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The real driver of trade credit[†]

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The real driver of trade credit

Abstract

This paper examines the effects of real and financial measures that firms adopt to respond to adverse shocks on trade credit that they owe. We find that a reduction in the quantity of purchases reduces trade credit, while lengthening the period of accounts payable increases it. However, the effect of the former is more economically significant than that of the latter. Our findings suggest that changes in the amount of underlying real transactions are the true driver of trade credit during a crisis period, and the flexible adjustment of trade credit terms might not be an effective means to respond to adverse shocks.

Keywords: Trade credit, real driver, financial driver, terms of trade credit

JEL classification codes: G32, L14

1. Introduction

The aim of this paper is to examine what drives the change in the amount of trade credit during a crisis period. Trade credit is an interfirm credit that is extended when a seller (supplier) allows the buyer (customer) to pay for goods or services *after* delivery. Trade credit is used all over the world (see, e.g., Demirgucüç-Kunt and Maksimovic 2001, Fisman and Love 2003). For firms as buyers, it is an important component of the liability side of their balance sheets and is a crucial component of their working capital (see, e.g., Hill et al. 2010 and Kieschnick et al. 2013).

When firms are hit by adverse shocks, for example, a shock from a financial crisis, they try to respond by taking various measures. Included in these measures are adjustments to the terms of trade credit, such as the postponement of a payment or an increase in the ratio of payments on credit. Ceteris paribus, such adjustments increase the amount of trade credit that firms owe as buyers, which is essentially an increase in borrowing from suppliers. These adjustments are therefore financial measures to cope with the shocks, and we refer to these measures collectively as the *financial driver* of trade credit.

However, firms hit by adverse shocks might also want to use *real* measures, such as changing the terms or volume of their transactions of goods or services by, for example, reducing the amount of purchases or by bargaining the purchase price down. Because trade credit is a means of payment for a real transaction, the volume of trade credit is always constrained by the volume of the underlying real transactions. Thus, the real measures that reduce the payment amount reduce the amount of trade credit, even if there is no change in its terms, or in the financial driver. In this sense, we refer to these real measures as the *real driver* of trade credit.

Although both the financial and real drivers should change the volume of trade credit,

the literature focuses extensively on the former. The main research interest in the literature on trade credit is why suppliers *lend* to their customers regardless that there are financial institutions that specialize in lending. There are many theories to answer this question, and they are collectively called the financial theory of trade credit (see, e.g., Petersen and Rajan 1997 and Giannetti et al. 2011 and the references therein).[1] Based on this theory, some studies examine whether trade credit is a substitute or complement to bank loans (e.g., Danielson and Scott 2004, Bougheas et al. 2009, Atanasova and Wilson 2004, Molina and Preve 2012, and Illueca et al. 2016).[2] The financial theory also argues that firms facing adverse shocks can raise funds through flexibly changing the terms of trade credit; and based on this view, some studies examine the amount or the use of trade credit in the aftermath of financial crises (Love et al., 2007, Casey and O'Toole 2014, and Illueca et al., 2016).

Compared with the extensive focus on the financial driver, the real driver attracts little attention; and to the best of our knowledge, no study has directly examined the questions of whether the real driver matters and which driver has a more quantitatively significant effect – the questions we focus on in this paper. There are good reasons why these questions are

[1] The financial theory predicts, for example, that suppliers have informational advantages over other creditors regarding their buyers' creditworthiness (e.g., Smith 1987, Biais and Gollier 1997, Bond 2004, McMillan and Woodruff 1999, and Johnson et al. 2002); that suppliers have a special ability to dispose of collateral when a buyer goes bankrupt (Longhofer and Santos 2003 and Frank and Maksimovic 2005); or that suppliers can prevent buyers from taking opportunistic behavior (Cuñat 2007, Burkart and Ellingsen 2004).

[2] There are also related studies that examine trade credit in the context of monetary policy transmission (e.g., Gertler and Gilchrist 1993, Marotta 1997, Choi and Kim 2005, and Mateut et al. 2006).

relevant, especially during a crisis period. First, the real driver might be important during a crisis due to the contraction of real transactions. In normal times, the volume of real transactions does not change much or even increases, and so the real driver might not impose significant constraints on the amount of trade credit. However, when the volume significantly shrinks during a crisis, the amount of trade credit might be tightly constrained by the real driver. Thus, the change in the amount of trade credit might not stem from active management of it as a source of financing.

Second, during a crisis period, the financial driver might be less significant due to the inflexibility of the trade credit terms. In business practice, the terms of trade credit are considered to be fixed by industry; and consistent with this view, there is evidence that once the decision to grant credit has been taken, industry fixed effects are the predominant determinants of the terms (Petersen and Rajan 1994). But many studies later report that even after controlling for industry effects, the terms vary depending on the different characteristics of the firms and their suppliers (e.g., Ng et al. 1999, Giannetti et al. 2011, Klapper et al. 2012, and Costello 2014). However, these studies examine cross-sectional or interfirm variations in credit terms and are unclear on whether firms can flexibly change the terms to respond to adverse shocks.[3] Whether changes to the terms are flexible or not is a priori uncertain. For example, firms might want to change the terms of trade credit to ease their borrowing, but suppliers might also suffer from the shocks and might not accept the changes in the terms. Also, the evidence shows that the relative bargaining power between buyers and sellers matters (Fisman and Raturi 2004, Van Horen 2005, 2007, Fabbri and

[3] Two recent studies examine the effect of shortening the maturity of trade credit on real outcomes (Breza and Liberman 2017 and Barrot 2016), but the shortening they examine stems from an exogenous imposition of regulations to restrict long-term trade credit.

Klapper 2008, Dass et al. 2014, Murfin and Njoroge 2015). Suppliers with bargaining power might simply reject the changes that are unfavorable to them.

As the third reason, recent studies find that trade credit might not be uniformly important as a source of financing. A conventional view based on the financial theory emphasizes the importance of trade credit for financially constrained firms, and this view coincides with the so-called redistribution hypothesis (Meltzer 1960). This hypothesis argues that unconstrained suppliers redistribute some of the funds they raise to constrained buyers through trade credit. Although some studies report empirical support for this hypothesis (e.g., Nilsen 2002, Choi and Kim 2005, Mateut et al. 2006, Guariglia and Mateut 2006, Demiroglu et al. 2012, Garcia-Appendini and Montoriol-Garriga, 2013), there is also evidence against the hypothesis (e.g., Gertler and Gilchrist 1993, Marotta 1997, Deutsche Bundesbank 2012, and Kestens et al. 2012). Furthermore, a growing body of literature finds that even large and creditworthy buyers use trade credit for purposes other than financing (e.g., Klapper et al. 2012, Breza and Liberman 2017, Murfin and Njoroge 2015).

Based on this background, this paper sheds light on the question of the importance of the real driver of trade credit in a shock period as compared with the financial driver. After formalizing these ideas in a simple modeling framework and explaining the difference between our analysis and existing studies on trade credit, this paper empirically examines the economic significance of the two drivers. Our empirical analysis uses data on firms during the 2008–2009 Global Financial Crisis that we obtain from a corporate survey in Japan and from their corresponding financial statements. The uniqueness of our data is its detailed information. First, the survey directly asks firms whether they use different real

and/or financial measures to cope with the so-called Lehman shock of September 2008.[4] Also, we have information from their balance sheets on the amount of trade credit that the firms owe to their suppliers.

The empirical approach in this paper is to take advantage of the fact that the two drivers could manifest themselves distinctly during a crisis period. To the extent that the financial driver is quantitatively important, the use of the financial measures should increase the amount of trade credit. However, if firms use the real measures, the amount should decrease. Taking advantage of a unique observation period when the two drivers could manifest themselves distinctly, we regress the year-over-year changes in the amount of trade debt on the indicators of these real and financial measures and compare the economic significance of their effects.

We also check the robustness of our findings by taking into account a possible endogeneity problem. Our baseline analysis focuses on the effect of the real and the financial measures once the firms adopt them. But as the studies on the determinants of trade credit argue (e.g., Petersen and Rajan 1997 and Giannetti et al. 2011), whether or not firms adopt the measures might depend on different factors: both the firms' (demand) and their suppliers' (supply). To the extent that the adoptions of the measures depend on these factors and are not randomly assigned, our analysis suffers from an endogeneity problem. Although our baseline regression alleviates this problem by controlling for time-invariant firm fixed effects, we additionally conduct a two-stage analysis to control for any remaining problem;

[4] The failure (collapse) of Lehman Brothers was a landmark event for the Japanese economy because in Japan, adverse shocks from the crisis were transmitted from abroad and the contraction in the economy began after this failure. Thus, in Japan, the shocks from the Global Financial Crisis are collectively called the "Lehman Shock."

in its first stage, we use instrumental variables and explicitly take into account the determinants of the adoption of the real and the financial measures.

