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The Role of Trade Credit During the Covid Crisis

A study on Swedish SMEs' use of trade credit as a financial aid and its role as a substitution to bank financing

Abstract

The Covid crisis has introduced substantial uncertainties for SMEs, making them more vulnerable. Our study investigates Swedish SMEs' use of trade credit, both received and extended, as a medium for the mitigation of financial distress during the crisis. Furthermore, we study the existence of a substitution effect and its magnitude change in the presence of a crisis. We have found that both receiving and extending trade credit has a negative relationship with SME financial distress, and this negative relationship with financial distress has been observed for the net extension of trade credit as well. Nevertheless, no significant direct impact from Covid was found. Our study also found evidence to support the existence of a substitution between bank financing and trade credit during the studied period. This effect was however weakened during the crisis.

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1. Introduction

1.1 Purpose of the study

This paper aims to study the relationship between a macroeconomic crisis and companies' use of trade credit in two parts. Firstly, the study will investigate firms' use of trade credit, both received and extended, as a method of increasing financial stability. The former as a way of securing financing, and the latter as a way of securing future sales by helping one's customers. The relationship will be explored through the investigation of trade credit's role as a mitigator of financial distress during the recent Covid crisis. Secondly, the study will explore the substitution effect, namely firms' diversion from financing through loans from financial institutions to financing through the receival of trade credit.

The research will be executed on private non-financial Small- and Medium sized Enterprises (SMEs) in Sweden during the period 2018-2021. The time frame will allow for an investigation of both the pre-crisis and during crisis period. For the first part of the study, a model developed by McGuiness et al., (2018), which incorporates the Altman Z-score, will be used. This model will allow for comparisons between the Swedish setting and the results from broader samples such as the results by McGuiness et al., (2018) which are based on 13 European countries (excluding Sweden amongst some). Their study revealed a significant negative impact of trade credit on firms' financial distress. For the second part of this study, the investigation of the substitution effect, an extended version of the method of Yazdanfar and Öhman (2017) will be used. With this, it is intended to shed light on the relationship between trade credit and bank financing, and how it may potentially be affected by a crisis. Consequently, this study aims to investigate the following research questions:

Did trade credit help financially constrained companies in Sweden mitigate the negative effects of the recent crisis?

And

Was there a significant substitution effect from bank financing to trade credit received during the crisis?

1.2 Background

1.2.1 Financing

There are three main ways through which a company can finance itself; either through equity financing, debt financing, or internal financing (retained earnings). Early research states that the decision between internal and external financing should not influence a firm's valuation. However, this is contingent on a perfect capital market setting (Modigliani, Miller 1958). Fazzari et al., (1988) nuance this statement by saying that it could be true for mature companies with well-known prospects even in imperfect market settings, but that for other firms the perfect substitution between internal and external financing does not hold, especially not in the short run (Fazzari et al., 1988).

On the other hand, according to the pecking order by Myers and Majluf (1984), there is a preferred order in which firms should structure their financing. According to the mentioned order, firms should first resort to internal financing, followed by debt financing, and lastly to equity issuance. The order is explained by the costs of financing in the sense that information asymmetry, where external parties do not have access to the same amount of information as internally, leads to a higher cost of financing (Myers, Majluf 1984). Baker and Martin (2011) emphasize this further by stating that the way firms decide to finance their operations has a large impact on their performance and survival.

When in a financially constrained period, firms may have difficulties using internal financing due to potential scarcity. Furthermore, due to the uncertainty in the economic environment, firms might have difficulties obtaining bank financing during times of financial constraint. This is especially true for Small- and Medium sized Enterprises (SMEs) (Bańkowska et al., 2020). An alternative for firms is to take on equity capital. However, unlisted firms are less likely to have the possibility to issue bonds and sell stocks in a secondary offering which decreases the opportunity for equity financing (Michael J. Boyle 2022). Consequently, firms may be forced to turn to other sources of capital such as trade credit.

1.2.2 Trade credit

Trade credit is the formal term for money lent to a business by its suppliers; the buyer receives the goods and is allowed to pay at a later date. Such an alternative way of financing may allow a firm to realize its projects in situations when bank financing is not possible. A further

advantage with the use of trade credit for the buyer is the time that is given for inspection of the goods before making the payment.

Suppliers might be motivated to extend trade credit due to the implicit equity stake that they have in their buyers' businesses – they want to preserve their sales (Petersen, Rajan 1997). Furthermore, there are several factors mitigating the risk taking associated with extending trade credit in a way which financial institutions do not experience. As a result, suppliers have a comparative advantage. Firstly, through the business relationship, they have the possibility to reduce the information asymmetry to their buyers' businesses. This may lead suppliers to extend trade credit in situations when banks choose not to lend out capital (Biais, Gollier 1997). Also, in case of default, suppliers can more easily liquidate assets compared to financial institutions (Petersen, Rajan 1997). As a result, even though suppliers offer discounts for immediate payment, they also have the ability to impose large penalties for late settlement, which means that the cost of defaulting for the buyers could prove to be more extreme than with other types of financing. Moreover, trade credit can exhibit a higher implicit interest rate compared to bank loans (Cuñat 2007; Jain 2001).

Despite the risk mitigating factors that suppliers experience in comparison to banks, they may be reluctant to extend trade credit due to the uncertainty associated with the extension when their buyers are in financial distress. Furthermore, buyers are not only dependent on the suppliers' willingness to give out trade credit, but also their ability to do so. This means the suppliers having enough liquidity, or them having better access to debt financing than their buyers (Bastos, Pindado 2013).

1.2.3 Covid crisis

The uncertainty linked to receiving trade credit does not only stem from the suppliers' willingness and ability to extend trade credit, but also from the macroenvironment surrounding the firms. Among these factors is the recent, unique, and unprecedented Covid crisis. Despite its non-economic origin, the crisis has had a negative impact on both the global economy as a whole and the business landscape.

The Covid crisis has been truly global, yet the timing and severity of the pandemic has varied greatly from country to country. Waldkirch (2021) confirms this by stating that "*Contagion rates have been very heterogeneous across countries and across regions within countries"* (Waldkirch 2021, p. 3). The extent to which countries were affected by the virus differed due

to differences in both the timing of experiencing the crisis as well as the amount of organization and preparations prior to the pandemic. Waldkirch (2021) further amplifies that the export sector is the main victim of the Covid crisis, something that could potentially have impacted Sweden as a net export country, significantly.

Not only did the effects of the virus vary between countries, but also the wide array of actions that were triggered in different parts of the world. Even within the European Union, where common rules and standards often apply, the reactions of different member states have varied widely. Many political leaders have sought to use measures such as quarantines and lockdowns as a way to combat the virus, but the extent to which these restrictions have been implemented and enforced might have had a significant effect on countries' business structure. It is clear that the decisions taken by governments on this matter have possibly had a significant impact on the fate of businesses in their respective countries.

1.3 Contribution

Through this study we aim to shed light on trade credit as a distress mitigating factor during the Covid crisis. We seek to provide valuable insights into its role as financing for firms, enabling them to manage their cash flows and meet financial obligations, as well as acting as a helping hand to buyers, facilitating their purchasing activities. We also intend to investigate the supplier and buyer relationship during the crisis. Furthermore, we aim to provide insights into the role of accounts payable as either a substitute or complement to bank financing.

Previous research has investigated the use of trade credit in normal economic conditions as well as various crises, most commonly the financial crisis in 2008. A contribution which holds for both parts of this study is the investigation of the Covid crisis, which due to its recent nature is not yet a well-researched area. Furthermore, to our knowledge, there is a gap for studies in terms of investigating Sweden as a single country. Additionally, prior studies have primarily examined trade credit measures in isolation, but this study investigates a relatively underexplored area: the interconnection between these measures. In terms of the substitution effect, to our knowledge, the distinction between short- and long-term debt is rarely explored in investigations of this effect. By making the distinction we hope to be able to provide a more detailed analysis while making a contribution.

The findings of this study not only have relevance for Sweden, but also provide a foundation for future replication studies in other geographical areas and for different types of capital structure decisions.

1.4 Scope of investigation

The study is restricted to Swedish unlisted Small- and Medium Enterprises (SMEs) between 2018 and 2021. The upper limitation of 2021 is set to address the potential impact of other crises occurring after 2021, and data being limited beyond this year. As a result, we do not consider whether firms *survived* the crisis when taking on more (less) trade credit but rather investigating the financial stability of firms *during* the crisis. Further, as the research is limited to Swedish companies, we do not intend to present the perspective of a comparative country study. Rather, the purpose of the study is to provide results for one country, which in future research can be used for comparison with other countries. Moreover, this article does not consider whether the extension of trade credit is a voluntary action from the creditor, or if the buyer "forces" the creditor by postponing its payments.

