separate dummies *(CriYr1* and *CriYr2)* and model 2 contains one dummy *(Crisis)* to represent the effects of the crisis period on the use of trade credit. The results of the trade receivables regression model 1 (table 6.7) show a significant (at 0,05% significance level) decline in trade credit of 1,7% (0,016 in table 6.7) in crisis year one. The effect of crisis year two on the use of trade credit is not significant. In model two the effect of the crisis period on the use of trade credit is of similar magnitude (0,016 in table 6.7) and significant at a 0,05% level. Since the mean of trade receivables of the entire data set is 26% of total assets, a decline of 1,7% and 1,6% is not immaterial.

Table 6.8 is similar build as table 6.7. The table contains two versions of the trade payables regression model. The effects of the crisis period is again marked by dummy variables. Model one shows a sizable decline in the use of trade payables: 2,5% (significant at 0,01 level) in year one and 2,1% (significant at 0,05 level) in year two.

Model two presents similar results: a decline of 2,3% during the crisis period (significant at 0,01 level). The significance level of these results is high.

Table 6.9 is similar build as well. However the results of these regressions in terms of the effect of the financial crisis on net trade credit is not significant. The crisis years separately do not indicate a decline or increase and neither does the variable crisis, which combines both years.

Table 6.7: Aggregate pattern of trade credit usage during the financial crisis: Trade receivables

	Expected Sign	(1) Recass	(2) Recass
Cash	Positive	-0,323***	-0,323***
		(-3,3)	(-3,36)
Curras	Not clear	0,483***	0,483***
		(7,27)	(7,21)
Lsize	Positive	-0,01***	-0,01***
		(-2,81)	(-2,85)
Lage	Positive	0,005*	0,005*
		(1,85)	(1,89)
Pgrowth	Positive	0,03*	0,029*
		(1,71)	(1,71)
Ngrowth	Negative	0,048*	0,048*
		(1,84)	(1,82)
CriYr 1	Positive	-0,017**	
		(-2,32)	
CriYr 2	Positive	-0,014	
		(-1,27)	
Crisis	Positive		-0,016**
			(-2,05)
Constant	N/A	0,064	0,065
		(1,04)	(1,06)
Observations		265	265
Adj R²		0,5966	0,5982

Note: Dependent variables: Recass is measured as trade receivables divided by total assets. Independent variables: Cash amount of cash stock divided by total assets; Curras current assets divided by total assets; Lsize is defined as total assets of a firm (in millions); Lage describes the number of years the firm exists; Pgrowth positive sales growth; Ngrowth negative sales growth; CriYr 1 & 2 and Crisis are dummy variables representing respectively a particular crisis year and both crisis years.
Absolute values of t-stats are between brackets. ***,**,* represent significant coefficients at 1%, 5% and 10% respectively.

Table 6.8: Aggregate pattern of trade credit usage during the financial crisis: Trade payables

	Expected Sign	(1) Payass	(2) Payass
Cash	Negative	-0,258**	-0,257**
		(-2,31)	(-2,41)
Currat	Negative	-0,104***	-0,104***
		(-6,74)	(-7,13)
Ltdebt	Negative	-0,161*	-0,161*
		(-1,69)	(-1,72)
Curras	Positive	0,388***	0,387***
		(6,43)	(6,5)
Lage	Negative	-0,007***	-0,007***
		(-2,86)	(-2,85)
Stfina	Negative	-0,595***	-0,594***
		(-5,26)	(-5,46)
Fcost	Positive	2,228**	2,211**
		(2,01)	(2,02)
Quoted	Negative	-0,051***	-0,051***
		(-3,02)	(-3,02)
CriYr 1	Positive	-0,025***	
		(-2,59)	
CriYr 2	Positive	-0,021**	
		(-2,2)	
Crisis	Positive		-0,023***
			(-2,7)
Constant	N/A	0,24***	0,24***
		(4,74)	(4,84)
Observations		265	265
Adj R²		0,6013	0,6027

Note: Dependent variables: Payass is trade payables divided by total assets. Independent variables: Cash is amount of cash stock divided by total assets; Currat is current ratio divided by current liabilities; Ltdebt the amount of long term debt; Curras current assets divided by total assets; Lage is the number of years the firm exists; Stfina the amount of short term finance; Fcost the amount of interest paid; Quoted is a dummy of being stock listed; CriYr 1 & 2 and Crisis are dummy variables representing respectively a particular crisis year and both crisis years.

Absolute values of t-stats are between brackets. ***,**,* represent significant coefficients at 1%, 5% and 10% respectively.

Table 6.9: Aggregate pattern of trade credit usage during the financial crisis: Net trade credit

	Expected Sign	(1) Netass	(2) Netass
Currat	Not clear	0,057***	0,057***
		(3,44)	(3,32)
Lsize	Positive	-0,019***	-0,019***
		(-3,05)	(-3,03)
Lage	Positive	0,015***	0,015***
		(3,85)	(3,82)
Stfina	Not clear	0,344***	0,345***
		(4,32)	(4,24)
Quoted	Positive	0,075***	0,075***
		(2,71)	(2,67)
CriYr 1	Positive	0,005	
		(0,75)	
CriYr 2	Positive	-0,001	
		(-0,08)	
Crisis	Positive		0,002
			(0,29)
Constant	N/A	0,071	0,071
		(0,87)	(0,86)
Observations		265	265
Adj R²		0,375	0,378

Note: Dependent variables: Netass is trade receivables minus trade payables divided by total assets. Independent variables: Currat is current ratio divided by current liabilities; Lsize is defined as total assets of a firm (in millions); Lage describes the number of years the firm exists; Stfina the amount of short term finance; Quoted is a dummy of being stock listed; CriYr 1 & 2 and Crisis are dummy variables representing respectively a particular crisis year and both crisis years.
Absolute values of t-stats are between brackets. ***,**,* represent significant coefficients at 1%, 5% and 10% respectively.

Love et al. (2007) reported an increase of trade payables and receivables in the first year after a crisis strikes an economy. In the following years Love et al. (2007) reported sharp declines in the amounts of receivables and payables. They explained this behaviour as a first short term reaction to a crisis event. Firms stop paying bills and therefore the amount of receivables and payables start to increase. Trade credit starts to accumulate until the customer resumes paying or the supplier takes the write-downs. In this research the initial increase of trade credit is not observed, instead trade credit immediately decreases. This pattern could be explained in two ways. The timing of the crisis period is not accurate, probably firms stopped paying their bills in 2007. I tried to capture this

explanation by adding an extra time dummy for 2007. However I did not find any results to strengthen this explanation. Another explanation which sadly cannot be investigated in this research is the severe global impact of this crisis compared to 'regional' crises in the article of Love et al. (2007) (crisis in Mexico and Japan). The immediate reduction in trade credit by suppliers fade the effect of customers which delay their payments.