From our empirical analysis, we find that both the real and the financial measures have the anticipated effects. For the firms that reduce the quantity of purchases to respond to the shock (a real measure), we find that the amount of trade credit decreases in an economically significant manner. Also, for the firms that lengthen the period of accounts payable (a financial measure), we find that the amount of trade credit increases. However, the result for the financial driver is not very robust, and the effect is economically small because only 1 percent of our sample firms use this financial measure. In contrast, the result for the real driver is robust, and the effect is economically significant due to a large number of firms that use this real measure. A further analysis from a lenders' perspective, where we focus on trade receivables rather than trade payables, also show similar results. On balance, although we find evidence for the financial driver, it works at most for a limited number of firms, and the real measure has a more significant effect. Our findings suggest that the real driver is the *real* (true) driver of the change in the amount of trade credit for many firms, at least during the crisis period.

The main contribution of this paper is to compare the economic significance of the real and the financial drivers of trade credit. Our findings of the effects of the real and the financial measures on the amount of trade credit might be unsurprising per se, because they individually represent a simple mechanical relationship behind a change in the amount of trade credit. However, actual quantification of these effects is empirically difficult, because usually we cannot observe what measures are actually taken. Using the unique data on such measures, we can separately quantify the effects of the two drivers and find that the real driver is more economically significant. This finding is important, because inconsistent with

the financial theory of trade credit, the finding means that the change in the amount of trade credit does not stem from the active management of borrowing from suppliers by flexibly adjusting the terms of trade credit.[5]

Another contribution of this paper is to sort out the relevance of various empirical metrics of trade credit. In addition to the gross amount of trade credit, prior studies use various metrics, such as the amount divided by the cost of goods sold or total assets, or terms of trade credit. The simple framework shown in section 2 tells us that the underlying driving factors might differ across metrics; and without considering these differences, a mismatch could arise between the metrics used and the theories tested. For example, the studies on the substitutability or complementarity between trade credit and bank loans conventionally examine the correlation between their amounts (e.g., Danielson and Scott 2004, Bougheas et al. 2009, Atanasova and Wilson 2004, and Molina and Preve 2012); but to the extent that the amount of trade credit is driven by the real driver, a finding of a statistical correlation does not indicate firms' active management of the two financing sources. Illueca et al. (2016) already express a concern for the conventional approach in these studies by pointing out significant differences in characteristics of trade credit and bank loans. Our paper points out another source of difference – the effect of the real driver on trade credit.[6]

Finally, this paper is closely related to the studies on the effect of the financial crisis on

[5] Note that because we are interested in the quantification of the real and financial drives, our baseline analysis does not focus on identification of the demand and supply factors as determinants of trade credit (see subsection 2.2.1). However, we do take into account these factors in the additional analysis that addresses endogeneity concerns.

[6] Yet another important concern for the conventional approach is an endogeneity problem due to a simultaneous determination of trade credit and bank loans (see Illueca et al. 2016).

trade credit. Love et al. (2007) find that the amount of trade payables (or receivables) scaled by the cost of goods sold (or sales) increases immediately after the crisis but collapses afterwards. Casey and O'Toole (2014) find that during the recent financial crisis, the probability of using or applying for trade credit is higher if the firms have already applied for bank loans and the bank has rejected them. Carbó-Valverde et al. (2016) find that when firms are financially constrained, their investment is sensitive to the change in the ratio of trade credit to total debt, and this sensitivity increases during the financial crisis. These studies are all based on the financial theory of trade credit and are consistent with our findings on the financial drivers. However, our findings show that the effect of the real driver might also be non-negligible, or even more significant for a larger number of firms. Illueca et al. (2016) allow for interfirm heterogeneity in the substitutability of trade credit with bank loans and find that the substitutability diminishes during the financial crisis. Our findings indicate the possibility that this diminishment might stem from the increased importance of the real driver of trade credit.

The reminder of this paper proceeds as follows. Section 2 establishes a modeling framework to explain what we empirically examine and to sort out how different factors drive different metrics of trade credit. In section 3, we introduce our data, and explain the methodology and the variables. Section 4 reports the results. In section 5, we check the robustness of the results to controlling for endogeneity, and we conduct the analysis from a lenders' perspective in section 6. The final section concludes the paper.

2. A modeling framework

2.1 Real measures, financial measures, and the amount of trade credit

In this section, we construct a simple modeling framework to demonstrate how a firm's

amount of trade credit changes due to the financial and real drivers. The aim of providing this framework is to formally define the two drivers and to explain how different empirical metrics of trade credit change due to different factors.

Let us denote the amount of trade credit that firm i owes supplier j during month t (in the flow term) as td_{ijt}. By definition, we can decompose this amount as:

$$td_{ijt} = \alpha_{ijt} \cdot p_{ijt} \cdot q_{ijt},$$

where p_{ijt} and q_{ijt} are respectively the purchase price and quantity, and α_{ijt} is the ratio of purchases made on credit between firm i and supplier j during month t. Also, we denote the amount of trade credit that firm i owes supplier j at the end of month t (in the stock term) by STD_{ijt}, then we can express this amount as:

$$\begin{aligned} STD_{ijt} &= \sum_{s=0}^{\infty} \beta_{ijt,t-s} \cdot td_{ijt-s} \\ &= \sum_{s=0}^{\infty} \beta_{ijt,t-s} \cdot \alpha_{ijt-s} \cdot p_{ijt-s} \cdot q_{ijt-s} \end{aligned}$$

where $\beta_{ijt,t-s}$ is the ratio of td_{ijt-s} that firm i still owes supplier j at the end of month t. For example, if the duration of the trade credit between firm i and supplier j is one month, then $\beta_{i1t,t} = \beta_{i1t,t-1} = 1$ and $\beta_{i1t,t-s} = 0$ for $s \geq 2$, and so $STD_{i1t} = td_{i1t} + td_{i1t-1}$. Also, if the duration is less than one month, then $\beta_{i1t,t} = 1$ and $\beta_{i1t,t-s} = 0$ for $s \geq 1$, and thus $STD_{i1t} = td_{i1t}$. Further, if the total amount that the firm owes all its suppliers ($j = 1, \dots, J$) at the end of month t (in the stock term) is STD_{it}, then:

$$\begin{aligned} STD_{it} &\equiv \sum_{j=1}^{J} STD_{ijt} \\ &= \sum_{j=1}^{J} \sum_{s=0}^{\infty} \beta_{ijt,t-s} \cdot \alpha_{ijt-s} \cdot p_{ijt-s} \cdot q_{ijt-s} \end{aligned} \quad (1)$$

Using this equation, we can express how changes in the terms of real transactions and of trade credit affect the amount of trade credit that firms owe. First, if the quantity of purchases (q_{ijt}) and/or the price of purchased goods (p_{ijt}) decrease, td_{ijt} decreases, and so

does STD_{it}. This decrease means that, if firms use real measures such as a reduction in purchase quantity or price to respond to adverse shocks, then *ceteris paribus* the amount of trade credit decreases. In this sense, we call these real measures the real driver of trade credit.

Second, if the ratio of the amount of payments paid on account (α_{ijt}) increases, td_{ijt} increases and so does STD_{it} increases. If the duration of trade credit is lengthened (i.e., $\beta_{ijt,t-i}$ increases), then STD_{it} increases. Thus, if firms use these financial measures, then *ceteris paribus* the amount of trade credit increases. In this sense, we call these financial measures the financial driver of trade credit.

Based on these considerations, we can make the following predictions, which are to be empirically tested:

(A) A decrease in the quantity of purchases decreases the amount of trade credit.
(B) A decrease in the price of purchase goods decreases the amount of trade credit.
(C) An increase in the ratio of payments paid on account increases the amount of trade credit.
(D) The lengthening of the duration of trade credit increases the amount of trade credit.