2. Earlier Research and Hypotheses Development

2.1 Trade credit

2.1.1 Determinants of the use of trade credit

Early research highlights significant variation in trade credit terms across industries, while finding consistency within industries (Ng et al., 1999). More recent research also confirms that industry is a determining factor to the use of trade credit. Yazdanfar and Öhman (2017) observe that Swedish SMEs' view on trade credit differs between industries. Retail, wholesale, and construction industries view trade credit as an alternative to long-term debt financing, while healthcare and manufacturing industries see them as complements.

Yazdanfar and Öhman (2017) additionally point toward the size of a firm being a determinant in the use of trade credit. They observe that larger SMEs tend to request more trade credit than smaller ones do (Yazdanfar, Öhman 2017). In contrast, Andrieu et al., (2017) observed that there is only a minor impact from size on the likelihood of receiving trade credit, meaning that a small positive effect was only observed for the largest SMEs. Furthermore, it was found that the age of a company does not have any bearing on its likelihood of obtaining trade credit.

Although the aggregate conclusion from the sample of eleven European countries was that of insignificance for age and size, variations were observed between countries.

While the impact of firm age and size on trade credit remains somewhat inconclusive, a well-known consensus within research is that access to bank financing is one of the most influential factors affecting changes in the use of trade credit. Burkart and Ellingsen (2004) have concluded that trade credit and bank credit can either be complements or substitutes, depending on the financial environment. The harder it is to obtain bank financing, the stronger the substitution effect becomes (Burkart, Ellingsen 2004).

Interestingly, it has also been found that financial distress can be a determinant of trade credit. Osinubi (2020) observed that while financial distress has a significant positive effect on accounts payable, the opposite is true for accounts receivable. The observable impact on accounts payable was partially attributed to the prevalence of financial distress among emerging companies, and that financially distressed emerging companies tend to default on their suppliers, which in turn explains the increase in trade payables (Osinubi 2020).

2.1.2 Implications of trade credit for the supply chain

Companies may be affected by the extension of trade credit of other firms than those that they are in partnership with. When one company extends trade credit to another, this often happens within a supply chain which more parties are a part of. Thus, the exchange of credit between two firms may also affect companies further down or up in the chain. Jacobson and von Schedvin (2015), who use data from Sweden which is said to entail conditions allowing the researchers to draw general conclusions for other parts of the world, contend that when a trade debtor fails, there is a propagation effect with respect to bankruptcy within the supply chain. Thus, the article points towards trade credit being an efficient medium of transportation for financial failure (Jacobson, von Schedvin 2015). The efficient medium of transportation could be affected by the switching costs between the supplier and buyer. Garcia-Appendini and Montoriol-Garriga (2020) state that when these costs are low, and the suppliers can more easily switch customers, they terminate the business relationship long before bankruptcy. However, when switching costs are high, the relationships are maintained until bankruptcy (Garcia-Appendini, Montoriol-Garriga 2020) and thus trade credit can take the role of a medium of transportation of financial failure.

Other studies exhibit similar chain reaction effects for liquidity shocks. Researchers have observed that in Europe, these types of shocks caused by the most recent financial crises may have been amplified by the trade credit chain (Bussoli, Marino 2018). According to Boissay and Gropp (2013), these shocks are transported through the supply chain until a more unconstrained firm, which has access to outside financing such as a bank loan, inserts cash into the chain and thus absorbs the chock. This further emphasizes that the firm ultimately getting affected by one party in the supply chain defaulting on its payment, does not have to be in a direct business relationship with it (Boissay, Gropp 2013).

2.2 Crises

2.2.1 General implications for firms during crises

Research has demonstrated that different crises have affected industries in different ways. Moore and Mirzaei (2016) observed that performance diminished in almost all 23 industries in their sample. However, the effect differed between the industries, with a larger impact on industries relying highly on external financing. Differing effects within industries have also been observed. Peric and Vitezic (2016) found that, during the recession following the financial crisis, medium- and large sized firms in the manufacturing and hospitability industries experienced more firm growth than small firms.

Crises not only have direct effects on firms, but also indirectly through other actors. In crisis times, bank financing for SMEs has been observed to decrease. Prior research has also identified that SMEs have more difficulties obtaining financing compared to larger firms, and this is a phenomenon especially prominent during financially constrained periods (Bussoli et al., 2023; Kaya 2022; Petersen, Rajan 1997).

As the relationship between crises and firms is clearly and naturally affected by the state and characteristics of firms when entering crises, this is a well-researched topic. Liquidity, leverage, profitability, solvency, and type of activity are commonly used categories to describe a firm's financial profile (Altman, Sabato 2007). Different measures for these classes have been investigated and different researchers have selected different ratios as the most meaningful in explaining financial distress.

2.2.2 Financial distress models.

Defining firms as financially constrained can be done in several ways, and research points towards there not being a unique superior way of doing so (Berger, Udell 2006; Jiménez et al., 2014; Beck, Demirgüç-Kunt et al., 2008). Amongst some methods, the classification can be done using market-based indicators such as stock prices (Distinguin et al., 2006), corporate governance indicators such as CEO renewal (Tron et al., 2022) and accounting-based numbers such as the Altman Z-score (Altman 1968) and Ohlson O-score (Ohlson 1980).

An early model in the accounting number approach is the Altman Z-score model (1968) which uses five accounting ratios to describe financial distress. This model, which initially was designed for public manufacturing firms, has been revised to fit new criterion. In 1983, the model was adapted to be applicable to private firms by substituting the market value of equity with the book value of equity and then re-estimating the weights (Altman 1983).

Other approaches on financial distress models have been taken in terms of specific variables and ratios included, as well as the combination of them. In 1980, Ohlson created the O-score model which includes nine financial ratios to predict bankruptcy (Ohlson 1980).

The model has in some contexts been shown to perform better than the Altman Z score (Wu et al., 2010), and in other contexts inferiorly with an accuracy of 54%, compared to 75% for the Z-score model (Shehni Karamzadeh 2013). A similar conclusion of the Z-score's superiority is drawn by Renalita and Tanjung (2020).

Later, more advanced techniques in the form of neutral networks and machine learning have started to become used (Salchenberger et al., 1992; Kim, Kang 2010; Liang et al., 2016). While initial comparisons between traditional statistical models and more advanced models found no significant difference in terms of predicting accuracy (Adnan Aziz, Dar 2006), more recent comparisons in combination with further development of advanced techniques have demonstrated that machine learning models appear to have improved bankruptcy prediction accuracy over traditional models (Barboza et al., 2017). Nevertheless, these models require a large amount of data to train the model prior to applying it on new data.

2.3 Trade credit in crises

2.3.1 Trade credits' impact on financial distress during crises

The precise relationship of "*Trade credits' impact on financial distress during crises"* is to our knowledge a fairly unresearched area within recent literature. Amongst some, McGuinness et al., (2018) looked at SMEs in 13 different European countries and drew the conclusions that the redistribution effect, i.e., liquid firms extending trade credit to more illiquid firms, significantly reduced the likelihood of financial distress. This, especially in the aftermath of the financial crisis in 2008. Carbó-Valverde et al., (2016), Lawrenz and Oberndorfer (2018) and Bastos and Pindado (2013) also conclude that trade credit is a possible way to alleviate financial constraints for SMEs being in crises.

While Kestens et al., (2012) found that an increase in accounts payable was associated with a decline in profitability during the financial crisis in 2008, they also found the opposite relationship for accounts receivables. Firms which increased their trade receivables during the crisis experienced a less severe decrease in profitability than other firms. This suggests that companies with higher trade payables may be having the higher amount due to them facing difficulties in paying back their suppliers (Kestens et al., 2012). These studies lead us to formulate our first and second hypothesis:

H1a: Receiving trade credit helps firms mitigate financial distress
H1b: Extending trade credit helps firms mitigate financial distress

H2: Covid increases the mitigation of trade credit on financial distress

2.3.2 Substitution effect during crises

During crises, bank financing is limited. Early research such as Petersen and Rajan (1997) show that when funds from financing institutions are limited, firms rely more on trade credit and this points towards the presence of a substitution effect (Petersen, Rajan 1997). However, more recent research has been inconclusive on the existence and the extent of the substitution effect, and whether trade credit should be seen as a substitute or complement to bank financing (Burkart, Ellingsen 2004; Yazdanfar, Öhman 2017).

Many researchers looking at both individual country samples and larger groups of country samples, have found support for the presence of a substitution effect during the financial crisis in 2008. For example, during the crisis, constrained Spanish SMEs relied more on trade credit, and less on bank financing, than in more normal economic conditions (Carbó-Valverde et al., 2016).