Multiple studies observed increased activity inter-firm liquidity market during periods of monetary contraction: accounts receivable and accounts payable increased (Choi & Kim, 2005; Kohler et al., 2000; Nilsen, 2002). Choi and Kim (2005) also observed that accounts payable and receivable increased parallel with the cost and availability of bank loans, this supports the view that trade credit can be seen as an substitute for bank loans. In terms of net trade credit the authors observed an increase: accounts receivable increased more than accounts payable. These results are contrary to the results presented in tables 6.7, 6.8 and 6.9. An important difference between the mentioned articles and this study is the nature of the crisis/recession observed. In all studies the crisis or recession was locally oriented. Choi and Kim focused on US firms between 1975 and 1997, Kohler et al. (2000) observed a UK recession in the 80s and Nilsen (2002) investigated US manufacturing firms during 1979-1982. Compared to the current financial crisis the previous articles all observed firms suffering from downturn of less magnitude. The impact and length is greater and partly unknown. Therefore firms probably are more reluctant than during 'normal' periods of monetary downturn. Firms need to have the expectation that within a reasonable period the economy will flourish again. Without this expectation firms will be reluctant to make extensive investments in trade credit.

Control variables

The trade receivables regression model contains six control variables. Most control variables behave as expected. However the amount of cash negatively affects the amount of trade receivables a firm extends. The effect of cash stocked (*Cash*), amount of current assets (*Curras)* and the size of the firm (*Lsize)* have significant effects on the use of trade receivables (all at a significance level of 0,01). Size has a slightly negative effect. Contrary cash and the amount of current assets have a strong effect, negative and positive respectively. Since trade receivables belongs to current assets, the effect is expected.

Probably the strong negative effect of cash on trade receivables is due to a substitute effect. Since the more working capital of a firm is stocked as cash the less working capital is available to extend to customers as trade credit. Love et al. (2007) observe opposite effects. This could be caused by the moment of measuring the amount of cash. If a firm has most of its current assets as cash it has automatically relatively less invested in trade receivables. If the cash amount was measured in the previous book year the relation could be reverse. A cash rich firm might invest relatively more of its cash into trade receivables the next year. In that way cash is still positively stimulating trade receivables.

Regarding trade payables the effects of the control variables are similar to the expected effects as described in the second column of table 6.8. The results show especially that the amount of interest paid (*Fcost*) and to a lesser extent the amount of current assets *(Curras)* positively influences the amount of payables of a firm. The negative effect of the amount of cash stocked and short term debt is not a surprising since trade credit is relatively expensive. A firm with high cash level and/or short term debt will not tend to take credit from their suppliers, since they have cheaper sources to finance their working capital. These firms repay therefore bills soon (causing low levels of trade payables).

The amount of long term debt (Ltdebt) seems to have a negative effect on the amount of trade payables outstanding. However this relation is only significant at the 10% level and is therefore of limited power, especially if you take the small sample size into account. Nevertheless it could still be interesting to investigate the effects of growth.

Concerning net trade credit, the effects of most control variables are as expected. The effects of all control variables are significant. Lsize however affects net trade credit negatively, while a positive effect was expected.

All regressions in tables 6.7 and 6.8 have an adjusted R-squared of around 0,60. It seems that the dependent variables in the models explain a large part of the use of trade receivables and trade payables. The adjusted R-squared in table 6.9 is around 0,37, a low amount probably caused by relatively less fluctuation in the net amount of trade

credit compared to the regressions which approach the two components of net trade credit separately: trade receivables and trade payables.

6.2.4.1 Hypothesis testing: Aggregate patterns

In chapter three hypothesis one about the use of trade credit is formulated:

"During a financial crisis non-financial manufacturing firms provide more trade credit to their customers and obtain more trade credit from their suppliers compared to the period before the crisis" (1)

Based upon the redistribution concept of Meltzer (1960) I expect firms to extend and take more trade credit in times of financial crisis. Therefore T-stat should exceed 1,960 (significance level of 0,05) to accept the hypothesis. In both regression models the crisis dummies do not exceed this number. Therefore I reject hypothesis one. The opposite effect appears in the regression models conducted, table 6.10 summarizes these result.

Table 6.10: Statistical results aggregate patterns of the use of trade credit

Dependent variable	Theoretical perspective	Reality: Results regression models	
		Crisis Year dummies	Crisis dummy
Trade receivables	Increases	(partly) Decreases	Decreases
Trade payables	Increases	Decreases	Decreases
Net trade credit	Increases	No significant result	No significant result

The regressions in table 6.7, 6.8 and 6.9 solely describe the effects of the crisis at an aggregate level. The objective of this research is to investigate whether creditworthiness of a firm determines trade credit usage during the financial crisis. In other words does a creditworthy firm differently use trade credit in a crisis than a firm, which suffers from liquidity problems or the heavy burden of high amounts of short term debt? The next paragraph contains the statistical attempts to find evidence of this theoretical concept.

6.2.5 OLS regression results: Heterogeneous firm responses

The theory chapter (two) and the hypotheses chapter (three) explains the theoretical relation between the price and availability of bank credit and the use of trade credit.

During periods of financial stability trade credit is a relative expensive source to finance the working capital of a firm. However during a financial crisis the price of bank credit increases and trade credit becomes a more attractive source of finance. This concept forms the basis of the expectations of heterogenic firm responses during a financial crisis. During a financial crisis especially the less creditworthy firms suffer from the reluctance of the banking sector in financing firms.

Three indicators determine the creditworthiness of a firm:

- Low proportion of short-term debt (as measured one year before the crisis)
- High cash flow generation capacity (as measured one year before the crisis)
- High cash stock (as measured one year before the crisis)

To improve comprehension the table 6.11 summarizes the expectations of the heterogeneous firm responses:

Table 6.11: Expected effect of creditworthiness variables on trade credit usage

Creditworthiness variable	Effect on trade receivables (trade credit extended)	Effect on trade payables (trade credit received)	Effect on net trade credit (Trade receivables minus trade payables)
High proportion of short-term debt	Decreases	Increases	Decreases
High cash flow generation capacity	Increases	Decreases	Increases
High cash stock	Increases	Decreases	Increases

To evaluate whether these factors played a significant role in determining the heterogeneous responses of firms during the financial crisis multiple regressions are conducted. The creditworthiness variables are multiplied with the crisis dummies. In that way the effect of creditworthiness in crisis years is isolated in the regression model. In the next three subparagraphs every indicator of creditworthiness is discussed individually.