We can formulate these predictions more formally by rewriting equation (1) as:

$$STD_{it} = STD_{it}(\boldsymbol{\alpha}_{it}, \boldsymbol{\beta}_{it}, \boldsymbol{p}_{it}, \boldsymbol{q}_{it}) \quad (1')$$

where $\boldsymbol{\alpha}_{it}, \boldsymbol{\beta}_{it}, \boldsymbol{p}_{it}$, and $\boldsymbol{q}_{it}$ are vectors of parameters α, β, p, and q respectively on the right-hand side of equation (1). By denoting the changes in the terms of underlying transactions ($\boldsymbol{p}_{it}$ and $\boldsymbol{q}_{it}$) as $\Delta\boldsymbol{p}_{it}$ and $\Delta\boldsymbol{q}_{it}$, and the changes in the terms of trade credit ($\boldsymbol{\alpha}_{it}$ and $\boldsymbol{\beta}_{it}$) as $\Delta\boldsymbol{\alpha}_{it}$ and $\Delta\boldsymbol{\beta}_{it}$, equation (1') indicates that the changes cause the change in the amount of trade credit, which we express as:

$$\Delta STD_{it} = \Delta STD_{it}(\Delta\boldsymbol{\alpha}_{it}, \Delta\boldsymbol{\beta}_{it}, \Delta\boldsymbol{p}_{it}, \Delta\boldsymbol{q}_{it}) \quad (2)$$

In this paper, we estimate this equation and compare the effects of the real drivers

($\Delta STD_{it}/\Delta \boldsymbol{p}_{it}$ or $\Delta STD_{it}/\Delta \boldsymbol{q}_{it}$) and those of the financial drivers ($\Delta STD_{it}/\Delta \boldsymbol{\alpha}_{it}$ or $\Delta STD_{it}/\Delta \boldsymbol{\beta}_{it}$).

2.2 Comparison with existing approaches

2.2.1 *Approach focusing on amount of trade credit on balance sheet*

Our estimation of equation (2) differs from the analyses in other studies. A typical empirical approach is to estimate an equation like this one by using balance sheet data:

$$Amount\ of\ Trade\ Credit = f(X), \tag{3}$$

where X is a vector of independent variables. The amount of accounts payable is most typically used as $Amount\ of\ Trade\ Credit$.[7]

In the studies on why trade credit is used as a source of financing (e.g., Petersen and Rajan 1997 and Giannetti et al. 2011 and the references therein), X includes proxies for the determinants of trade credit that are selected based on the financial theory of trade credit. In the studies on the substitutability or complementarity between trade credit and bank loans (e.g., Danielson and Scott 2004, Bougheas et al. 2009, Atanasova and Wilson 2004, Molina and Preve 2012, and Illueca et al. 2016), X includes the amount of bank loans. In the studies on the effect of a crisis on trade credit (e.g., Love et al., 2007 and Casey and O'Toole 2014), X includes an indicator for adverse shocks that firms suffer from the crisis.

Because these studies are based on theories about the financial driver (or the financial

[7] Some studies examine the determinants of whether trade credit is used or not (e.g., Casey and O'Toole 2014). In these studies, the dependent variable is the probability that $Amount\ of\ Trade\ Credit > 0$.

theory), any effects of X on *Amount of Trade Credit* take place through $\boldsymbol{\alpha}_{it}$ or $\boldsymbol{\beta}_{it}$.[8] In other words, these studies implicitly assume that equation (3) is theoretically equivalent to:

$$STD_{it} = STD_{it}(\boldsymbol{\alpha}_{it}(X), \boldsymbol{\beta}_{it}(X), \boldsymbol{p}_{it}, \boldsymbol{q}_{it}). \quad (4)$$

A comparison between equations (3) or (4) and (2) highlights the differences between our examination and those in the literature. First, most studies focus on the cross-sectional or interfirm difference in the amount of trade credit, while we focus on the change in the amount of trade credit. Focusing on changes enables us to control for time-invariant firm fixed effects. Second, and more importantly, these studies are interested in the determinants of trade credit, that is, the effect of demand (firms') and supply (suppliers') factors that are indicated by X (through $\boldsymbol{\alpha}_{it}$ or $\boldsymbol{\beta}_{it}$), but we are interested in a quantitative comparison of the effects of the real and financial drivers, that is, the effects of the measures $\Delta\boldsymbol{\alpha}_{it}$ and $\Delta\boldsymbol{\beta}_{it}$ and of $\Delta\boldsymbol{p}_{it}$ and $\Delta\boldsymbol{q}_{it}$, once they are taken.[9]

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[8] It is worthwhile to note that there is a so-called transaction-based theory of trade credit, which explains the use of trade credit for non-financing purposes (see Petersen and Rajan 1997). In this theory, trade credit is used to reduce transaction costs when making multiple payments, especially those stemming from seasonal or uncertain transactions (e.g., Ferris 1981); to reduce the costs of inventory holding (e.g., Emery 1987, Bougheas et al. 2009, and Daripa and Nilsen 2011); to guarantee product quality (e.g., Emery and Nayar 1998); and to enable price discrimination (e.g., Schwartz and Whitcomb 1979, and Brennan et al. 1998). In the terminology used in this paper, the effect of these factors are not classified as the real driver in the sense that they all are related to changes in the terms of trade credit and not to changes in the underlying real transactions.

[9] We will consider the determination of the measures (i.e., the effects of X on $\Delta\boldsymbol{\alpha}_{it}$, $\Delta\boldsymbol{\beta}_{it}$, $\Delta\boldsymbol{p}_{it}$ and $\Delta\boldsymbol{q}_{it}$) in section 5.

Equation (4) also indicates possible shortcomings in these studies. First, to correctly identify the effect of the determinant (X) on *Amount of Trade Credit*, we need appropriate controls for $\boldsymbol{p}_{it}$ and $\boldsymbol{q}_{it}$, or for the real driver, when estimating equation (4). Second, and more importantly, we cannot rule out the possibility that in practice, $\boldsymbol{p}_{it}$ and $\boldsymbol{q}_{it}$ also depend on variables in the vector X. Unless these two concerns are appropriately addressed, the estimation of equation (4) produces biased results and does not adequately report the true effects of the financial theory.

2.2.2 *Approach using standardization*

The concerns for identification are less severe in some studies that use the standardized amount of trade credit as a dependent variable. Many studies (e.g., Petersen and Rajan 1997, Love et al., 2007, Giannetti et al. 2011, and Shenoy and Williams 2011) divide the left-hand side of equation (3) by cost of goods sold and estimate an equation like:

$$\frac{Amount\ of\ Trade\ Credit}{Cost\ of\ Goods\ Sold} = f^*(X), \qquad (3')$$

If we multiply this dependent variable by 365 (days), we obtain a financial indicator that in practice is often called days in payables (days (of) purchases outstanding, days (of) payables outstanding) that captures the effective length of a payment period.[10]

Because the cost of goods sold is a proxy for the amount of purchases, equation (3') is

[10] Different from other studies, Nilsen (2002) divides accounts payable by sales, not the cost of goods sold, in his VAR model to study the trade credit and the bank lending channels of monetary policy. Nilsen (2002) is also unique in stating that this standardization is to control for "the transactions motive ... since we expect a sales reduction at the onset of tight money to induce a reduction in AP" (p. 232). In this sense, Nilsen (2002) recognizes the importance of eliminating the effect of the real driver when examining the financial driver, although he does not compare the magnitude of the two.

theoretically equivalent to:

$$\begin{aligned} STD_{it}/(\boldsymbol{pq}_{it}) &= STD(\boldsymbol{\alpha}_{it}(X), \boldsymbol{\beta}_{it}(X), \boldsymbol{p}_{it}, \boldsymbol{q}_{it})/(\boldsymbol{pq}_{it}), \\ &\equiv g(\boldsymbol{\alpha}_{it}(X), \boldsymbol{\beta}_{it}(X), \boldsymbol{p}_{it}, \boldsymbol{q}_{it}), \end{aligned}$$

where $\boldsymbol{pq}_{it} \equiv \sum_{j=1}^{J} \sum_{s=0}^{\infty} td_{ijt-s} = \sum_{j=1}^{J} \sum_{s=0}^{\infty} p_{ijt-s} \cdot q_{ijt-s}$ is the amount that the firm purchases in our formulation. If the function $g(\cdot)$ is linear in $\boldsymbol{pq}_{it}$, that is, if it can be rewritten as $g = h(\boldsymbol{\alpha}_{it}(X), \boldsymbol{\beta}_{it}(X)) \cdot \boldsymbol{pq}_{it}$ and so $STD_{it}/(\boldsymbol{pq}_{it}) = h(\boldsymbol{\alpha}_{it}(X), \boldsymbol{\beta}_{it}(X))$, then the effects of X, if any, are only those through $\boldsymbol{\alpha}_{it}$ or $\boldsymbol{\beta}_{it}$, or the effect of the financial driver. However, the linearity is not generally guaranteed in practice because of the significant heterogeneity in the terms of underlying transactions and those of credit, and the multiplicity of suppliers. Thus, whether the effect of the financial driver is appropriately identified in these studies is still unclear.[11]