More crises have been observed, and what is a common factor between the research on the different economic downturns is that there are differing conclusions regarding the duration of the substitution effect. A cross-country sample of firms from Argentina, Brazil and Turkey, each undergone a financial crisis during the observation period, showed that suppliers act as an important agent in mitigating credit tightening from financial institutions by giving low credit rated firms trade credit financing. The article further argues that the substitution effect was only temporary, for two reasons. Firstly, the suppliers also get credit constrained from the crisis, which makes it difficult for them to extend trade credit. Secondly, the supply chain effect reduces liquidity on the market which contributes to the credit constraint (Bastos, Pindado 2013). Furthermore, a sample drawn from European SMEs concludes that the substitution effect exists but weakens during economic downturns (Bussoli, Marino 2018).

The same researchers have in a later research paper further looked into the substitution effect during a financial crisis and concluded that it does exist and that it is an important mechanic for SMEs to survive. The article also recognizes the research ambiguity with regards to the substitution effect by stating that it can partly be explained by differences in the type of financial crisis that is examined, and which countries are affected by it (Bussoli et al., 2023).

Other researchers also found that the substitution effect is present, but that there is a firm size effect, meaning that it is mainly observed in larger firms. SMEs have more difficulties substituting their decrease in bank financing with trade credit compared to larger firms (Lawrenz, Oberndorfer 2018). This conviction is further emphasized by Andrieu et al., (2017) who looked at a sample of European SMEs and concluded that for firms of larger size, trade credit and bank debt should be seen as complements rather than substitutes. A firm getting bank financing may signal to its potential future creditor of trade credit that it is reliable, and vice versa. Thus, they can be seen as complements (Andrieu et al., 2017).

Although being somewhat inconclusive with regards to duration, presence during crises and to potential magnitude change of the substitution effect during times of financial distress, most

studies point towards firms demanding more trade credit when bank financing is limited. Thus, we intend to shed light on this in a Swedish context. In line with Yazdanfar and Öhman (2017), we will look at short- and long-term bank debt separately. This leads us to formulate our third and fourth hypothesis:

H3a: Short-term bank debt is negatively associated with trade credit
H3b: Long-term bank debt is negatively associated with trade credit

H4: Covid increases the substitution effect

3. Data, Sample Construction and Research Design

3.1 Sample

3.1.1 Data collection

The models will be applied on panel data gathered from the Serrano database. The database contains information on firms from the year of 1997 and beyond, and is an assemblage of data from the Swedish Companies Registration Office (Bolagsverket), Statistics Sweden (Statistiska Centralbyrån), and from Bisnode's group register.

3.1.2 Selection of observation objects

As mentioned above, research shows that the effects of the Covid crisis have been heterogenous between countries. Also, different governments took various diverse actions and thus SMEs were affected differently depending on where they were based (Waldkirch 2021). When taking this into consideration, studying an individual country rather than investigating several countries simultaneously has been found suitable.

Choosing Sweden as the country to be investigated is motivated by several factors. Firstly, during the crisis, the country took a quite diverging strategy compared to countries such as its neighbors Norway, Denmark, and Finland (Ludvigsson 2023). Secondly, it is easy to access data about Swedish unlisted firms. Thirdly, the fact that prior research looking into the effect of trade credit on financial distress excluded Sweden from their study due to a lack of access to data, means that this gap can now be filled (McGuinness et al., 2018).

In terms of the type of firms, the study will be restricted to unlisted Small- and Medium sized Enterprises, which also includes Micro sized companies. The classification partly follows the European Commission's definition; "*The category of micro-, small- and medium sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million."* (European Commission 2003). Due to insufficient reporting from unlisted companies on the number of employees, the data has been restricted in terms of turnover and balance sheet size.

The value of researching SMEs lies in their meaningful contribution to the Swedish economy, as they account for 99.9% of the total amount of companies and 61.3% of the value added (Nilsson, von Hofsten 2022). Thus, it is of great importance to investigate potential improvement areas for SMEs and what actions are beneficial to take for SMEs to be able to grow, contribute to the economy and survive periods of financial constraints.

In addition to limiting the study to unlisted firms, the study will also be restricted to non-financial companies. The financial sector's business model often comprises high leverage, which is something that for other types of firms could be interpreted as indicating distress (Fama, French 1992). Thus, they should not be compared in this type of research. Also, authorities will be excluded due to them being government financed and as such might not face the same financing constraints as other firms.

3.1.3 Selection of observation years

Even though the effects of the Covid virus are undoubtedly having consequences post 2021, it has been decided to define the time of the crisis as the years 2020 and 2021. Several factors underlie this decision. Firstly, since the Russian invasion of Ukraine started in February 2022 which likely had effects on firms and thus the relationship which will be studied, an attempt is made to try to isolate these effects from the ones stemming from the Covid crisis. Secondly, data from the Swedish National Institute of Economic Research (NIER) gives an indication that Swedish firms with 200 or less employees perceived bank financing to be more difficult to obtain during the year 2020, compared to the prior years. During late 2021, firms' perceptions returned to be more similar to what they were prior to Covid (see appendix 2). This trend is one further reason why it has been decided to restrict the crisis to the years 2020 and 2021. Thirdly, there is difficulty in finding more recent data than for the year 2021 due to financial reports of 2022 not being released at the time of the research.

Moreover, the pre-crisis period is restricted to the years 2018 and 2019, generating a balance with two years of pre-crisis data, and two years of crisis data.

3.1.4 Further delimitations

In an attempt to mitigate the effects of internal trade which affect the accounts of trade receivables and trade payables, a series of delimitations are being applied. Firstly, if the company is classified as independent and its data originates from a consolidated financial statement, the observation is dropped. Secondly, if the company is classified as a Swedish parent company, and the data originates from the individual company's financial statement, the observation is dropped. Lastly, all firms classified as subsidiaries are dropped. Consequently, the remaining sample consists of firms which have adjusted their reports for internal trade and firms that did not have any internal trade.

Further cleaning of the data includes setting a lower bound of 500 000 SEK and 1 000 000 SEK, for assets and revenue respectively to exclude firms with questionable economic activity such as "zombie firms". Also, we remove firms with negative liability. Lastly, after creating all necessary variables, all observations that contain any missing data for any of the variables are dropped.

3.1.5 Balanced and unbalanced sample

A balanced sample includes observations for all variables during all years of the examined time period. As this allows for consistency and completeness of data, it is preferred when analyzing effects over time. Given its ability to capture these effects accurately, a balanced sample will be used for the investigation of the substitution effect. Nonetheless, for the examination of financial distress and trade credit, it has been decided to use an unbalanced sample instead. The reason is that a balanced sample may suffer from a survivorship bias, as it excludes new entry firms, but more importantly for this study, firms that exit the market. For the first part of the study, this constitutes a meaningful problem as the sole purpose of it is to investigate financial distress. Thus, it is non-suitable to exclude the firms that exit the market as that would exclude all bankruptcy firms which are likely to be associated with more financial distress, potentially creating distorted results.

The generation of a balanced sample will lead to a reduction in number of observations as this will be the result when excluding all firms that lack observations for any of the years 2018-2021.

3.2 Methodology – Relationship between trade credit and financial distress

3.2.1 Choice of financial distress model

Although late research has concluded that machine learning approaches to assess the financial conditions of firms is more accurate than traditional models such as the Altman Z-score model and the Ohlson O-score model, this type of method has been disregarded in this study. This because such techniques require training data which we do not have access to, and financial distress prediction being the single thing we test, we find that a traditional accounting-based method will be sufficient to predict financial distress, in line with McGuiness et al., (2018). Further, as described by Kumar and Kumar (2012), the Z-Score and O-Score, both created over three decades ago, remain integral in predicting financial distress in contemporary business practices. Their persistent usage highlights their widespread popularity within society, as they offer simple and straightforward applications (Kumar, Kumar 2012).

As research has shown to be inconclusive on whether the Altman or Ohlson models are most accurate, both have been considered. However, due to a lack of data in terms of some of the variables needed in the latter mentioned model, the former has been chosen. An alternative could have been to make estimations about the variables, but as it is believed that this would affect the predictability of the model it has been chosen to generate Z-scores rather than O-scores.

3.2.2 Classification of firms

Firstly, each firm in the data set is classified as either being likely to experience insolvency with a greater likelihood of bankruptcy, or not. This is done by applying the well-established Altman Z-score model, which measures likelihood of financial distress. However, as the study is conducted on private firms, and not listed firms which the original Altman Z-score model is based on, we will use Altman's modified Z-score model which does not require stock-price data and is applicable on private firms.

$$Z_{i,t} = \sum 0.717WC_{i,t} + 0.847Cash_{i,t} + 3.107EBIT_{i,t} + 0.42BVE_{i,t} + 0.998Sales_{i,t}$$

The dependent variable $Z_{i,t}$, is the Z-score which is a measure of the likelihood of a firm, i, being in financial distress in the time period t.