6.2.5.1 The influence of short term debt

Regressions 1 and 2 in tables 6.12, 6.13 and 6.14 present the result of six regressions evaluating the effect of the pre-crisis amount of short term debt. In other words, to what extent does the presence of short-term debt influences a firm's use of trade credit during the crisis.

Table 6.12: Effect of creditworthiness indicators on trade credit usage: Trade receivables

Financial indicator:	(1) Recass Stfina	(2) Recass Stfina	(3) Recass Ebitdaa	(4) Recass Ebitdaa	(5) Recass Cash	(6) Recass Cash
Cash	-0,328***	-0,327***	-0,322***	-0,322***		
	(-3,31)	(-3,47)	(-3,33)	(-3,33)		
Curras	0,485***	0,484***	0,482***	0,482***	0,386***	0,386***
	(7,29)	(7,15)	(7,34)	(7,33)	(6,34)	(6,32)
Lsize	-0,01***	-0,01***	-0,01***	-0,01***	-0,014***	-0,014***
	(-2,84)	(-2,72)	(-2,93)	(-2,96)	(-3,93)	(-3,87)
Lage	0,005*	0,005*	0,005*	0,005*	0,006**	0,006**
	(1,91)	(1,87)	(1,94)	(1,88)	(2,18)	(2,13)
Pgrowth	0,029*	0,029*	0,03*	0,029*	0,013	0,014
	(1,68)	(1,76)	(1,71)	(1,75)	(0,62)	(0,72)
Ngrowth	0,047*	0,047*	0,048*	0,048*	0,025	0,024
	(1,75)	(1,85)	(1,83)	(1,87)	(0,83)	(0,86)
CriYr 1 * FIN	-0,072		0,006		-0,208*	
	(-0,76)		(0,06)		(-1,68)	
CriYr 2 * FIN	-0,031		-0,024		-0,238*	
	(-0,33)		(-0,26)		(-1,65)	
CriYr 1	-0,011		-0,018		0,003	
	(-0,89)		(-1,12)		(0,32)	
CriYr 2	-0,011		-0,011		-0,003	
	(-0,83)		(-0,64)		(-0,18)	
Crisis * FIN		-0,051		-0,010		-0,224*
		(-0,55)		(-0,1)		(-1,72)
Crisis		-0,011		-0,015		0,001
		(-0,97)		(-0,97)		(0,08)
Constant	0,066	0,066	0,066	0,066	0,163**	0,162**
	(1,07)	(1,04)	(1,16)	(1,13)	(2,48)	(2,51)
Observations	265	265	265	265	265	265
Adj R²	0,595	0,598	0,594	0,597	0,536	0,539

Note: Dependent variables: Recass is measured as trade receivables divided by total assets. Independent variables: CASH amount of cash stock divided by total assets; CURRAS current assets divided by total assets; Lsize is defined as total assets of a firm (in millions); Lage describes the number of years the firm exists; Pgrowth positive sales growth; Ngrowth negative sales growth; CriYr 1 & 2 and Crisis are dummy variables representing respectively a particular crisis year and both crisis years. FIN represents one of the three creditworthiness indicators: Stfina, Ebitdaa or Cash, the third row indicates which financial indicator is used in the particular regression.

Absolute values of t-stats are between brackets. ***,**,* represent significant coefficients at 1%, 5% and 10% respectively.

Table 6.13: Effect of creditworthiness indicators on trade credit usage: Trade payables

Financial indicator:	(1) Payass Stfina	(2) Payass Stfina	(3) Payass Ebitdaa	(4) Payass Ebitdaa	(5) Payass Cash	(6) Payass Cash
Cash	-0,164	-0,164	-0,254**	-0,253**		
	(-1,39)	(-1,39)	(-2,21)	(-2,22)		
Currat	-0,077***	-0,077***	-0,102***	-0,102***	-0,105***	-0,105***
	(-5,93)	(-6,03)	(-6,62)	(-6,6)	(-6,55)	(-6,66)
Ltdebt	-0,100	-0,099	-0,17*	-0,17*	-0,150	-0,145
	(-0,8)	(-0,84)	(-1,83)	(-1,79)	(-1,46)	(-1,4)
Curras	0,314***	0,314***	0,381***	0,38***	0,333***	0,334***
	(4,23)	(4,27)	(6,47)	(6,2)	(5,12)	(5,09)
Lage	-0,006**	-0,006**	-0,007***	-0,007***	-0,007***	-0,007***
	(-2)	(-2,07)	(-3,03)	(-3,02)	(-2,62)	(-2,61)
Stfina			-0,592***	-0,591***	-0,533***	-0,531***
			(-5,3)	(-5,26)	(-4,86)	(-4,88)
Fcost	0,035	0,033	2,306**	2,291**	2,44**	2,372**
	(0,03)	(0,03)	(2,13)	(2,13)	(2,01)	(1,98)
Quoted	-0,048**	-0,048**	-0,052***	-0,052***	-0,052***	-0,052***
	(-2,21)	(-2,15)	(-3,2)	(-3,15)	(-2,79)	(-2,86)
CriYr 1 * FIN	-0,332***		-0,054		-0,161	
	(-3,54)		(-0,46)		(-1,09)	
CriYr 2 * FIN	-0,359***		-0,069		-0,287**	
	(-3,06)		(-0,65)		(-2,01)	
CriYr 1	0,022*		-0,014		-0,009	
	(1,68)		(-0,75)		(-0,63)	
CriYr 2	0,018		-0,012		0,000	
	(1,57)		(-0,59)		(-0,02)	
Crisis * FIN		-0,346***		-0,062		-0,224*
		(-3,6)		(-0,59)		(-1,77)
Crisis		0,02*		-0,013		-0,004
		(1,87)		(-0,73)		(-0,38)
Constant	0,199***	0,199***	0,242***	0,243***	0,242***	0,242***
	(3,18)	(3,3)	(4,92)	(4,79)	(4,61)	(4,66)
Observations	265	265	265	265	265	265
Adj R²	0,44	0,443	0,6	0,603	0,564	0,565

Note: Dependent variables: Payass is trade payables divided by total assets. Independent variables: Cash is amount of cash stock divided by total assets; Currat is current ratio divided by current liabilities; Ltdebt the amount of long term debt; Curras current assets divided by total assets; Lage is the number of years the firm exists; Stfina the amount of short term finance; Fcost the amount of interest paid; Quoted is a dummy of being stock listed; CriYr 1 & 2 and Crisis are dummy variables representing respectively a particular crisis year and both crisis years. FIN represents one of the three creditworthiness indicators: Stfina, Ebitdaa or Cash, the third row indicates which financial indicator is used in the particular regression.
Absolute values of t-stats are between brackets. ***,**,* represent significant coefficients at 1%, 5% and 10% respectively.