2.2.3 Approach using more granular data

Some more recent studies use detailed information at the firm-supplier level (e.g., McMillan and Woodruff 1999 and Johnson et al. 2002), or at the transaction level (e.g., Klapper et al. 2012). The identification of the financial driver is less problematic in these studies. For example, the amount of trade credit standardized at the firm-supplier level ($STD_{ijt}/\boldsymbol{pq}_{ijt}$) more precisely captures the effective length of the credit period by eliminating the effect of X through $\boldsymbol{p}_{ijt}$ or $\boldsymbol{q}_{ijt}$. Furthermore, if the terms are observed, a direct estimation of the functions $\boldsymbol{\alpha}_{it} = \boldsymbol{\alpha}_{it}(X)$ and $\boldsymbol{\beta}_{it} = \boldsymbol{\beta}_{it}(X)$ is also possible. However, the

[11] Note also that whether the standardization is to identify the financial driver or to control for size effects is often unclear. In some studies, the standardization is conducted by dividing the *Amount of Trade Credit* by total assets or total debt. The identification concern is more severe in such studies.

precise identification of the effect of the financial driver in this approach comes at the expense of an elimination of the effect of the real driver, and this approach is appropriate only for examining the financial driver.

3. Data and methodology

3.1 Data source

The main data source for this paper is a corporate survey conducted in Japan in February 2009 by the Research Institute of Economy, Trade, and Industry (RIETI). The survey was called the *Survey on the Status of Transactions between Businesses and Financial Institutions following the Financial Crisis* (hereafter the RIETI 2009 survey).[12] This survey aims to capture the status of firms' financing during the recession after the global financial crisis.

The failure of Lehman Brothers on September 2008 was a landmark event for the Japanese economy, because it started the transmission of the effect of the financial crisis in the United States and Europe to Japan. Thus, the survey asks questions about the measures that firms use to cope with the exogenous shocks that followed September 2008. The survey separately asks about the measures that firms used for suppliers, customers, and banks. We focus on measures for suppliers.

The survey was outsourced to Tokyo Shoko Research inc. (TSR), which is one of the largest credit bureaus in Japan. The financial statements of many responding firms are also available from the TSR's database. We use the statements for 2008 and 2009.

[12] Uesugi et al. (2009) report the summary statistics and include the survey questionnaire.

3.2 Sample selection

The RIETI 2009 survey is a follow-up to a similar survey conducted in February 2008 before Lehman's failure (the RIETI 2008 survey), so the sample firms for the 2009 survey were chosen from the firms that were surveyed in 2008. The original 2008 survey targeted 17,018 firms that were chosen from the firms that had responded to past government surveys compiled by the Small and Medium Enterprise Agency of the Government of Japan. The number of responding firms to the 2008 survey was 6,124 (response rate of 36%), which was the initial target of the RIETI 2009 survey. However, at the time of the 2009 survey, some firms had already exited the market due, for example, to bankruptcy. Thus, the actual target of the 2009 survey was revised downward to 5,979 firms. The number of respondents to the 2009 survey was 4,103 (response rate of 68.6%). However, eight firms did not provide usable answers to the questionnaire, so our starting point was 4,095 firms.

From these 4,095 firms, we first eliminate 635 firms whose financial statement information is not available for either 2008 or 2009, or whose accounting period is not 12 months. We further eliminate 1,454 firms that fall under any of the following categories: (i) firms that answered that their primary supplier had changed between 2008 and 2009; (2) those that did not answer any of the questions about the measures used for their primary suppliers to respond to the recession; (3) those for which any of the control variables used for the analysis below were not available, or (4) those whose accounting year did not start sometime between March and September. The first criterion is to eliminate any effect of supplier changes on the amount of trade credit, but the number of observations eliminated due to this criterion is small (124 firms). The final criterion focuses on the change in the volume of trade credit due to the firms' measures adopted after September 2008 (the Lehman shock) and before February 2009 (when the survey was conducted)

As a result of this selection process, our sample for the baseline analysis consists of 2,006 firms, although the number of observations is smaller in the regression analyses due to the non-availability of the dependent variables or the main independent variables.

Table 1 compares the characteristics of the firms in our baseline sample (2,006 firms), with those in the original sample (4,095 firms), and those of the firms in the 2009 Economic Census (Ministry of Internal Affairs and Communications of the Government of Japan) that represent the universe of firms in Japan. In terms of the number of employees (Panel (A)), the firms in the baseline sample are slightly larger than those in the original sample. As compared with the Economic Census, we have more large firms because smaller firms dominate the Economic Census. In terms of the industry composition (Panel (B)), the firms in the baseline sample and the original sample include a slightly larger number of firms in the Construction, Manufacturing, and Wholesales industries, and a slightly smaller number of firms in the Retail and Real estate industries.

3.3 Regression and dependent variable

The empirical counterpart of equation (1') in subsection 2.1 is:

$$Trade\ \ credit_{it} = b_0 + b_1 \cdot Terms_{it} + b_2 \cdot X_{it} + b_3 \cdot \varphi_i + \varepsilon_{it}, \tag{5}$$

where $Trade\ \ credit_i$ is the amount of trade credit that firm i (= 1, ... , N) owes in year t, $Terms_i$ is a vector the terms of the underlying transactions of goods or services ($\boldsymbol{p}_{it}$ and $\boldsymbol{q}_{it}$ in equation (1')) and of trade credit ($\boldsymbol{\alpha}_{it}$ and $\boldsymbol{\beta}_{it}$), X_i is a vector of other determinants of the amount of trade credit, and φ_i is observable and unobservable time-invariant firm fixed effects.

By taking a year-over-year difference of equation (5), we obtain the following regression that we estimate as:

$$\Delta Trade\ \ credit_i = b_0 + b_1 \cdot \Delta Terms_i + b_2 \cdot \Delta X_i + \epsilon_i, \tag{6}$$

where $\Delta Trade\ credit_i$ is the change in the amount of trade credit for firm i, $\Delta Terms_i$ is a vector of the changes in the terms of the underlying transactions of goods or services ($\Delta \boldsymbol{p}_{it}$ and $\Delta \boldsymbol{q}_{it}$ in equation (2)) and trade credit ($\Delta \boldsymbol{\alpha}_{it}$ and $\Delta \boldsymbol{\beta}_{it}$), and ΔX_i is the change in other determinants. This equation is a linear version of equation (2) in subsection 2.1. In estimating this equation, we do not have to control for time-invariant firm fixed effects (φ_i) because they disappear when taking a year-over-year difference.

The variables we actually use as $\Delta Trade\ credit_i$, $\Delta Terms_i$ and ΔX_i are defined in Tables 2 (Panel A) and 3, together with their summary statistics. As our dependent variable $\Delta Trade\ credit_i$, we use DTP, the change in the amount of trade credit that the sample firms owe their suppliers from 2008 to 2009.[13] We measure the amount of trade credit by the amount of trade payables, which is the sum of accounts payable and promissory bills payable on the firms' balance sheets, the two most commonly used types of trade credit in Japan.[14] The time frame of 2008 to 2009 captures the effects of the measures used to respond to the crisis after the Lehman's collapse in September 2008.

Because equation (6) is an empirical counterpart of equation (2) in section 2.1, we do not

[13] The estimation results are qualitatively unchanged even if we use ln(DTP) or Dln(TP) (= ln(TP2009/TP2008)) as a dependent variable. We focus on the results that use DTP to keep consistency with the theoretical model (equation (2)).