The independent variables in the Z-score regression consist of ratios that are meaningful in determining financial distress (Altman 1983). Working capital scaled by firm assets, $WC_{i,t}$ measures short-term liquidity. Retained earnings scaled by firm assets, $Cash_{i,t}$ suggests what amount of the profits that have been reinvested. The third ratio, $EBIT_{i,t}$ is a measure of the company's earnings before interest and tax scaled to firm assets, which should indicate how well the assets are used to generate profits. Book value of equity scaled by total liabilities, $BVE_{i,t}$, accounts for investors' perception of the company in relation to its liabilities. Lastly, $Sales_{i,t}$ which is net sales scaled by firm assets shows how well the assets generate revenue.

If the Z-score for a specific firm is lower than 1.23, it is considered to be likely to experience financial distress with a greater likelihood of bankruptcy. If this is the case, the firm is given the value 1. If not, it is given a 0.

3.2.3 Investigation of relationship

Following the classification of the firms which create a binary dependent variable, the relationship between financial distress and trade credit is investigated with logit models.

The basic models are as following:

Model 1: Base model

$$Y_{i,t} = \beta_1 Trade\ credit_{i,t-1} + \beta_2 \ln(assets)_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Sales\ growth_{i,t-1} + \beta_5 Age_{i,t-1} + \beta_6 Age^2_{i,t-1} + \beta_7 Year_{2019} + \beta_8 Year_{2020} + \beta_9 Year_{2021} + \beta_j Industry_j + u_{i,t}$$

Model 2: Includes a crisis dummy and interaction variable.

$$Y_{i,t} = \beta_1 Trade\ credit_{i,t-1} + \beta_2 \ln(assets)_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Sales\ growth_{i,t-1} + \beta_5 Age_{i,t-1} + \beta_6 Age^2_{i,t-1} + \beta_7 Crisis + \beta_8 Crisis * Trade\ credit_{i,t-1} + \beta_j Industry_j + u_{i,t}$$

What differs between the two models is that the latter includes a crisis dummy and an interaction variable. The crisis dummy variable takes on the value 0 if the observation is from the years 2018 or 2019 which are defined as the pre-crisis period, and 1 if the observation is from the years 2020 or 2021 which are defined as the crisis period. Including this is done in order to be able to separate and account for the effects between the time of the crisis and the pre-crisis time. The interaction term is included in order to investigate if there was a distinct effect of trade credit on financial distress specifically during the crisis.

Model 1 and model 2 will be the starting point throughout the analysis. Nonetheless, alternative versions of them will be used. The dependent variable, $Y_{i,t}$, is binary and either takes on the value 1 or 0, depending on the output from the Altman Z-score formulas. This variable will consistently be the same in all the models. However, the independent variable trade credit will be measured in different ways in alternative versions of model 1 and model 2. It will be measured as:

(1) Trade credit received, scaled by assets
(2) Trade credit extended, scaled by assets
(3) Net trade credit extended, scaled by assets

Firstly, the two gross measures of trade credit, trade credit received and trade credit extended will be looked at to see if they are associated with financial distress independently. Thereafter, we want to see if the *relationship* between trade credit received, and trade credit extended is associated with financial distress. In other words, it is interesting to see whether being a net extender, i.e., extending more trade credit than receiving, is positively or negatively associated with financial distress.

The control variables which will be included in the regressions are size, cash reserves, sales growth, firm age, year dummies and dummies controlling for differences between industries.

Size of the firm is measured as the natural logarithmic of assets and is included to account for the possible association between larger asset holdings and reduced financial distress, as there are then more assets to liquidate and use to avoid insolvency.

Cash holdings is measured as liquid assets and is included to control for the possibility that large cash holdings might be associated with a lower likelihood of insolvency.

Sales growth is defined as the percentage difference between sales in the current year, at time t, and sales in the previous year, in time $t-1$. The reason it is included as a control variable in the model is because growth in sales might be associated with a lower likelihood of insolvency.

The model controls for firm age, defined as years from establishment to account for potential differences in stability between established firms and startups during the crisis. Age^2 is also included to capture the potential diminishing marginal effect of age on financial distress.

Moreover, the explanatory variables are lagged in an attempt to avoid simultaneity, i.e., that the dependent variable affects the explanatory variables at the same time as the opposite occurs.

All variables are winzorised at a 5% and 95% level. Although the common approach is to winzorise at a 1% and 99% level, when analyzing the data, it has been observed that a higher level is appropriate. This decision is consistent with the higher variability typically observed in private firms, which have less stringent reporting requirements.

3.2.4 The models

As the dependent variable in the relationship of interest takes a binary form, the choice of type of regression has been between two of the most commonly used models for this type of regressions: the logit and the probit model. Following the argument of McGuinness et al., (2018) in combination with prior reasoning from Pindado et al., (2008) and Arellano, Honoré (2001), the choice between using a probit or logit model is based on the assumptions regarding the distribution of the error term. Due to difficulties in obtaining information about the mentioned distribution, it has been decided to choose the logit models as it does not assume normality of the error term, but rather a logistic distribution which accommodates a wider range of potential distributions for the error term.

Initially, it was also investigated to use a fixed effect model in addition to the logit models above. This has been used in previous research. However, as it has shown to decrease the sample size with a large magnitude, making the conclusions potentially inaccurate, it has been decided that the fixed effect model is not appropriate with the current data. Thus, the model choice is solely the logit model.

3.3 Methodology – Substitution effect

3.3.1 Investigation of relationship

The method used for investigating the relationship between trade credit and bank financing is to a large part replicated from "*Substitute or complement? The use of trade credit as a financing source among SMEs"* by Yazdanfar and Öhman (2017). However, an extension is introduced by comparing and contrasting different time periods, more specifically the pre-Covid and during Covid. Two models are used in this analysis: a regular OLS and a fixed effect model. Initially, a random effects model was estimated as well, but after conducting a Hausman test

which shows significance, the random effects is abandoned, and the fixed effects model is used instead.

The basic regression is the following:

$$Trade\ credit\ received_{i,t} = \alpha_t + \beta_1 STD_{i,t} + \beta_2 LTD_{i,t} + \beta_3 ROA_{i,t} + \beta_4 \ln(assets)_{i,t} + \beta_5 \ln(age)_{i,t} + \beta_6 Crisis + \beta_7 Crisis * STD_{i,t} + \beta_8 Crisis * LTD_{i,t} + \beta_j Industry_j + u_{i,t}$$

The dependent variable, trade credit received, is scaled by assets. The independent variables short-term debt (STD), i.e., debt repayable within one year, and long-term debt (LTD), i.e., debt repayable in more than one year, are also scaled by assets. The control variables included in the models are return on assets (ROA), size, age, a crisis dummy as well as industry dummies to control for differences across industries.

Return on assets (ROA) is computed as operating income scaled by assets. The reason it is included as a control variable is that profitability, which ROA is a measure of, could affect how much trade credit a firm requests. For example, a profitable firm may need less external financing and thus has a lower amount of accounts payable than a more unprofitable firm.

Size is measured as the natural logarithmic of assets, and age is measured as the natural logarithmic of the number of years since the establishment of the firm. Controlling for this allows us to mitigate potential effects of larger and older firms having access to better credit terms.

Similarly to the previous stated arguments, all variables are winzorised at a 5% and 95% level.

4. Findings and Analysis

4.1 Description of data

4.1.1 Composition of sample

Table 1

Industry sector sample composition

Industry Sectors	SNI code	2018	2019	2020	2021	Total	Percentage
Agriculture, forestry and fisheries	01-03	1 840	1 899	2 032	2 123	7 894	2.97%
Extraction of petroleum, natural gas, metals and minerals	06-09	58	59	61	57	235	0.09%
Manufacturing	10-33	4 303	4 337	4 305	4 585	17 530	6.60%
Supply of electricity, gas, heating and cooling	35	143	153	142	155	593	0.22%
Water supply, sewage treatment, waste management and sanitation	36-39	155	156	152	160	623	0.23%
Construction activities	41-43	10 471	11 105	11 817	12 912	46 305	17.44%
Trade, repair of motor vehicles and motorcycles	45-47	10 690	10 970	11 285	12 220	45 165	17.01%
Transport and maganisation	49-53	3 466	3 531	3 456	3 556	14 009	5.28%
Hotel and restaurant operations	55-56	3 066	3 252	3 405	3 949	13 672	5.15%
Information and communication activities	58-63	4 261	4 899	5 418	6 321	20 899	7.87%
Real estate business	68	2 604	2 735	2 929	3 666	11 934	4.50%
Activities in law, economics, science and technology	69-75	10 999	11 996	12 535	14 274	49 804	18.76%
Rentals, property services, travel services and other support services	77-82	2 644	2 843	2 808	3 114	11 409	4.30%
Training	85	974	1 010	1 020	1 104	4 108	1.55%
Health and social care	86-88	2 617	2 744	2 700	2 840	10 901	4.11%
Culture, fun and leisure	90-93	1 216	1 317	1 319	1 452	5 304	2.00%
Other service activities	94-96	1 107	1 191	1 337	1 465	5 100	1.92%
Total		60 614	64 197	66 721	73 953	265 485	100.00%

The table shows the industry composition by year. SNI (Standard för Näringsgrensindelning) represents the SNI 2007 classifications which are used to classify units as companies and workplaces based on their economic activities. Excluded industries are: SNI codes 64 – 66 as they represent finance and insurance related activities, SNI code 84 as this represents the public sector, and lastly further exclusions of public sector firms in the remaining industries have been made.