Table 6.14: Effect of creditworthiness indicators on trade credit usage: Net trade credit

Financial indicator:	(1) Netass Stfina	(2) Netass Stfina	(3) Netass Ebitdaa	(4) Netass Ebitdaa	(5) Netass Cash	(6) Netass Cash
Currat	0,042***	0,042***	0,057***	0,057***	0,057***	0,057***
	(2,92)	(2,88)	(3,33)	(3,26)	(3,38)	(3,25)
Lsize	-0,022***	-0,022***	-0,018***	-0,018***	-0,019***	-0,019***
	(-3,79)	(-3,7)	(-3,04)	(-3,04)	(-3,03)	(-3,14)
Lage	0,015***	0,015***	0,015***	0,015***	0,015***	0,015***
	(3,81)	(3,81)	(3,8)	(3,82)	(3,81)	(3,78)
Stfina			0,342***	0,344***	0,351***	0,352***
			(4,18)	(4,19)	(4,38)	(4,07)
Quoted	0,083***	0,083***	0,075***	0,075***	0,079***	0,079***
	(2,99)	(2,94)	(2,72)	(2,71)	(2,67)	(2,76)
CriYr 1 * FIN	0,257***		0,093		0,078	
	(2,67)		(0,76)		(1,04)	
CriYr 2 * FIN	0,329***		-0,017		0,113	
	(3,22)		(-0,12)		(1,17)	
CriYr 1	-0,023**		-0,010		-0,001	
	(-2,1)		(-0,5)		(-0,12)	
CriYr 2	-0,038***		0,002		-0,010	
	(-3,02)		(0,07)		(-0,84)	
Crisis * FIN		0,293***		0,038		0,096
		(3,4)		(0,33)		(1,17)
Crisis		-0,03***		-0,004		-0,006
		(-3,09)		(-0,2)		(-0,59)
Constant	0,16**	0,16**	0,071	0,070	0,078	0,078
	(2,3)	(2,2)	(0,86)	(0,86)	(0,94)	(0,93)
Observations	265	265	265	265	265	265
Adj R²	0,327	0,331	0,373	0,376	0,375	0,380

Note: Dependent variables: Netass is trade receivables minus trade payables divided by total assets. Independent variables: Currat is current ratio divided by current liabilities; Lsize is defined as total assets of a firm (in millions); Lage describes the number of years the firm exists; Stfina the amount of short term finance; Quoted is a dummy of being stock listed; CriYr 1 & 2 and Crisis are dummy variables representing respectively a particular crisis year and both crisis years. FIN represents one of the three creditworthiness indicators: Stfina, Ebitdaa or Cash, the third row indicates which financial indicator is used in the particular regression.
*Absolute values of t-stats are between brackets. ***,**,* represent significant coefficients at 1%, 5% and 10% respectively.*

The literature suggests that firms with high proportion of short term debt at the beginning of the crisis suffer more from difficulties in rolling over short term debt. As shown in figure 4.2, the acceptance criteria became more strict during the crisis, which lead to increased costs of short term debt making trade credit more attractive.

The regressions separate the general effect of crisis years (*CriYr 1; CriYr 2* and *Crisis*) and the effect of the pre-crisis amount of short term debt in both crisis years (*CriYr 1 * stfina07; CriYr 2 * stfina07* and *Crisis * stfina07*). The regressions contain control variables, as determined in the model specification paragraph 4.2.3.

The effect of the control variables on the use of trade credit (both trade receivables, trade payables and net trade credit) in tables 6.12, 6.13 and 6.14 behave more or less similar as in the regressions concerning the aggregate pattern of trade credit usage, table 6.6 and 6.7. The effect of the amount of short term debt at the start of the crisis during the two crisis years on trade receivables (dependent variables: *CriYr 1 * stfina07; CriYr 2 * stfina07* and *Crisis * Stfina07*) is not significant. The effect of these variables on trade payables and on net trade credit is significant (at a alpha level of 0,01). High amounts of short term finance results in reduced trade payables during crisis years. At the same time net trade credit increases at firms which had high proportions of short term finance at the start of the crisis. This is contrary to the effect expected preliminary. Love et al. (2007) who did similar research observed the same pattern only in the aftermath of the crisis. In the first year of the crisis trade payables of firms with high amounts of short term debt increased instead.

However an important difference between the results of this research and Love et al. (2007) is the fact that they found an extreme reduction in trade receivables of firms with high amounts of short-term debt. In this research the effect on trade receivables plays a minor non-significant role. Since trade payables is reduced by these firms the amount of net trade credit these firms offer increases.

Multiple studies found that bank-dependent firms used more trade credit in times of monetary contraction and recession (Kohler et al., 2000; Nilsen, 2002). Contrary to the results I found. However the distinction Nilsen (2002) made between creditworthy and less creditworthy is based on size and whether or not a firm has a bond rating and Kohler et al. (2000) focused on the difference between quoted and non-quoted firms. Nevertheless the main cause of the contrary result compared to the results presented in this chapter is the size and impact of the current financial crisis.

Choi and Kim (2005) which investigated a sample of S&P 500 firms compared to a group of smaller non- S&P500 firms, did not found any evidence that large and financially stronger firms played a more active role as (net) trade credit suppliers.

The adjusted R-squared is regarding trade payables and net trade credit a bit lower compared to the regressions conducted in investigation of the aggregate pattern (table 6.8). Compared to Love et al. (2007) the adjusted R-square is lower. There is no clear explanation for this fact.

To conclude short term finance does not play the role as expected in determining differences in how firms respond during the financial crisis in terms of obtaining or providing trade credit.

6.2.5.2 The influence of cash flows

Regressions 3 and 4 in tables 6.2, 6.13 and 6.14 contain the influence of the capacity to generate cash flows on the use of trade credit during the financial crisis. From a theoretical perspective the capacity to generate cash flows would lead to decisions to make extra sales by extending trade credit. Since in a financial crisis trade credit becomes relatively more attractive, it would be assumable that firms with a good ability to generate cash flows extend more trade credit.