[14] Accounts payable are payments by bank transfer (wire transfer) or checks, while promissory bills payable are payments by issuing paper-based promissory bills ("tegata" in Japanese) that promise payment at a future date. See Appendix A for more information on these two types of credit payments in Japan. Appendix A also reports the results when we separately analyze accounts payable and promissory bills payable.

standardize this variable by asset or cost of goods sold, for example, because doing so makes it hard to interpret the results (see section 2.2.2).[15] However, there might be some size-related differences in the results, so we also report the results when we split the sample by firm size.[16]

Panel (A) of Table 2 reports the descriptive statistics for the dependent variable. More than half of the firms decrease their amount of trade credit in the period from 2008 to 2009. Although this is a univariate result, it is consistent with the view that shrinking real transactions reduce trade credit (real driver). However, there are also firms that increase the amount, which is consistent with a view that firms use financial measures to respond to adverse shocks (financial driver).

3.4 Independent variables

3.4.1 Measures to cope with adverse shock

For our main independent variables $\Delta Terms_i$, we use dummy variables to indicate real and financial measures used by the responding firms. The RIETI 2009 survey has a question on how firms respond to the global financial crisis and the subsequent recession, which reads: "How did you respond to the financial crisis and the recession? From the list below, choose all the descriptions that explain measures you actually took after September 2008." Responding firms are provided with seven options to choose from, regarding the measures

[15] The main results are qualitatively unchanged even if we normalize the dependent variable by subtracting the cross-sectional industry mean and divide by the within-industry standard deviation.

[16] We exclude outliers by eliminating those sample firms whose DTP is less than its 1st percentile or more than its 99th percentile. The main results are qualitatively unchanged even if we take the natural logarithm of DTP to take into account a nonlinear effect.

used for suppliers (multiple answers allowed):

1. Reduced the quantity of purchases
2. Decreased the price of goods to be purchased
3. Lengthened the duration of accounts payable
4. Lengthened the duration of promissory bills payable
5. Increased the ratio of the amount of payments by accounts payable or promissory bills to the total amount of payments
6. Explained to suppliers the difficulty of your company's situation
7. Did not take any particular measure

For this question, the measures used for primary suppliers and those used for the other (non-primary) suppliers are asked separately.[17] The primary supplier is defined as the supplier(s) from which the firm purchases the most. The question is limited to purchases of products or goods, while the purchases of services or commission sales are excluded in advance.

Among the seven options, we focus on the first five because they are relevant to our investigation. First, options 1 and 2 are the real measures that directly change the quantity or price of real transactions, and correspond respectively to $\Delta \boldsymbol{q}_{it}$ and $\Delta \boldsymbol{p}_{it}$ in equation (2). Second, options 3-5 are the financial measures that change (ease) the terms of trade credit. Options 3 and 4 correspond to $\Delta \boldsymbol{\beta}_{it}$ in equation (2), and option 5 corresponds to $\Delta \boldsymbol{\alpha}_{it}$.

We create five dummy variables. AS_Red_Q takes the value of unity if option 1 is chosen for any (either primary or other, or both) supplier, and zero otherwise. The other four

[17] Although the survey makes this distinction, we do not have data on the amount of trade credit for each type of supplier.

dummies, AS_Dec_P, Length_AP, Length_BP, and Inc_TPratio, are similarly defined with respect to options 2-5. We also create dummy variables PS_Red_Q through PS_Inc_TPratio in a similar manner using the answers for the primary suppliers. Furthermore, we create dummy variables OS_Red_Q through OS_Inc_TPratio in a similar manner using the answers for the other suppliers.

We expect that the dummies for the real measures (Red_Q and Dec_P dummies) will have a negative effect on the amount of trade credit. If a buyer responds to the recession by using real measures, then the amount of purchases will decrease, and thus the maximum amount of trade credit that the buyer can obtain from its suppliers will decrease. Thus, to the extent that this constraint is binding and the real driver is significant, the coefficients for these dummies will be negative. However, the coefficients might be insignificant because the constraint might not be binding for a variety of reasons. For example, when the amount of purchases decreases, firms might only reduce the amount of outright (i.e., non-credit) payment and not the amount of credit payment. Also, even if they are statistically significant, the magnitude of the effects of the real measures might be economically small.

We also expect that the dummies for the financial measures (Length_AP, Length_BP, Inc_TPratio) will have positive coefficients, because they capture the financial driver of trade credit. These dummies represent the financial measures to postpone credit payments or to increase payments on account and so directly increase the amount of trade credit. However, to the extent that the magnitudes of the financial measures are economically small, we might find that these dummies are insignificant. This insignificance might be the case, for example, if the postponement of the payment is only a few days out of a much longer duration.

3.4.2 *Univariate analysis on the measures*

In Table 3, we report the descriptive statistics for the dummies for the real and the financial measures. We show the total number of observations and the numbers of observations for which the relevant dummy equals one and zero. Column (1) has all the sample firms, and columns (2) and (3) are for the small and the large firms when we divide the sample based on their median assets.

Regardless of which suppliers we focus on, column (1) shows that the real measures are far more frequently used than the financial ones. Almost more than a quarter of the responding firms answer that they "2. Decreased the price of purchase goods" to cope with the recession, and the next most frequently used measure is the first measure, "1. Reduced the quantity of purchases." Compared with these, the financial measures (i.e., those labeled Length_AP, Length_BP, and Inc_TPratio) are less frequently used. These findings indicate that the effect of the real driver is significant, although we have not yet established that these measures actually reduce the firms' total amount of trade credit.

It should be noted that if firms want to cope with the shock financially, they might also use *banks* rather than suppliers. We can check this possibility because the RIETI 2009 survey also asks whether the firms use measures for banks, when it asks how firms respond to the financial crisis and the recession. The survey results show that among our sample firms, 30.8% of them answered that they "borrowed money from their top lending bank" to cope with the adverse shock. This result suggests that firms rely on banks rather than suppliers when they want to respond to adverse shocks financially. It also suggests that the role of trade credit as a means of financing is of secondary importance to its role as a means

of payment, at least during the recession.[18]

To further examine the roles of banks and suppliers, in Table 4 we report a correlation matrix of the dummies for top lending banks and those for primary suppliers. In this table, B_Borrow is a dummy that indicates the firm borrowed money from its top lending bank to cope with the shock, and B_Postpone is a dummy that indicates the firm postponed repayment to the top lending bank. We find that the two dummies are positively associated with the financial measures used for some suppliers. This association might indicate that borrowing from main banks and using trade credit from primary suppliers are complementary activities. However, because the two dummies also have a positive correlation with the real measures used for primary suppliers, these findings might simply mean that firms try to use as many measures as possible to cope with an adverse shock.

3.4.3 Control variables

In estimating equation (6), we also use some control variables, which are shown in column (B) of Table 2. Although the real and the financial measures directly capture changes in the terms of the underlying transactions and of the trade credit to cope with adverse shocks, the changes might also stem from reasons other than responses to the shocks. For example, *ceteris paribus*, growing firms might increase the quantity of purchases ($\Delta \boldsymbol{q}_{it} > 0$ in equation (2)) regardless of whether they use measures to cope with adverse shocks. Thus, $\Delta Terms_i$ (or $\Delta \boldsymbol{\alpha}_{it}$, $\Delta \boldsymbol{\beta}_{it}$, $\Delta \boldsymbol{p}_{it}$, and $\Delta \boldsymbol{q}_{it}$ in equation (2)) can be decomposed into the changes due to the measures ($\Delta Terms_i^m$) and other changes ($\Delta Terms_i^o$), and we need to

[18] There is another option that responding firms can choose as a financial measure for top lending banks: "postponing repayment to their top lending bank." However, only 2.8% of the sample firms make this choice.

control for the latter. Because we do not directly observe variables in the vector $\Delta Terms_i^o$, we use proxies as control variables.[19]

Because the variables in the vector $\Delta Terms_i^o$ are year-over-year differences, we do not need control variables that are time-invariant, or time-invariant firm fixed effects. We thus add control variables whose year-over-year differences might affect our dependent variables. We use the year-over-year change in total assets (DAsset) and the change in the firm's leverage (DLeverage).[20] We also use the change in the TSR score of the firm (DScore), and the change in the ROA (DROA = difference in Operating income/Assets).[21] The descriptive statistics for these variables are in column (B) of Table 2. Also, the effect of the adverse shocks following Lehman's failure might differ depending on when the accounting year of the firms starts. We thus add accounting month dummies to control for such differences.