Table 1, which presents the industry sector sample composition reports a sample which comprises a wide range of industries. Notably, there are three industries that can be seen as representing approximately 53% of the sample: "*Construction activities*", "*Trade, repair of motor vehicles and motorcycles*", and "*Activities in law, economics, science and technology*". The remaining portion of the sample is distributed to the other industries. When comparing the sample distribution to the Swedish industry composition presented in appendix 3, it can be observed that the composition of the sample is relatively representative of the total distribution of firms in Sweden.

4.1.2 Summary statistics of the main explanatory variables

Table 2

Summary statistics for the main variables

Variables	N	Mean	SD	Median
Unbalanced sample				
Received $_{t-1}$	248603	0.091	0.129	0.044
Extended $_{t-1}$	248603	0.167	0.176	0.118
Net extended $_{t-1}$	248603	0.077	0.184	0.050
Ln(assets) $_{t-1}$	248603	14.779	1.072	14.607
Cash $_{t-1}$	248603	0.328	0.265	0.271
Age $_{t-1}$	248603	13.997	12.769	9.148
Sales growth $_{t-1}$	248603	0.104	0.523	0.0177
Balanced sample				
Received	71846	0.098	0.115	0.065
STD	71846	0.041	0.056	0.025
LTD	71846	0.191	0.169	0.167
ROA	71846	0.086	0.136	0.075
Ln(assets)	71846	15.309	1.104	15.230
Ln(age)	71846	2.495	0.806	2.463

The table reports summary statistics for the lagged independent variables used in the investigation of the relationship between trade credit and financial distress (unbalanced sample). Also, it reports the dependent variable and independent variables used in the investigation of the subsitution effect (balanced sample). Received is measured as accounts payable scaled by assets, Extended is measured as accounts receivable scaled by assets and Net extended is measured as accounts receivable minus accounts payable, scaled by assets. Cash is measured as liquid assets as a ratio of total assets. STD and LTD are measured as short- and long-term debt to credit insitutions respectively, both scaled by assets. ROA is operating income scaled by assets.

Table 2 presents descriptive statistics of the main variables. In the unbalanced sample, the mean of trade credit extended scaled by assets is on average 0.167, meaning that firms' assets are on average composed by 16.7% accounts receivables. Net credit extended has a positive mean (0.077), indicating that firms in the sample on average extend more trade credit than they receive. It is also observable that firms on average are quite young (13.997). The largest variability in the unbalanced sample is observed to be in the logarithm of assets (1.072), firm age (12.769) and sales growth (0.523).

Observations that can be made in the balanced sample are that on average SMEs in our sample have more long-term debt (0.191) compared to short-term debt (0.041), and that firms on average have a return on assets (ROA) of 8.6%.

4.1.3 Correlation

In appendices 4 and 5, Pearson correlations coefficients as well as significance levels from two-sided t-tests are presented in matrices. This is to investigate whether there is a potential problem of high correlations between the independent variables. As such a problem could distort the reported regression coefficients and thus the results, it is something important to investigate.

The first correlation matrix presents the variables used in the examination of the relationship between financial distress and trade credit, utilizing the unbalanced sample as the basis for the analysis. When excluding the correlations between the independent variables of interest, i.e., the different measures of trade credit, it is observable that in general there are no high correlations between the control variables and each of the trade credit measure variables. The highest correlation, - 0.2880, between all the independent variables can be found between assets and cash scaled by assets. However, this correlation is expected as the cash reserves measure is cash scaled by assets, and that when assets grow, it will decrease the cash to assets ratio which explains the negative correlation. Further, all the correlations are significant at a 1% level.

The second matrix reports the Pearson correlation between the variables that are used for investigating the substitution effect, utilizing the balanced sample as the basis for the analysis. The two highest correlations are between the logarithm of assets and age (0.2600) and the logarithm of assets and short-term debt (-0.1840). Although significant correlations are found, all at a 1% level, no correlation has a high magnitude.

4.1.4 Firm characteristics by the amount of trade credit received

Table 3
Quartiles based on trade credit received

	1st quartile		2nd quartile		3rd quartile		4th quartile	
Variables	**Pre-crisis**	**During crisis**	**Pre-crisis**	**During crisis**	**Pre-crisis**	**During crisis**	**Pre-crisis**	**During crisis**
Unbalanced								
Extended	0.115	0.102	0.140	0.125	0.174	0.154	0.260	0.236
Ln(assets)	14.591	14.686	14.755	14.831	14.937	15.026	14.511	14.555
Cash	0.448	0.459	0.364	0.393	0.288	0.325	0.235	0.273
Age	10.125	10.117	13.303	13.085	14.876	14.634	12.698	12.252
Sales growth	0.080	0.095	0.082	0.098	0.106	0.132	0.167	0.208
Balanced								
STD	0.033	0.031	0.044	0.041	0.043	0.040	0.042	0.039
LTD	0.233	0.210	0.235	0.211	0.192	0.173	0.154	0.143
ROA	0.102	0.097	0.093	0.094	0.085	0.093	0.058	0.070
Ln(assets)	15.392	15.509	15.468	15.555	15.480	15.630	14.845	14.940
Ln(age)	2.370	2.600	2.555	2.723	2.609	2.753	2.464	2.638

The table reports the mean of firm characteristics, both pre- and during crisis. The firms are divided into quartiles based on the amount of trade credit received, measured as accounts receivable scaled by assets. Extended is measured as accounts receivable scaled by assets. Cash is measured as liquid assets scaled by total assets. STD and LTD are short- and long-term debt to credit institutions respectively, scaled by assets. ROA is operating income scaled by assets.

In table 3, firms are divided in quartiles based on the amount of trade credit received. All the variables in the table are presented as the means for pre- and during crisis. Starting with the unbalanced sample, the first observation that can be made is that firms that tend to receive more trade credit also extend more trade credit. A second observation is that firms with low trade

credit received have higher cash reserves. Furthermore, firms in the higher quartiles tend to have higher sales growth. Also, there is an indication that during the crisis, firms had a higher cash to asset ratio and sales growth compared to the pre-crisis time period. Lastly, older and larger firms seem to obtain more trade credit up until the 4th quartile where the trend changes direction, i.e., age and size decreases.

A first observation for the balanced sample is that, except for the increase in the 2nd quartile, there is a decreasing trend in amount of long-term bank debt taken. This indicates towards firms with a higher ratio of accounts payable having a smaller proportion of long-term debt. This could give an indication towards long-term bank debt and trade credit received potentially being substitutes. Nonetheless, further investigations are needed.

Moreover, the balanced sample indicates towards firms which receive more trade credit being associated with a lower profitability. Lastly, the trend which was observed for larger and older firms in the unbalanced sample can also be observed in the balanced sample.

4.1.5 Financial distress sample composition

Table 4
Sample composition using the Altman Z-score model

Classification	2018	2019	2020	2021	Total
Non-financially distressed	55 782 (92.03%)	59 145 (92.13%)	61 370 (91.98%)	68 127 (92.12%)	244 424 (92.07%)
Financially distressed	4 832 (7.97%)	5 052 (7.87%)	5 351 (8.02%)	5 826 (7.88%)	21 061 (7.93%)
Change in proportion of firms classified as financially distressed		-1.28%	1.91%	-1.77%	
Total	**60 614**	**64 197**	**66 721**	**73 953**	**265 485**

The table reports the composition of firms classified as non financially distressed (0) versus financially distressed (1) when using the Altman Z-score model. The numbers in parentheses are percentages of total amount per year. The changes are computed as the change in proportion of firms classified as financially distressed compared to prior year.

In table 4, it is observable that there is an increase in the number of firms that are classified as being financially distressed each year. However, as the total number of firms in the sample also increases over the years, it is important to look at the relationship between the number of firms classified as financially distressed and the number classified as not being in financial distress.