Regarding payables theoretically the reverse would be expected. Firms with an inability to generate sufficient cash flows take more easily trade credit from their suppliers to finance their working capital. Let's see the results of the regression.

Again the control variables in both tables behave similar as the previous regressions. The results of the regressions do not give any evidence that firms with a capacity to generate cash flows extend relatively more trade credit and obtain less trade credit. There is no single significant effect observed in the regressions. Love et al. (2007) found a strong relation between the cash flow generating capacity of a firm and its trade credit behaviour during a crisis. A firm with a strong capacity to generate cash flows extends more trade credit and obtains less trade credit during a crisis. The results presented in this research cannot confirm nor reject this relation, since the results are insignificant.

To conclude the capacity to generate cash flows does not play the role as expected in determining differences in how firms respond during the financial crisis in terms of obtaining or providing trade credit.

6.2.5.3 The influence of Cash stock

Theoretically, the influence of cash stock is more or less equal to the influence of the ability to generate cash flow, as described in the previous paragraph. Both factors are indicators of the liquidity of the firm. Therefore theoretically these indicators should give the same results. The rationale behind the relation between the amount of cash stock and the heterogeneous responses of firms in their trade credit usage during the financial crisis is the same as described above. Thus high cash stock would lead to more trade credit extending (positive effect on trade receivables) and lead to less obtaining of trade credit (negative effect on trade payables).

Regressions 5 and 6 in tables 6.12, 6.13 and 6.14 present the relation between trade credit usage and the amount of cash stock in the year before the financial crisis started. The regressions in table 6.14 provide little evidence that the amount of cash stock is negatively influencing the amount of trade credit extended by a firm. Only if the crisis years are combined trade receivables is negatively affected by high cash balances at the start of the crisis. The same pattern is visible regarding trade payables. The crisis dummy multiplied with the cash balances at the start of the crisis negatively affects trade payables of a firm. In other words a firm, which had relatively high cash balances at the start of the crisis obtains and provides relatively less trade credit during the crisis. These effects are insignificant if the crisis dummy is separated into two crisis year dummies. Concerning net trade credit no significant results are found.

6.2.5.4 Hypothesis testing: Heterogeneous firm responses

The previous paragraphs addressed the effects of three creditworthiness indicators on the heterogeneous firm responses of trade credit usage during the crisis. In chapter three hypothesis two is formulated regarding which heterogeneous firm responses I could expect:

"Non-financial manufacturing firms in the Netherlands with relatively low (high) creditworthiness will relatively use more (less) and extend less (more) trade credit during periods of financial contraction than high (low) creditworthy non-financial manufacturing firms."   *(2)*

To improve the comprehension of the various results presented, table 6.15, 6.16 and 6.17 provide an overview of the results compared to the expected results.

Table 6.15: Statistical results heterogeneous firm responses: Trade receivables

	Theoretical perspective	Reality: Results from regressions	
Creditworthiness variable		Crisis Year dummies	Crisis dummy
High proportion of short-term debt	Decreases	*No significant result*	*No significant result*
High cash flow generation capacity	Increases	*No significant result*	*No significant result*
High cash stock	Increases	Decreases	Decreases

Table 6.16: Statistical results heterogeneous firm responses: Trade payables

	Theoretical perspective	Reality: Results from regressions	
Creditworthiness variable		Crisis Year dummies	Crisis dummy
High proportion of short-term debt	Increases	Decreases	Decreases
High cash flow generation capacity	Decreases	*No significant result*	*No significant result*
High cash stock	Decreases	(partly) Decreases	Decreases

Table 6.17: Statistical results heterogeneous firm responses: Net trade credit

	Theoretical perspective	Reality: Results from regressions	
Creditworthiness variable		Crisis Year dummies	Crisis dummy
High proportion of short-term debt	Decreases	Increases	Increases
High cash flow generation capacity	Increases	*No significant result*	*No significant result*
High cash stock	Increases	*No significant result*	*No significant result*

To accept hypothesis two the t-statistics should exceed a value of 1,960 (alpha level of 0,05%) if a positive effect is expected and need to be lower than -1,960 if a negative effect is expected. However the results of all indicators have the opposite sign as expected or give insignificant results. Except the effect of a high amount of cash stock on trade payables. This indicator gives a correct sign and significant result in the second year of the crisis: an decrease of trade payables.

Chapter 7:   Conclusion and discussion

Trade credit is an important tool to finance the activities of a firm. An economy to flourish need trust between suppliers and their customers. This research started with several charts (figure 5.1 in chapter 5), which reflected the usage of trade credit by firms categorised by size. Especially the very large firms extend more trade credit than they obtain, which makes them important net suppliers of credit in general.

The capital market is another important source for firms to obtain the financial resources to finance their working capital. However the current financial crisis resulted in an extremely reluctant capital market. Consequently firms need alternative sources to finance their activities. One of these alternative sources is trade credit. The main objective of this research is to see whether trade credit (partly) absorbs the negative effects of the financial crisis on the capital market. Besides this aggregate pattern of trade credit usage, this research addressed the connection between creditworthiness and the use of trade credit. Creditworthy firms are expected to extend more trade credit and obtain less trade credit compared to less creditworthy firms. The expectations of trade credit usage are tested by conducting regression models.

To improve the ability to draw conclusions and discuss the impact of all the results presented in this research, the main results are summarized in tables. Table 7.1 represents the aggregate patterns of the usage of trade credit in times of financial crisis. Tables 7.2 and 7.3 show the results in all three tables the second column represents the expected pattern based on relevant literature. The last columns cover the results from several statistical tests.

7.1   Aggregate patterns of the use of trade credit

Table 7.1 represents the results corresponding with the effort to find statistical evidence to reject or accept hypothesis one. At forehand I expected based on the trade credit channel literature an increase in trade receivables and trade payables as well. Without any exception all regression results showed that the opposite effect occurred. Non-financial manufacturing Dutch firms in the data set provided and obtained significant

less trade credit to their customers and from their suppliers. However it is important to state that the normality test was negative (paragraph 6.2.1). Therefore based on these result it is not valid to claim that this opposite effect is true for the entire population.