Because less than 1 percent of the responding firms change their industry during the period in which we measure the change in the amount of trade credit, most of the time-invariant industry effects are absorbed in the firm fixed effects. However, to control for any

[19] Note that the main results are qualitatively unchanged even if we do not use these variables. We can thus rule out the possibility that these control variables partly capture the effect of the measures and weaken their effects.

[20] Because we find extraordinary values in DAsset for some firms, we eliminate the sample firms if DAsset is less than its 1st percentile or more than the 99th percentile.

[21] The TSR score is TSR's own evaluation of the responding firms. The firms' suppliers, customers, or other stakeholders can purchase and use this evaluation for their own credit risk management for example. It takes a value between 0 and 100, with 50 being an average firm. The evaluation is based on four criteria: the ability of managers (20%), growth (25%), stability (45%), and disclosure and general reputation (20%).

remaining industry effects, especially time-variant ones, we use three industry dummies (Construction, Manufacturing, and Wholesale and Retail). Also, we do not use variables for the primary suppliers. This is because we have already selected firms without changes in their primary suppliers. For the other suppliers, we have no information to identify the change.

4. Results

4.1 Baseline results

Table 5 presents our main results. The dependent variable is DTP (the change in the amount of trade payables), and the main independent variables are the indicators for the real and the financial measures. Columns (1), (2), and (3) respectively report the results when we focus on the dummies for any supplier (AS dummies), for the primary supplier (PS dummies), and for the other suppliers (OS dummies).

Focusing on the variables of primary interest, we consistently find that AS_Red_Q, OS_Red_Q, or AS_Red_Q has a negative and statistically significant effect on the amount of trade credit. Consistent with our prediction, a reduction in the quantity of purchases decreases the amount of trade credit. These findings show that the real driver is economically significant. It is also interesting to find that the effect of this measure is smaller (both statistically and economically) for the primary supplier than for the other suppliers. In contrast, the Dec_P dummies are insignificant, although their coefficients are negative. This finding means that a decrease in purchase prices does not lead to a significant reduction in the amount of trade credit. The decrease in the purchase price might be small and/or take place mostly for buyers making non-credit payments.

As for the financial measures, although they are mostly insignificant, the third dummy

for the primary supplier (PS_Length_AP) has a statistically significant positive effect on the amount of trade credit. This finding means that firms' trade credit increases due to the postponement of payments, and that changing the terms of credit payments is also an important driver of trade credit. The finding is consistent with the existing evidence for the financial driver during a crisis period (Love et al. 2007, Casey and O'Toole 2014, Carbó-Valverde et al. 2016), but different from these studies, our measure allows us to identify that the increase is truly due to the financial driver. It is also interesting to find that this effect occurs only for the primary supplier, because it is consistent with versions of the financial theory that emphasize the importance of strong supplier-customer relationships (e.g., Ng, Smith, and Smith 1999, McMillan and Woodruff 1999, Wilner 2000, Cuñat 2007).

Which driver is more important, real or financial? The results in columns (1) and (3) show that only the real driver is important; but if we focus on the primary supplier (column (2)), both drivers matter. If we compare the relative magnitudes of the economic effects of the real versus financial measures for the primary supplier, the reduction in the purchase quantity (PS_Red_Q) decreases the amount of trade credit by 56 million yen, while the lengthening of the duration of accounts payable (PS_Length_AP) increases it by 79 million yen.[22] Thus, for those firms that use both measures for the primary suppliers, the overall amount of trade credit increases, ceteris paribus, and so the financial driver is more significant.

We can also compare the aggregate effect by taking into account the number of firms that use PS_Red_Q and PS_Length_AP. As Table 2 shows, the number of firms with PS_Red_Q = 1 is far larger than those with PS_Length_AP = 1, so the aggregate economic effect of the

[22] In 2009, 1 USD was worth around 90-100 Japanese yen.

real measure far exceeds that of the financial one. Specifically, the reduction in the quantity of purchases decreases the total amount of trade credit by 16.47 billion yen (= - 56.20 million yen * 15.1% * 1941firms), while the lengthening of the maturity of accounts payable increases the amount by 1.53 billion yen (= + 78.95 million yen * 1.0% * 1941 firms). In aggregate, there are few firms that use the financial measure, so the changes in the amount of trade credit are driven primarily by the contraction in real transactions and not by adjustments in the terms of trade credit. This finding means that the real driver is more economically significant than the financial one, at least in a crisis period, and suggest that changes in the volume of trade credit during a crisis period might not necessarily be the result of an active adjustment in the terms of trade credit.

4.2 Subsample analysis: Size split

To take into account any size-related difference in the effects of the real and the financial measures, we also run the regressions by splitting the sample firms into small and large firms based on their median asset. Table 6 gives the results, where columns (1) through (3) are for small firms, and columns (4) through (6) are for large firms. For each subsample, there are three specifications that use the measures for any supplier, the primary supplier, and the other suppliers.

Comparing the results for the small and the large firms, we find that the results are size-sensitive. The magnitudes of the coefficients are larger for large firms, and the statistical significance is also different across firm sizes. We also find that the results for the large firms are mostly similar to those for the whole sample (Table 5): the first (real) measure decreases the amount of trade credit, while the third (financial) measure increases it only for the primary suppliers. One interesting difference is that the first measure for the primary supplier is now insignificant for large firms. This finding, and the finding of the significant

and positive effect of the third measure for the primary supplier, again supports the view that strong relationships with suppliers might be helpful because they do not reduce real transactions and increase trade credit. However, in this split sample, the third measure for the primary supplier is used by only four firms (column (3) in Table 3).

As for the small firms, few measures are statistically significant. We find that PS_Length_DP has a negative effect and OS_Length_AP has a positive effect, but these measures are respectively used by only 6 and 11 firms (column (2) in Table 3). The insignificance of many measures for small firms does not necessarily mean that they do not take the real and the financial measures. As reported in Table 3, the fraction of firms that use the respective measures is not very different between the two subsamples, or rather slightly larger for the small firms. Thus, the insignificance of many variables might simply indicate that the effects are not sizable, or have relatively larger variance.[23] It might also be possible that the measures are used by firms with little trade credit.

4.3 Subsample analysis: Industry split

As an additional analysis, we run the regression by industry to see whether there are any differences in the intensity or the timing of the real versus the financial drivers. Because the number of observations is too small for firms in some industries, we conduct the analyses for Construction, Manufacturing, and Wholesale and Retail firms. The results are reported in Table 7, where columns (1) through (3) are for Construction, (4) through (6) are for Manufacturing, and (7) through (9) are for Wholesale and Retail. Among these three columns for the respective industries, the first, second, and third columns use the variables

[23] The average size of the dependent variable DTP for small firms is -20.3 in mean and -4.3 in median, while they are -276.1 and -66.5 for the large firms.

for the measures for any, primary, and other suppliers.

The results show remarkable differences. For Construction, we find that most of the main independent variables are insignificant, but the third dummy for a financial measure (lengthening the duration of accounts payable) has a positive effect. We also find a similar effect for Wholesale and Retail, but we additionally find that the fourth and the fifth dummy variables (lengthening the duration of promissory bills payable and an increase in the ratio of payments by trade payables) often have positive effects as well. These findings mean that only the financial measures matter for these industries, although we need to be careful with the small number of observations for the firms that use these financial measures. These findings also show that Construction and Wholesale and Retail are industries in which the effect of the real measures are less intense and/or delayed.

In contrast, the findings for Manufacturing are similar to those for the whole sample. We find that the reduction in the amount of purchases (Red_Q) decreases the amount of trade payables, and the lengthening of the duration of accounts payable (Length_AP) increases it. Different from the finding for the whole sample, we also find that the lengthening of the duration of promissory bills payable (Length_BP) or an increase in the ratio of payments by trade payables (Inc_TPratio) increases the amount of trade payables. These findings show that the effect of the real and the financial measures that we find for the whole sample stem mostly from the effects for manufacturing firms, and that manufacturing is the industry that the effect of the real measures are more intense and/or quick.

4.4 Subsample analysis: Financial constraint

We further run the regression by taking into account firms' financial constraints. We have some information to identify financially constrained firms. As we explained in subsection 3.4.1, the RIETI 2009 survey asks how firms responded to the financial crisis and

the recession and firms chose answers from seven options. Although we already use five of them to identify the real and the financial measures, we can also use the seventh option, "7. Did not take any particular measure" to identify firms that did not face any financial constraint. Therefore, we run the baseline regression by eliminating the firms that choose option 7.