The change percentages reported are relative differences, i.e., not absolute values. During 2019, there was a decrease of 1.28% in the proportion of distressed firms in our sample in relation to

2018. For the two following years, there was an increase of 1.91% and a decrease of 1.77% respectively.

4.2 Regression results

Table 5
Financial distress and trade credit

Variables	Financial distress 1	Financial distress 2	Financial distress 3	Financial distress 4	Financial distress 5
Received $_{t-1}$	-4.80***		-5.05***		
	(0.14)		(0.19)		
Extended $_{t-1}$		-6.11***		-6.23***	
		(0.11)		(0.15)	
Net extended $_{t-1}$					-2.05***
					(0.06)
Ln(assets) $_{t-1}$	0.42***	0.36***	0.42***	0.36***	0.47***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Cash $_{t-1}$	-5.60***	-5.39***	-5.60***	-5.40***	-5.17***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Sales growth $_{t-1}$	-0.11***	-0.07***	-0.11***	-0.07***	-0.14***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age $_{t-1}$	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age^2_{t-1}	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Crisis			-0.00	-0.03	
			(0.02)	(0.02)	
Crisis*Received $_{t-1}$			0.50		
			(0.26)		
Crisis*Extended $_{t-1}$				0.26	
				(0.20)	
Constant	-6.22***	-5.17***	-6.22***	-5.16***	-7.37***
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Year dummies	Yes	Yes	No	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.31	0.34	0.31	0.34	0.31
N	214016	214016	214016	214016	214016

The table reports the logit regressions for the investigation of the relationship between trade credit and financial distress. The dependent variable is financial distress and is binary. It takes on the value 1 if being classified as financiay distressed, and 0 otherwise. Received is measured as accounts payable scaled by assets, Extended is measured as accounts receivable scaled by assets and Net extended is measured as accounts receivable minus accounts payable, scaled by assets. Cash is measured by the firms liquid assets as a ratio to total assets. The crisis dummy takes the value 1 if the observation is from the years 2020 or 2021, and 0 otherwise. All explanatory variables are lagged.
The significance levels are denoted as follows: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are reported in parentheses.

4.2.1 Relationship between financial distress and trade credit

The results from the regressions on the relationship between financial distress and trade credit are reported in table 5. All models are logit models. The regressions show trade credit received (model 1), trade credit extended (model 2), trade credit received while accounting for Covid

(model 3), trade credit extended while accounting for Covid (model 4), and net trade credit extended (model 5).

The estimates of the logit models are in log-odds form, meaning that a one unit increase in one of the independent variables will lead to a β increase in the log-odds of the dependent variable.

Model 1 and 2 both show that trade credit received and extended respectively are negatively associated with financial distress at a 1% level, meaning that both H1a and H1b are supported.

Models 3 and 4 are the same as model 1 and 2 except them accounting for the Covid crisis period through the addition of a crisis dummy and interaction variable. The models display a similar negative association for trade credit received and trade credit extended as in model 1 and 2. The crisis dummy is insignificant in both model 3 and 4 and the same holds for the interaction variables and thus, H2 cannot be said to be supported.

In model 5, where the relationship between trade credit received and trade credit extended is investigated, net trade credit extended is negatively associated with financial distress at a 1% significance level, meaning that firms with the ability to extend more trade credit than they receive are associated with lower financial distress.

For all the models, age and sales growth show a negative association with financial distress, while the opposite is observable for assets; all at the significance level of 1%. It is also notable that age^2 is significant but seemingly zero, indicating that there is not a diminishing marginal effect from firm age on financial distress.

The most influential control variable on financial distress seems to be cash scaled by assets, which is shown to be negatively associated with the dependent variable at a 1% level in all models.

The pseudo R^2 values for all five models are found to be between 0.31 and 0.34 which indicates that all the models are approximately as good at explaining the dependent variable. Furthermore, a good pseudo R^2 value lies in the interval of 0.2 – 0.4 which all the logit models do. The overall high statistical significance of the estimates could be a result of the large sample size leading to an increased accuracy in the data.

The next section examines the relationship between trade credit received and bank financing and whether these should be seen as complements or substitutes, pre-and during crisis.

4.2.2 Substitution effect

Table 6
Substitution effect

Variables	OLS	With fixed effects
STD	-0.07***	-0.12***
	(0.01)	(0.01)
LTD	-0.11***	-0.08***
	(0.00)	(0.00)
ROA	-0.15***	-0.10***
	(0.00)	(0.00)
Ln(assets)	-0.02***	-0.01***
	(0.00)	(0.00)
Ln(age)	-0.00***	-0.01***
	(0.00)	(0.00)
Crisis	-0.01***	-0.01***
	(0.00)	(0.00)
Crisis*STD	0.02	0.02**
	(0.01)	(0.01)
Crisis*LTD	0.02***	0.02***
	(0.00)	(0.00)
Constant	0.47***	0.29***
	(0.01)	(0.02)
Adjusted R^2	0.18	
R^2		0.07
N	71846	71846

The table reports the regressions for the investigation of a substitution effect. The dependent variable is trade credit received and is measured as accounts payable scaled by assets. STD and LTD are short- and long-term debt to credit institutions respectively, scaled by assets. ROA is operating income scaled by assets. The crisis dummy takes on the value 1 if the observation is from 2020 or 2021, and 0 otherwise. The significance levels are as follows: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are reported in parentheses.

As seen in table 6, the only variable for which the direction and significance of the explanatory variables differs between the OLS and the fixed effect model is the interaction variable between crisis and short-term debt. The analysis provided below will start with the other independent variables.

Both short-term debt and long-term debt have a significant negative relationship with trade credit received, indicating that firms with high debt tend to take on less trade credit. This means that support for both H3a and H3b has been found.

The crisis dummy is negatively significant at the 1% level, indicating that firms took on less trade credit during the crisis. For the interaction variable with long-term debt, a positive significant coefficient is reported, showing that the negative relationship between long-term debt and accounts payable seems to be mitigated during the crisis period.

Further, the interaction variable with short-term debt also reveals a significant positive relation, but only in the fixed effects model. Thus, when controlling for fixed effects, the crisis period does have an impact on the relationship between short-term debt and trade credit. Consequently, with both the interaction variables of STD and LTD being positive, no support has been found for H4 as the overall results demonstrate that the substitution effect was not strengthened during Covid but rather weakened.

Looking at the control variables allows for certain observations too. Size is negatively significant at the 1% level, indicating that large firms have less accounts payable. The same relationship can be seen for the variable age, which is also significantly negative, meaning that older firms tend to take on less trade credit.

The explanatory power of the models are an adjusted R^2 of 0.18 for model 1 and a regular R^2 of 0.07 for model 2, which are in line with the benchmark article. Also, as in the previous regressions, the overall high statistical significance of the estimates could be a result of the large sample size leading to an increased accuracy in the data.

5. Discussion

5.1 Relationship between trade credit and financial distress

The first aim of this study was to answer the question whether trade credit helped financially constrained companies in Sweden mitigate the negative effects of the recent Covid crisis. The main conclusions drawn was that trade credit, both received and extended, was negatively associated with financial distress. Nonetheless, no specific direct impact on the relationship was attributable to the Covid crisis. Thus, although a relationship was found *during* the time of the crisis, the crisis does not seem to have had an observable effect on the relationship between financial distress and trade credit. In terms of the stated hypotheses, support has thus been found for 1a and 1b, but not for 2.

In line with Bastos and Pindado (2013), Carbó-Valverde et al., (2016), Lawrenz and Oberndorfer (2018) and McGuiness et al., (2018), it has been found that the use of accounts payable is negatively associated with financial distress. What is however in contrast to McGuiness et al., (2018), is that we cannot observe this effect to have been stronger during the Covid crisis in the way they did for the financial crisis in 2008. There could be multiple explanations for these differing results. Firstly, it is important to consider that different crises

have been investigated. Secondly, McGuiness et al., (2018) evaluated a longer post-crisis period while we, due to already explained reasons, have restricted ourselves to a "during crisis*"* period. Lastly, differences in effects between countries have been proven by previous research, which could also explain our different results.

In line with Petersen and Rajan (1997) who show that suppliers have an implicit equity stake in their buyers' businesses and thus have incentives to preserve their sales, our results indicate that extending trade credit is negatively associated with financial distress. The observation we have made which suggests that firms helping their buyers through the extension of credit is positive for the lender's financial position is something that has been observed before (Kestens et al., 2012). While Kestens et al., (2012) observe that it has a direct positive impact on profitability, we observe the same but indirectly through its negative effect on financial distress. Thus, a similar phenomenon has been observed as good profitability is in line with less financial distress. Kestens et al., (2012) further observed that their effect was strengthened during a financial crisis, which our study does not confirm.