Table 7.1: Statistical results aggregate patterns of the use of trade credit

Dependent variable	Theoretical perspective	Reality: Results regression models	
		Crisis Year dummies	Crisis dummy
Trade receivables	Increases	(partly) Decreases	Decreases
Trade payables	Increases	Decreases	Decreases
Net trade credit	Increases	No significant result	No significant result

Possibly the massive impact of the current global financial crisis explain this deviating pattern. Financial experts and the international media compare the current financial crisis with the great depression in 1929.[9] The rationale behind hypothesis one - in which an increase in the use of trade credit is expected- is based upon the fact that firms expect their struggling clients to be important clients in the future. This expectation stimulates the firm to extend trade credit and therefore securing future sales. However this financial crisis is so severe that firms are unable to estimate how long these times of economic downturn continues. For instance if a firm expects the market to recover in about a year the decision to extent extra trade credit to risky, but attractive (in terms of future sales) is far easier made.

Love et al. (2007) investigated the Mexican crisis of 1994 and south-east Asia crisis of 1997. They also registered a fall of the use of trade credit in the years after the start of the crisis and a short rise of trade credit in the first year when the crisis unfolded. Corresponding with the statement I made above, Love et al. (2007) affirm the difference between a crisis and more ordinary periods of monetary contraction. A crisis results in far more uncertainty for the real economy, since the GDP is decreasing. In a period of monetary contraction bank credit is limited, but firms could still be positive with respect to market opportunities. As long as firms see market opportunities in the future, they are

---

[9] See for example *"Current crisis shows uncanny parallels to great depression"* in Der Spiegel (April 29th 2009)

willing to grant additional trade credit - working capital – to customers suffering from limited availability of bank credit. However at some point in a crisis bank lending is cut to an extent that the redistribution of credit through the trade credit channel constipates.

Additionally to focus more on the Dutch situation an interesting article written by a trade credit insurance company called Atradius gives meaningful insights to explain the opposite results. Based upon interviews Atradius describes the relation between supplier and buyer of trade credit as harsh. This rigid relation could have lead to increased distrust and consequently in a reluctance to provide trade credit, which is visible in the aggregate patterns of trade credit usage presented in this research (Atradius, 2010).

7.2 Heterogeneous firm responses

The second research question addresses the differences among firms and how these differences could determine their responses during a crisis in terms of trade credit. Based upon the trade credit literature I expected less creditworthy firms to be willing to obtain more trade credit and creditworthy firms to provide these trade credit. However the results of the regressions ran were disappointing (most results were insignificant, see tables 7.2, 7.3 and 7.4). Running the regressions did not provide sufficient statistical evidence to support hypothesis two. The heterogeneous firm responses in their usage of trade credit cannot be determined by these indicators of creditworthiness.

Table 7.2: Statistical results heterogeneous firm responses: Trade receivables

Creditworthiness variable	Theoretical perspective	Reality: Results from regressions	
		Crisis Year dummies	Crisis dummy
High proportion of short-term debt	Decreases	No significant result	No significant result
High cash flow generation capacity	Increases	No significant result	No significant result
High cash stock	Increases	Decreases	Decreases

Table 7.3: Statistical results heterogeneous firm responses: Trade payables

Creditworthiness variable	Theoretical perspective	Reality: Results from regressions	
		Crisis Year dummies	Crisis dummy
High proportion of short-term debt	Increases	Decreases	Decreases
High cash flow generation capacity	Decreases	No significant result	No significant result
High cash stock	Decreases	(partly) Decreases	Decreases

Table 7.4: Statistical results heterogeneous firm responses: Net trade credit

Creditworthiness variable	Theoretical perspective	Reality: Results from regressions	
		Crisis Year dummies	Crisis dummy
High proportion of short-term debt	Decreases	Increases	Increases
High cash flow generation capacity	Increases	No significant result	No significant result
High cash stock	Increases	No significant result	No significant result

Attrition bias

An important concern considering the data in this research is attrition bias. A period of financial contraction logically goes along with defaults and consolidation of firms. Obtaining data of defaulted firms is extremely hard; company.info automatically deletes defaulted firms in their data set. Therefore consequently the data set used in this report is free from defaulted firms. It is plausible that defaulted firms correlate with specific patterns of trade credit usage than surviving firms, or perhaps these (defaulted) firms had significantly harder access to trade credit extended by their suppliers, subsequently leading to their default. Especially with respect to the external validity of the results attrition bias is a threat.

Larger sample size

Probably the reason why the regression results in chapter six did not showed any significant results lies within the available sample size. Love et al. (2007) conducted similar regressions in their article, however they were able to ran the regressions on the entire population. In this research the sample contained only data from 53 firms. Increasing the sample size would result in a larger data set, which would allow more accurate estimates (Studenmund, 2010).

However investigating the trade credit usage of a larger group of firms is outside the scope of this study. It would cost too much effort and time to gather more data, due to insufficient access to databases appropriate for scientific research (databases like *Amadeus* and *Worldscope*)[10].

Due to the small sample size, the limitations of this study in terms of generalizability are obvious. It is rather impossible to draw reasonable conclusions concerning the entire sample frame. Additionally the test results of normality were negative, implying it is not possible to make claims about the entire population based on these OLS regressions.

To conclude, the answer to the research questions central in this research is: This research suggests that the severe impact of the crisis and the extremely uncertain future might have caused both a decline in availability and price of bank credit and a decline in the use of trade credit. Additionally there is no substantial prove that a firm's vulnerability to a crisis predicts heterogeneous responses in trade credit usage of firms.

7.3   Future research

I recommend to redo the research on the heterogeneous firm responses with a larger data set. Therefore the University of Twente should consider to acquire subscription to one of the larger financial databanks to support more intensive statistical financial scientific research. Furthermore this databank can act as data source for numerous research in the future.

Future research on this topic should give attention to the potential threat to external validity: attrition bias. If a future student or researcher is able to find financial statements of defaulted firms, it is interesting to make some comparison between defaulted and existing firms.

The ability to explain the use of trade credit solely based on data from financial statements is limited. Firms have to register only once a year and besides there are

---

[10] See for more information the website of Bureau Van Dijk: http://www.bvdinfo.com/Home.aspx

accountancy tricks, which can result in a biased picture (a firm can write off (doubtful) receivables). Additional information can be gathered by interviewing CFOs. Perhaps these interviews could act as input to better specify regression models to explain the heterogeneous firm responses. Secondly perhaps data from accountancy firms can be analyzed. Information about the use of trade credit of their clients can enrich the knowledge of trade credit usage in periods of crisis.