Table 8 shows the results. We find that the results for the first and the third dummies are qualitatively unchanged, with greater statistical significance for the first measure. We also find that the second dummy for the real measure (decreased the price of purchase goods) now has a statistically significant and negative effect. These findings not only reinforce our conclusion that real measures are more important but also indicate that their effects are stronger for financially constrained firms.

5. Endogeneity

5.1 Empirical strategy

In this section, we address a possible bias that might stem from an endogenous choice between the real and the financial measures. To the extent that the choices of these measures are not random, our analysis might suffer from endogeneity. The studies on the determinants of trade credit (e.g., Petersen and Rajan 1997 and Giannetti et al. 2011) argue that whether or not firms adopt the measures might depend on different factors, both the firms' (demand) and their suppliers' (supply). Relative bargaining power might also affect the adoption. A firm that has strong bargaining power over its suppliers might easily demand reductions in the quantity or price of its purchases, but suppliers with more bargaining power might demand a reduction in the amount of credit that they grant (Fisman and Raturi 2004, Van Horen 2005, 2007, Fabbri and Klapper 2008, Dass et al. 2014, Murfin and

Njoroge 2015).

Our approach already alleviates such endogeneity to some extent because we examine the change in the amount of trade credit and control for the time-invariant firm fixed effects. However, to address any remaining endogeneity, we explicitly take into account the adoption of the measures to cope with an adverse shock in a two-stage analysis. The first stage of this analysis is for the adoption of the measures, where we use the variables in other studies as independent variables to determine trade credit. The second stage is an analysis of the change in the amount of trade credit.

For this two-stage analysis, we use both multinomial and binary treatment models. Ideally, we should model the determination of the five measures in the first stage. However, there are many firms that use multiple measures simultaneously, and some of the measures are rarely adopted. We thus decided to use multinomial and binary choice models to reconstruct the variables for the measures to be integrated and nested with each other.

The multinomial treatment model considers a choice from four options on the adoption of the measures in its first stage. The variables we use are: (1) AS_REALONLY that indicates the firm uses at least one real (AS_Red_Q or AS_Dec_P) and no financial measures (AS_Length_AP, AS_Length_BP, or AS_Inc_TPratio) for any supplier; (2) AS_FINONLY that indicates the firm uses one or more financial and no real measures for any supplier; and (3) AS_BOTH that indicates the firm uses at least one real and one financial measure for any supplier. The default is not using any measures. As before, we also create variables for the measures for the primary supplier (PS) and for the other suppliers (OS).

However, the use of the multinomial regression might not be appropriate because the number of firms for which AS_FINONLY or AS_BOTH equals one is small. This is because the number of firms that use the three financial measures is small (see Table 3), and many

of them also use one or both of the real measures simultaneously. Thus, we also estimate a binary treatment model, where we only use AS_REALONLY (or its PS or OS counterpart).[24]

In these treatment models, we need instruments that affect the first-stage dependent variables but not the second-stage one. By referring to the financial theory of trade credit, we use several alternative instruments obtained from the RIETI 2008 survey. First, we use PS_PURCHASE_RATIO, which is defined as the fraction of purchases from the primary supplier. We also use a dummy variable DEPENDENCE that indicates that, as to the products that the firm purchases from the primary supplier, the firm does not purchase the relevant or similar products from the other (non-primary) suppliers. These variables capture the dependence of the firms on their primary suppliers and are used to take into account the choice of the measures depending on the relative bargaining power between the firms and their primary suppliers. The use of these variables is based on the prediction that the bargaining power matters as a determinant of trade credit (Fisman and Raturi 2004, Van Horen 2005, 2007, Fabbri and Klapper 2008, Dass et al. 2014, Murfin and Njoroge 2015).

Second, we use the length (years) of the transactional relationship with the primary supplier (PS_DURATION), and a dummy variable to indicate that the firm and the primary supplier have frequent contact with each other (more than once a week) (PS_MEETING). The use of these variables is based on the predictions that suppliers with strong transactional relationships have informational advantages over other creditors regarding the buyers' creditworthiness (e.g., Smith 1987, Biais and Gollier 1997, Bond 2004, McMillan and Woodruff 1999, and Johnson et al. 2002) and that when firms experience financial distress,

[24] We do not include firms with AS_BOTH = 1 in the group of firms that take a real measure, because for such firms, the financial measure should increase the amount of trade credit while the real measure should decrease it, and the overall effect is a priori uncertain.

their suppliers make more concessions in debt renegotiation if they have close relationships with the firms (Wilner 2000). As to the relation with lending banks, we also use a dummy variable to indicate that at least one of the firm's lenders that had been aggressive in their lending changed its attitude toward the firm after the crisis (BANK_ATTITUDE).[25] This variable is to capture firms that have more needs to use the real and the financial measures for primary suppliers to cope with adverse shocks.

As additional controls, we use ROA, leverage (LEVERAGE), and the TSR score (SCORE) (in 2008) as the first-stage independent variables, because it might be difficult for unprofitable or risky firms to use the real and/or the financial measures due to the suppliers' reluctance to ease credit terms to such firms. We also use an industry dummy as an additional control. Because the number of firms for which AS_REALONLY, AS_FINONLY, or AS_BOTH equals one (or their PS or OS counterparts) is small for many industries, we only use a dummy variable for manufacturing firms (Manufacturing).

These variables that we use in the first stage are commonly used in the literature as proxies for the determinants of trade credit (see, e.g., Peterson and Rajan 1997 and Giannetti et al. 2011). Also, these variables are less likely to affect the dependent variable in the second stage, which is in a year-over-year difference and is not affected by time-invariant firm fixed effects. Especially, we have already excluded firms that change their primary suppliers in the sample period.

[25] The relevant question reads that "Did any of your lenders that had been aggressive in lending before September 2008 drastically changed their lending attitude afterwards?" and the responding firms chose either yes or no.

5.2 Results

The results for the multinomial treatment model are shown in Table 9, where columns (1), (2), and (3) respectively present the results using the variables for any, the primary, and the other suppliers. From the first-stage results in columns (1) and (2), we find that a firm with frequent contact with its primary supplier uses the real and the financial measures simultaneously. We also find that firms that depend on the primary supplier in terms of their purchases (DEPENDENCE) do not use the real measures, and firms are more likely to use the real and the financial measures when some of their lenders changed their lending attitude. In column (3), we also find that more dependence on the primary supplier (PS_PURCHASE_RATIO) reduces the probability of using the real measures by the other supplier. We further find that manufacturing firms tend to use real measures more frequently, and highly-scored firms do not use financial measures. The Wald test for the joint significance of the variables for the first stage rejects the hypothesis that they have no effect on the first-stage dependent variables at the 5% level of significance (unreported results).

The second-stage results show that the coefficients for REALONLY and FINONLY are respectively negative and positive, which is consistent with the results in the previous section. However, the statistical significance decreases due to relatively larger standard errors. But REALONLY has a statistically significant and negative effect in columns (2) and (3). These results indicate that the findings in the previous section are robust to controlling for endogeneity, although there is a concern for the specification due to the small number of firms for which FINONLY or BOTH equals one.

To resolve this concern, the results for the binary treatment model are shown in Table 10. The results for the first stage are on balance consistent with those for the REALONLY

regression in Table 9 (the left most sub-columns (1) through (3)), although DEPENDENCE and PS_PURCHASE_RATIO now decrease their statistical significance. However, we now find significantly strong and positive effects of leverage and the firms' score. The second-stage results are clearer. We find that a firm that uses a real driver significantly decreases the amount of trade credit. Taken together, we can conclude that during the crisis period, the reduction in the volume of real transactions reduces the amount of trade credit, and the real driver is economically significant.