When investigating the relationship between how much trade credit a firm receives and how much the firm extends, i.e., net trade credit extended it can be seen that the net extension of trade credit is negatively associated with financial distress. While this may seem counterintuitive, it can be explained by the fact that firms who have the ability to extend more than they receive must be associated with a good financial position and may have good cash reserves. This is in line with the fact that our measure for cash reserves has a strong negative association with financial distress.

Another interesting conclusion that can be drawn is that older and larger firms seem to receive more trade credit. However, the effect shifts at the 4^{th} quartile (see table 3). The reason for the change is unknown, but an explanation could be that there may be an optimal level of age and size beyond which trade credit may become less important or harder to obtain. The regression also indicates that older firms are less likely to be in financial distress, while the opposite relationship is observed for larger firms. The latter is somewhat contrary to prior literature and could potentially be explained by the phenomenon of liquidity shocks which Boissay and Gropp (2017) have observed. As larger firms have an advantage in obtaining bank financing due to the smaller amount of information asymmetry associated with them (Park et al., 2020) (Qu et al., 2018), they may be the ones having to absorb the liquidity shocks by increasing their bank

financing. As higher leverage is associated with higher risk, it could thus be associated with financial distress.

However, it is important to acknowledge that the observed relationship could be influenced by the study's unbalanced sample composition. It is possible that smaller financially distressed firms have exited the market due to bankruptcy and thus increased the proportion of larger firms within the sample of financially constrained firms. The alternative of working with a balanced sample would however, as mentioned previously, have introduced the issue of survivorship bias.

A further observation which is somewhat unexpected is the increase in sales growth during the crisis (see table 3). While data on the overall trend of sales growth in Sweden 2020 and 2021 is scarce, data from the retail sector shows an overall positive sales growth over the years which reduces the unexpected result of a positive sales growth (see appendix 6). What is however more expected is the regression results which demonstrate a negative significant relationship between financial distress and sales growth. Thus, while sales growth increased during the crisis, the regression supports that sales growth was a part of alleviating the effect of financially distressed firms.

5.2 Substitution effect

The second aim of the study was to answer the question whether there was a significant substitution effect from bank financing to trade credit received during the crisis. When investigating this question, it is observable that the results point to a significantly present substitution effect, both in terms of short-term debt and long-term debt. Thus, support has been found for both hypothesis 3a and 3b. Nonetheless, the results indicated towards a weakening substitution effect during the crises, which means that support was not found for hypothesis 4.

The results exhibiting the presence of a substitution effect are in line with previous studies stating that bank debt is an important determinant in the use of trade credit (Petersen and Rajan 1997). As mentioned earlier, in table 3 there is an indication towards bank financing and trade credit received potentially being substitutes.

Nonetheless, the findings in this study stand in contrast with other studies which have concluded that trade credit and bank financing could, and should, be seen as both substitutes and complements depending on the situation (Andrieu et al., 2017; Burkart, Ellingsen 2004;

Yazdanfar, Öhman 2017). Furthermore, the distinction which is made by Yazdanfar and Öhman (2017) in terms of short-term debt being a complement and long-term debt being a substitute is not the result that has been found in this study.

As our results reveal the presence of a substitution effect, and so also during the crisis period, it builds on previous studies observing the same phenomenon during the financial crisis in 2008. It can thus be said that this effect has a presence in crises of different nature, with different origins.

Regarding the change in magnitude of the substitution effect during Covid, our results indicate an overall weakening effect, but with some variations. In the fixed effect model, both interaction variables signify a statistically significant weakening effect. However, in the OLS model, although both interaction terms suggest a weakening effect, only the one for long-term debt is statistically significant. The overall results stand in contrast to Burkart and Ellingsen (2004) who observe the substitution effect getting stronger when bank financing is more difficult to obtain, which Covid was for Swedish SMEs (see appendix 2) (Bańkowska et al., 2020). However, it is in line with Bussoli et al., (2018), who concluded that the substitution effect weakens during economic downturns.

In line with Yazdanfar and Öhman (2017), it is found that there is an association between profitability and the use of trade credit received. This observation is in line with the pecking order theory by Myers (1984) as it points to firms unable to generate their financing internally turning to other, external, forms of financing; a phenomenon which also has been confirmed by more recent studies (Niskanen, Niskanen 2006; Petersen, Rajan 1997).

In contrast to Yazdanfar and Öhman (2017), our results suggest that size is negatively associated with trade credit which could be explained by the phenomenon of information asymmetry. Previous studies show that information asymmetry is negatively associated with size (Park et al., 2020; Qu et al., 2018). This in combination with Biais and Gollier (1997) showing that banks have larger information asymmetry than suppliers suggests that larger firms may have less difficulties in obtaining bank financing. For small firms however, the supplier relationship, which mitigates information asymmetry (Biais, Gollier 1997) enables them to get trade credit when bank financing is not possible. Thus, smaller firms are associated with more trade credit in relation to assets.

5.3 Contrasting results

Seemingly, one can observe that our results both in terms of financial distress impact, and the substitution effect are to some part in line with previous studies, but also in large part in contrast to many studies. A possible explanation could be because of the different types of crises being studied. Prior research has mostly looked at the financial crisis in 2008 while this research was applied on a pandemic crisis. This in combination with countries responding in "heterogenous" ways to the pandemic as well as the study being conducted in Sweden as a single country possibly contributes to the contrasting results.

5.4 Robustness tests

In order to ensure the robustness of the results, the regressions are re-run with a modification made to the scaling of the independent variable of interest. Instead of scaling the trade credit measures by assets, they are scaled by sales, which has been found to be suitable as it also can be a measure of size. By doing this, we can check if the relationships still hold with another scaling variable.

For the first part of the study, which investigates the relationship between financial distress and trade credit, the results of the robustness test are presented in appendix 7. What can be noted by the test is that trade credit received, in model 1 and 3, is now positively associated with financial distress. This is the opposite to what was found in the original models. Support for hypothesis 1a can thus not be found in these regressions. The remaining variables exhibit consistent trends as observed in the original models, thereby indicating support for hypothesis 1b and lack of support for hypothesis 2.

As presented in appendix 8, a similar robustness test is also conducted on the models for the substitution effect. Here, the only observable difference between the original models and these models is that the significance of the interaction variable between the crisis dummy and short-term debt in the fixed effects model changes from 5% to 10%. However, this does not change the conclusions already drawn. Consequently, we still find support for hypotheses 3a and 3b, and no support for hypothesis 4.

6. Conclusion, Limitations, and Suggestions for Future Research

Firstly, this research attempts to conclude whether trade credit helped financially constrained companies in Sweden mitigate the negative effects of the recent Covid crisis. Previous research has found that receiving trade credit from one's suppliers reduces financial distress, especially during crises. A similar conclusion for financial distress was found in this study for both trade credit received, and trade credit extended. Nonetheless, no stronger effect during the crisis has been observed from either of the trade credit measures. Furthermore, it has been observed that the net extension of trade credit is negatively associated with financial distress. This is an interesting extension as, to our knowledge, most previous studies have looked at the measures of trade credit separately.

The paper then moves on to investigate if there was a significant substitution effect from bank financing to trade credit received during the crisis. Although being inconclusive with regards to the characteristics of the substitution effect, most studies observe the effect of firms demanding more trade credit in time periods in which bank financing is more limited. What this study observes in Sweden is that receiving trade credit works as a substitute for both short- and long-term bank debt, with a somewhat weakened effect during the Covid crisis. Thus, in line with previous research.

In terms of the relationship between financial distress and trade credit, some caution should be taken as the robustness test reveals somewhat differing results. The main regressions (see table 5) and the robustness test (see appendix 7), do not consistently find that trade credit received is negatively and significantly related to financial distress, suggesting that caution is warranted when interpreting the results and that further research is needed. For the substitution effect however, both the original models and the robustness test models present the same support for the hypotheses.

Like any research, the present study is subject to limitations that could affect suggestions for further research. One of these is our limitation in terms of not observing the post-crisis time period. This would be an interesting extension as the effects of Covid are possibly more long-term than what our time period delimitation allows us to observe. It would also be interesting due to the fact that many other studies, including our benchmark article, have looked at the aftermaths of crises.

Further limitations are the fact that this study does not control for governmental grants which could of course have helped firms which would have been in financial distress without them. With better access to data about this, it would potentially be accurate to include it in the regressions.