To be able to make a reasonable comparison between the firms in the sample I left out firms using factoring techniques (see paragraph 5.4.1). However the evolution of financial techniques like these obviously affect the availability of external finance. Securitization of accounts receivable and credit-default swaps enable firms to obtain external capital easily. These developments on the financial market may affect firm's trade credit behaviour. Certainly an interesting topic for further research, a good starting point on credit-default swaps is an article of Longstaff, Mithal and Neis (2004).

Originally I intended to focus on small and medium sized firms. The main reason of my interest was the vulnerability of SMEs towards contraction in bank lending. However due to the unavailability of SMEs sufficient data I had to drop this original idea. Nevertheless it is still interesting to focus on these types of firms, since the fact it is reasonable to expect their dependence to finance of suppliers in times of financial harsh times. Perhaps hypothesis two would be accepted focusing on SMEs.

Strategic suppliers/customers and supply chain finance

Another drawback of the approach of this research is the fact that data of trade credit usage is analyzed at an aggregate level. The data does not contain any information about trade credit provision to individual customers of a firm, though this might be very interesting. Perhaps firms have altered their trade credit policy in favour of certain *strategic* suppliers or customers. At an aggregate level it seems the firm reduced its trade credit supply. While in reality the firm extended more trade credit to (financially struggling) *strategic* customers and reduced trade credit to non-strategic customers. Additionally in the automobile industry supply chain finance regularly occurs. Supply chain finance (SCF) can be - similar like trade credit - an alternative finance source when the

capital market is reluctant. A good starting point might be an article of Seifert and Seifert (2008). They discuss ways to overcome the effects of the financial crisis by supplying trade credit to strategic customers and/or extending supply chain finance to strategic suppliers. Perhaps future research could be conducted in the form of a case study, focusing on a few exemplary firms which use the concept of strategic suppliers/customers and/or supply chain finance.

Economic and monetary policy and the use of trade credit

Finally economic and monetary policy can play an important role in the use of trade credit. Central banks should realize that their monetary decisions (in terms of interest rates) could affect the use of trade credit by firms. Also governments should carefully evaluate to what extent their policies affect the use of trade credit. For example recently in the UK new government plans exempt small firms from the obligation to file account with Companies House[11]. This government policy was intended to ease the administrative burden of small firms in the UK. However the absence of information retrievable at the Companies House make larger firms reluctant to extend trade credit. Illustrative is the following quote of Martin Williams, head of External Affairs at Graydon UK[12]: "The government has repeatedly overlooked the simple fact that it is not just banks that provide small businesses with credit, but also their suppliers in the form of trade credit." This example carefully illustrates how government policy can harm trade credit usage of firms unintended.

Finally, this research illustrated the decrease in trade credit overall during the financial crisis. Theoretical it is illogical that the decrease in trade credit is demand-driven: i.e. a reduction in the supply of trade credit is the cause of the observed decrease in trade credit. Since the availability of external capital diminished in the financial crisis, it would be logical that the demand for an alternative like trade credit increases. Therefore it is interesting to investigate what causes the supply to dry up in a severe global

---

[11] Official UK government register of UK firms, similar to the Dutch Chamber of Commerce.
[12] Graydon UK is a credit and risk intelligence company. More information about this example of government policy and its effect on the use of trade credit: http://www.creditman.biz/uk/members/news-view.asp?newsviewID=13841

financial crisis. Contrary to recessions and monetary contractions where net trade credit indeed increased. Moreover it would be interesting to see in the future how to trade credit recovers from this decline during the financial crisis.

Since trade credit can be seen as a *lubricant* for the entire economy of a nation it is extremely important for governments and central banks to evaluate the effects of their decisions on the use of trade credit, especially in times of financial downturn.

References

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance, 23(4)*, 589-609.

Atradius. (2010). The future of trade credit. *Atradius white paper*, from http://www.atradius.com.hk/en/images/stories/reports/White_paper_2010_summary_final.pdf

Babbie, E. (2004). *The practice of social research* (10th ed.). Belmont, USA: Wadsworth.

Baltagi, B. H. (1994). *Econometric analysis of panel data* (4th ed. ed.). Chichester, UK: John Wiley & Sons LTD.

Baum, C. F. (2006). *An introduction to modern econometrics using stata*. College Station, USA: Stata Press.

Berger, A. N., & Udell, G. F. (2006). A more complete conceptual framework for SME finance. *Journal of Banking and Finance, 20*, 2945-2966.

Biais, B., & Gollier, C. (1997). Trade credit and credit rationing. *Review of Financial Studies, 10*, 903-937.

Blasio, d. (2005). Does trade credit substitute bank credit? Evidence from firm-level data. *Economic Notes, 34(1)*, 85-112.

Brennan, B., Maksimovic, V., & Zechner, J. (1988). Vendor financing. *Journal of Finance, 43*, 1127-1141.

Burkart, M., & Ellingsen, T. (2004). In-kind finance: A theory of trade credit. *American Economic Review, 94(3)*, 569-590.

Choi, W. G., & Kim, Y. (2005). Trade credit and the effect of macro-financial shocks: evidence from US panel data. *Journal of Financial and Quantitative Analysis, 40(4)*, 897-925.

Cole, R. (2010). Bank credit, trade credit or no credit: Evidence from the surveys of small business finances. *U.S. Small Business Administration, Office of Advocacy* (60404).

Deloof, M., & Jergers, M. (1999). Trade credit, corporate groups, and the financing of Belgian firms. *Journal of Business, Finance and Accounting, 26*, 33-43.

Demigürc-Kunt, A., & Maksimovic, V. (2001). Firms as financial intermediaries: evidence from trade credit data. *World Bank, Policy Research Working Paper Series* (2696).

DNB. (2009). Krediet verlening Nederlandse bedrijven loopt terug. *DNB: kwartaalbericht maart 2009*.

Emery, G. W. (1987). An optimal financial response to variable demand. *Journal of Financial and Quantitative Analysis, 22*, 209-225.

Fama, E., & French, K. (1992). The cross-section of expected stock returns. *The Journal of Finance, 47*, 427–465.

Ferris, J. (1981). A transaction theory of trade credit use. *Quarterly Journal of Economics, 94(2)*, 243-270.

Fratianni, M., & Marchionne, F. (2009). The role of banks in the subprime financial crisis. *Review of Economic Conditions in Italy, 2009(1)*, 11-48.

Freedman, D. A. (1981). Bootstrapping regression models. *The Annals of Statistics, 9(6)*, 1218-1228.