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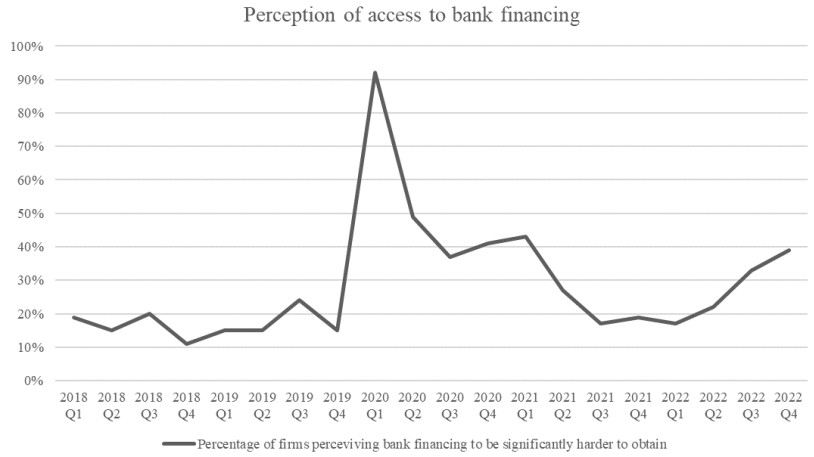
Appendices

Appendix 1

Variables	Description of variables
Variables of interest	
Received	Accounts payable scaled by firm assets
Extended	Accounts receivable scaled by firm assets
Net extended	Accounts receivable minus accounts payable, scaled by assets
STD	Short-term debt to credit institutions
LTD	Long-term debt to credit institutions
Control variables	
Ln(assets)	Size measured as the natural logarithmic of assets
Cash	Amount of cash in hands of firm and deposited in bank, scaled by firm assets
Age	Firm age (number of years since incorporation)
Sales growth	Firm ($sales_t$ – $sales_{t-1}$)/ $sales_{t-1}$
ROA	Return on assets calculated as earnings as interest and tax scaled by assets
Financial distress variables	
WC	Working capital scaled by firm assets
Cash	Amount of cash in hands of firm and deposited in bank, scaled by firm assets
EBIT	Earnings before interest and tax scaled by assets
BVE	Book value of equity scaled by total liability
Sales	Total sales over firm assets
Z-score	Sum((0.717(WC) + 0.847(Cash) + 3.107(EBIT) + 0.42(BVE) + 0.998(Sales))

Appendix 2



Source: Konjunkturinstitutet, 2020

Appendix 3

Industry Sectors	SNI code	Amount	Percentage
Agriculture, forestry and fisheries	01-03	243 069	17.45%
Extraction of petroleum, natural gas, metals and minerals	06-09	895	0.06%
Manufacturing	10-33	56 115	4.03%
Supply of electricity, gas, heating and cooling	35	3 660	0.26%
Water supply, sewage treatment, waste management and sanitation	36-39	2 805	0.20%
Construction activities	41-43	124 326	8.92%
Trade, repair of motor vehicles and motorcycles	45-47	147 286	10.57%
Transport and maganisation	49-53	36 176	2.60%
Hotel and restaurant operations	55-56	38 282	2.75%
Information and communication activities	58-63	75 665	5.43%
Financial and insurance operations	64-66	28 548	2.05%
Real estate business	68	114 535	8.22%
Activities in law, economics, science and technology	69-75	213 233	15.31%
Rentals, property services, travel services and other support services	77-82	50 297	3.61%
Public administration and defence	84	4 354	0.31%
Training	85	45 905	3.30%
Health and social care	86-88	56 958	4.09%
Culture, fun and leisure	90-93	77 451	5.56%
Other service activities	94-96	73 418	5.27%
Acquisition work in households	97-98	10	0.00%
Activities at international organizations	99	96	0.01%
Total		1 393 084	100.00%

The table reports the industry sample composition for the retail sector in Sweden in November 2022. SNI (Standard för Näringsgrensindelning) represents the SNI 2007 classifications which are used to classify units as companies and workplaces based on their economic activities. Industries that are excluded are: SNI codes 64 – 66 as they represent finance and insurance related activities, SNI code 84 as this represents the public sector, and lastly further exclusions of public sector firms in the remaining industries have been made.

Source: Statistics Sweden. (2022a)

Appendix 4

Correlation matrix, unbalanced sample

	Received	Extended	Net extended	Ln(assets)	Cash	Age	Sales growth	Crisis
Received	1.0000							
Extended	0.2941 ***	1.0000						
Net extended	-0.4075 ***	0.7530 ***	1.0000					
Ln(assets)	-0.1033 ***	-0.2111 ***	-0.1305 ***	1.0000				
Cash	-0.2220 ***	-0.1579 ***	0.0020 ***	-0.2880 ***	1.0000			
Age	-0.0081 ***	-0.0767 ***	-0.0677 ***	0.2645 ***	-0.1410 ***	1.0000		
Sales growth	0.0652 ***	0.0740 ***	0.0258 ***	0.0432 ***	-0.0015 ***	-0.1099 ***	1.0000	
Crisis	-0.0384 ***	-0.0623 ***	-0.0330 ***	0.0350 ***	0.0649 ***	-0.0128 ***	0.0197 ***	1.0000

Pearson correlation. The significance levels are denoted as follows: * p < 0.1, ** p < 0.05, *** p < 0.01.

Appendix 5

Correlation matrix, balanced sample

	STD	LTD	ROA	Ln(assets)	Ln(age)	Crisis
STD	1.0000					
LTD	0.0336 ***	1.0000				
ROA	-0.1088 ***	-0.1762 ***	1.0000			
Ln(assets)	-0.1840 ***	-0.0289 ***	-0.0013 ***	1.0000		
Ln(age)	-0.0642 ***	-0.0388 ***	-0.1005 ***	0.2600 ***	1.0000	
Crisis	-0.0233 ***	-0.0504 ***	0.0144 ***	0.0626 ***	0.1173 ***	1.0000

Pearson correlation. The significance levels are denoted as follows: * p < 0.1, ** p < 0.05, *** p < 0.01.

Appendix 6

Source: Statistics Sweden. (2022b)

Appendix 7

Robustness test on financial distress and trade credit

Variables	Financial distress 1	Financial distress 2	Financial distress 3	Financial distress 4	Financial distress 5
Received $_{t-1}$	1.96***		1.91***		
	(0.09)		(0.13)		
Extended $_{t-1}$		-0.78***		-0.86***	
		(0.07)		(0.09)	
Net extended $_{t-1}$					-1.66***
					(0.07)
Ln(assets) $_{t-1}$	0.96***	1.05***	0.96***	1.05***	1.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Cash $_{t-1}$	-5.50***	-5.61***	-5.48***	-5.59***	-5.52***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Sales growth $_{t-1}$	-0.10***	-0.13***	-0.11***	-0.13***	-0.13***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Age $_{t-1}$	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age^2 $_{t-1}$	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Crisis			0.03	-0.01	
			(0.02)	(0.02)	
Crisis*Received $_{t-1}$			0.01		
			(0.17)		
Crisis*Extended $_{t-1}$				0.14	
				(0.12)	
Constant	-14.82***	-15.90***	-14.85***	-15.91***	-15.83***
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Year dummies	Yes	Yes	No	No	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.37	0.37	0.37	0.37	0.37
N	214016	214016	214016	214016	214016

The table reports the logit regressions for the investigation of the relationship between trade credit and financial distress. The dependent variable is financial distress and is binary. It takes on the value 1 if being classified as financially distressed, and 0 otherwise. Received is measured as accounts payable scaled by assets, Extended is measured as accounts receivable scaled by assets and Net extended is measured as accounts receivable minus accounts payable, scaled by assets. Cash is measured by the firms liquid assets as a ratio to total assets. The crisis dummy takes the value 1 if the observation is from the years 2020 or 2021, and 0 otherwise. All explanatory variables are lagged The significance levels are denoted as follows: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard error are reported in parentheses.

Appendix 8

Robustness test on substitution effect

Variables	OLS	With fixed effects
STD	-0.19***	-0.10***
	(0.01)	(0.01)
LTD	-0.06***	-0.03***
	(0.00)	(0.00)
ROA	-0.15***	-0.09***
	(0.00)	(0.00)
Ln(assets)	-0.01***	-0.01***
	(0.00)	(0.00)
Ln(age)	-0.00***	-0.01***
	(0.00)	(0.00)
Crisis	-0.01***	-0.01***
	(0.00)	(0.00)
Crisis*STD	0.02	0.02*
	(0.02)	(0.01)
Crisis*LTD	0.01***	0.00***
	(0.00)	(0.00)
Constant	0.35***	0.22***
	(0.01)	(0.02)
Adjusted R^2	0.20	
R^2		0.10
N	71846	71846

The table reports the robustness test for the investigation of a substitution effect. The dependent variable is trade credit received and is measured as accounts payable scaled by sales. STD and LTD are short- and long-term debt to credit institutions respectively, scaled by assets. ROA is operating income scaled by assets. The crisis dummy takes on the value 1 if the observation is from 2020 or 2021, and 0 otherwise. The significance levels are as follows: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard error are reported in parentheses.