Garcia-Teruel, P. J., & Martinez-Solano, P. (2010). Determinants of trade credit: A comparative study of European SMEs. *International Small Business Journal, 28(3)*, 215-233.

Kohler, M., Britton, E., & Yates, T. (2000). Trade credit and the monetary transmission mechanism. *Bank of England, Working Paper Series No. 115*.

Long, M. S., Malitz, R. B., & Ravid, S. A. (1994). Trade credit, quality guarantees, and product marketability. *Financial Management, 22*, 117-127.

Longstaff, F. A., Mithal, S., & Neis, E. (2004). Corporate yield spreads: default risk or liquidity? New evidence from the credit-default swap market *Journal of Finance, 9(5)*, 2213-2253.

Love, I., Preve, L., & Sarria-Allende, V. (2007). Trade credit and bank credit: Evidence from recent financial crises. *Journal of Financial Economics, 83*, 453-469.

Mateut, S., Bougheas, S., & Mizen, P. (2006). Trade credit. Bank lending and monetary policy transmission. Journal of European Economic Review, 50, 603-629.

Meltzer, A. H. (1960). Mercantile credit, monetary policy, and size of firms. The Review of Economics and Statistics, 42, 429–437.

Mian, S., & Smith, C. W. (1992). Accounts receivable management policy: theory and evidence. Journal of Finance, 47, 169-200.

Moore, D. S., & McCabe, G. P. (1999). Introduction to the practice of statistics (3rd ed. ed.). New York, USA: W.H. Freeman and company.

Nilsen, J. (2002). Trade credit and the bank lending channel. Journal of Money, Credit and Banking, 34(1), 226-253.

Niskanen, J., & Niskanen, M. (2006). The determinants of corporate trade credit policies in a bank-dominated financial environment: The case of Finnish small firms. European Financial Management, 12, 81–102.

Oxford English Dictionary. (2005) 2nd rev ed. Oxford: University Press.

Petersen, M., & Rajan, R. (1997). Trade credit: Theories and evidence. The Review of Financial Studies, 10, 661–691.

Preve, L. (2004). The use of trade credit under extreme conditions: financial distress and financial crisis. the university of Texas, (Doctoral dissertation). Austin

Rajan, R., & Zingales, L. (1998). Financial dependence and growth. American Economic Review, 88, 559-586.

Schwartz, R. A. (1974). An economic model of trade credit. Journal of Financial and Quantitative Analysis, 9(4), 643-657.

Seifert, R. W., & Seifert, D. (2008). Working capital in times of financial crisis: three trade credit strategies. IMD: Perspectives for Managers, from http://www.imd.org/research/publications/upload/PFM166_LR_Seifert.pdf

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). Biometrika, 52(3/4), 591-611.

Smith, J. (1987). Trade credit and information asymmetry. Journal of Finance, 4, 863-869.

Studenmund, A. H. (2010). Using econometrics: a practical guide (6th ed. ed.). Boston, USA: Pearson.

Taketa, K., & Udell, G. F. (2007). Lending channels and financial shocks: The case of small and medium-sized enterprise trade credit and the japanese banking crisis. Monetary and Economic Studies, 25(2), 1-44.

VVCM. (2010). Consistent in moeilijke tijden. Credit management onderzoek, from http://rhi.emsecure.net/rhi/PDF/NL/2010/Credit_Management_Onderzoek.pdf

Zellner, D., Keller, F., & Zellner, G. E. (2004). Variable selection in logistic regression models Communications in Statistics Part B: Simulation and Computation 33(3), 787-805.

Appendixes

Appendix A: Correlation tables

Table 8.2: Correlations regression model trade receivables

	recass	cash	curras	lsize	lage	pgrowth	ngrowth	y2008	y2009
recass	1.000								
cash	-0.030	1.000							
curras	0.659	0.433	1.000						
lsize	-0.478	0.074	-0.411	1.000					
lage	0.180	-0.081	-0.002	0.083	1.000				
pgrowth	0.047	0.072	0.079	0.009	-0.085	1.000			
ngrowth	0.025	0.037	0.016	-0.007	0.096	-0.879	1.000		
y2008	-0.038	-0.056	-0.020	0.016	0.008	-0.056	0.067	1.000	
y2009	-0.081	0.056	-0.050	0.005	0.012	-0.422	0.417	-0.250	1.000

Note: the table presents the correlations between the variables in the regression model. 1 or minus 1 represents completely correlated, a measure near zero indicates no correlation between the two variables. Ngrowth and pgrowth have the highest correlation measure, this is not surprising since the first variable only contains firms with negative growth and the latter only contains positive observations. All other correlations seem harmless.

Table 8.3: Correlations regression model trade payables

	payass	cash	currat	ltdebt	curras	lage	stfina	fcost	quoted	y2008	y2009
payass	1.000										
cash	0.017	1.000									
currat	-0.299	0.227	1.000								
ltdebt	-0.265	-0.252	0.040	1.000							
curras	0.379	0.433	0.327	-0.455	1.000						
lage	-0.131	-0.081	-0.029	-0.193	-0.002	1.000					
stfina	-0.135	-0.290	-0.374	-0.026	0.020	0.024	1.000				
fcost	-0.109	-0.308	-0.096	0.538	-0.304	-0.026	0.303	1.000			
quoted	-0.221	-0.068	-0.054	0.059	-0.282	-0.306	-0.066	0.027	1.000		
y2008	-0.021	-0.056	-0.019	0.013	-0.020	0.008	-0.030	0.103	0.000	1.000	
y2009	-0.072	0.056	0.015	-0.052	-0.050	0.012	-0.078	-0.063	0.000	-0.250	1.000

Note: the table presents the correlations between the variables in the regression model. 1 or -1 represents completely correlated, a measure near zero indicates no correlation between the two variables. All correlations seem harmless.

Table 8.4: Correlations regression model net trade credit

	netass	currat	lsize	lage	stfina	quoted	y2008	y2009
netass	1.000							
currat	0.231	1.000						
lsize	-0.207	-0.085	1.000					
lage	0.388	-0.029	0.083	1.000				
stfina	0.245	-0.374	-0.183	0.024	1.000			
quoted	-0.134	-0.054	0.658	-0.306	-0.066	1.000		
y2008	0.001	-0.019	0.016	0.008	-0.030	0.000	1.000	
y2009	-0.023	0.015	0.005	0.012	-0.078	0.000	-0.250	1.000

Note: the table presents the correlations between the variables in the regression model. 1 or -1 represents completely correlated, a measure near zero indicates no correlation between the two variables. All correlations seem harmless.