6. Trade receivables and net trade credit

6.1 Empirical strategy

We have thus far investigated the effects of the real and the financial measures used for suppliers on firms' trade payables recorded on the liability side of their balance sheets. Although this analysis directly examines the effects of these measures from a borrowers' perspective, if we focus on the measures used for firms' customers and trade receivables recorded on the asset side of the balance sheets, we might be able to observe the same effect from a lenders' perspective. In this section, we conduct this analysis on trade receivables that complements the previous analyses on trade payables.[26]

[26] Because firms ordinarily borrow from suppliers (trade payables) and lend to customers (trade receivables) at the same time, we also conduct the analysis by replacing the dependent variable of the baseline regression from trade payables to net trade payables (trade payables – trade receivables) and add the measures used for customers that we use in this section as independent variables. However, most of the main independent variables (the real and the financial measures for suppliers and customers) are statistically insignificant. This result indicates that when facing adverse shocks, firms have a hard time managing net trade payables, although they might be able to separately manage

The regression we estimate here is:

$$\Delta Trade\ \ receivables_i = d_0 + d_1 \cdot \Delta Terms_i^R + d_2 \cdot \Delta X_i + \epsilon_i^R, \quad (7)$$

where $\Delta Trade\ \ receivables_i$ is the change in the amount of trade receivables for firm i, $\Delta Terms_i^R$ is a vector of the changes in the terms of the underlying transactions of goods or services and trade receivables, and ΔX_i is the change in control variables.

For the dependent variable $\Delta Trade\ \ receivables_i$, we use DTR, defined as the year-over-year change in the amount of trade receivables (accounts receivable + promissory bills receivable) that the sample firms provide to their customers from 2008 to 2009. For ΔX_i, we use the same control variables as those used in the previous sections.

For our main independent variables $\Delta Terms_i^R$, we use dummy variables to indicate real and financial measures that the responding firms use for their customers, which we create from the RIETI 2009 survey. The survey asks these questions of customers together with those of suppliers that we already used in previous sections.[27] There are eight options to choose (multiple answers allowed):

1. Increased the quantity of sales
2. Increased the price of sale goods
3. Shortened the duration of accounts receivable
4. Shortened the duration of promissory bills receivable
5. Changed payment from customers from receivables to cash

gross trade payables or receivables.

[27] To restate, the relevant question reads "How did your company respond to the financial crisis and the recession? From the list below, choose all the descriptions that explain measures your company actually took after September 2008."

6. Used trade credit insurance
7. Explained to customers the difficulty of your company's situation
8. Did not take any particular measure

We create two dummy variables for the real measures: Inc_Q and Inc_P respectively takes the value of unity if options 1 and 2 are chosen, and the value of zero otherwise. We also create three dummy variables for the financial measures: Short_AR, Short_BR, and Change_to_cash, which respectively takes the value of unity if options 3, 4, and 5 are chosen, and the value of zero otherwise. The survey does not separately ask these measures for primary and the other customers, so we cannot create these variables by customer. We expect that the former two variables have a positive effect, while the latter three variables have a negative one on the dependent variable.

6.2 Results

Table 11 reports the results for the estimation of equation (7). In this table, column (1) presents the results using the whole sample. We also report the results when we split the sample into smaller (column (2)) and larger (column (3)) firms by the sample median of total assets. We consistently find that Inc_Q has a statistically significant and positive effect on DTR, which means that an increase in the amount of sales to respond to adverse shocks leads to an increase in the amount of trade receivables. This finding indicates that the real measure is important and is consistent with our previous findings for trade payables.

We also find in column (1) that the shortening of the duration of accounts receivable has a negative effect, which indicates that the financial measure also matters. However, the effect is statistically weak and disappears when we split the sample by firm size. On balance, these findings from the lender-side analysis (firms as lenders or providers of trade credit) are

consistent with our previous findings from the borrower-side analysis (firms as borrowers or receivers of trade credit). Both of these findings indicate that the real measures are more important than the financial measures.

7. Conclusion

Taking advantage of our unique data from the crisis period, we disentangled the change in the amount of trade credit due to the real versus financial measures used to cope with the recession. We find evidence that both measures have anticipated effects, but the results for the real measures are more robust, more sizable, and more important for a large number of firms. Our findings suggest that the real driver of trade credit is more economically significant than the financial driver during the crisis period. This result urges caution for those studies that neglect the working of the real driver and explain the change in the amount of trade credit solely based on the financial driver, especially those that examine the substitutability and/or complementarity of trade credit and bank loans.

It should be stressed that our analysis focuses on the recession period. Although our findings suggest the significance of the real driver in an economic downturn, this does not necessarily mean that the driver is always important. The adjustment in the terms of trade credit as a means of financing (i.e., the financial driver) might be more important in an ordinary economic environment. Our findings however indicate that further investigation of the relative importance of the two roles of trade credit (i.e., payment versus financing) and the controllability of trade credit as a means of working capital management in different environments is an important avenue for future research.

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Tables

Table 1 Sample characteristics

This table compares the characteristics of our sample firms with those of the survey targets and with those of the firms in the Econoimc Census. Panels (A) and (B) respectivelly report the results on the number of employees and on the industry composition.

	Economic Census (2009)		Original sample		Baseline sample	
(A) Number of Employees						
	No. of obs.	(%)	No. of obs.	(%)	No. of obs.	(%)
0-4	1,067,825	59.1%	320	7.8%	68	3.4%
5-9	309,445	17.1%	608	14.8%	210	10.5%
10-19	200,451	11.1%	873	21.3%	347	17.3%
20-29	75,974	4.2%	470	11.5%	220	11.0%
30-49	62,940	3.5%	469	11.5%	256	12.8%
50-99	46,090	2.6%	554	13.5%	345	17.2%
100-299	30,218	1.7%	581	14.2%	390	19.4%
300-	12,602	0.7%	220	5.4%	170	8.5%
Total	1,805,545	100.0%	4,095	100.0%	2,006	8.5%
(B) Industries						
	No. of obs.	(%)	No. of obs.	(%)	No. of obs.	(%)
Construction	331,359	18.8%	952	23.6%	521	26.2%
Manufacturing	277,066	15.8%	951	23.6%	509	25.6%
Information and Communications	47,969	2.7%	113	2.8%	50	2.5%
Transportations	56,695	3.2%	158	3.9%	75	3.8%
Wholesales	191,314	10.9%	890	22.1%	444	22.4%
Retail	282,036	16.0%	407	10.1%	161	8.1%
Real Estate	182,363	10.4%	128	3.2%	36	1.8%
Restaurants	74,090	4.2%	7	0.2%	3	0.2%
Other services	315,498	17.9%	423	10.5%	187	9.4%
Others	47,155	2.7%	48	1.2%	20	1.0%
(Unknown)	NA	NA	18	0.4%	NA	NA
Total	1,805,545	100.0%	4,095	101.6%	2,006	100.0%

Table 2 Descriptive statistics

This table shows the descriptive statistics for the variables we use in this paper.

Variable	Definition	Obs	Mean	Median	Std. Dev.	Min	Max
	(A) Dependent variable						
DTP	One year difference in firms' trade payables: Trade payables$_{2009}$ - Trade payables$_{2008}$ (in million yen)	1941	-148.137	-16.358	473.773	-6049.000	484.792
	(B) Control variables						
DAsset	One year difference in firm asset: Asset$_{2008}$ - Asset$_{2007}$ (in million yen)	1941	-41.779	-5.138	647.544	-7611.000	3207.568
DLeverage	One year difference in firm leverage: (Total debt/Asset)$_{2008}$ - (Total debt/Asset)$_{2007}$	1941	-0.008	-0.008	0.078	-0.771	0.975
DScore	One year difference in firms' score: Score$_{2008}$ - Score$_{2007}$	1941	-0.617	0.000	2.169	-12.000	9.000
DROA	One year difference in firms' ROA: (Operating income/Asset)$_{2008}$ - (Operating income/Asset)$_{2007}$	1941	-0.005	-0.002	0.061	-0.538	0.484
Accounting months dummy (April)	Dummy = 1 if the firm's accounting month is April.	1941	0.072	0.000	0.259	0.000	1.000
Accounting months dummy (May)	Dummy = 1 if the firm's accounting month is May.	1941	0.120	0.000	0.324	0.000	1.000
Accounting months dummy (June)	Dummy = 1 if the firm's accounting month is June	1941	0.123	0.000	0.329	0.000	1.000
Accounting months dummy (July)	Dummy = 1 if the firm's accounting month is July	1941	0.055	0.000	0.228	0.000	1.000
Accounting months dummy (August)	Dummy = 1 if the firm's accounting month is August	1941	0.073	0.000	0.260	0.000	1.000
Accounting months dummy (September)	Dummy = 1 if the firm's accounting month is September	1941	0.120	0.000	0.325	0.000	1.000
Industry Dummy (Construction)	Dummy = 1 if the industry classification is Construction.	1941	0.263	0.000	0.440	0.000	1.000
Industry Dummy (Manufacturing)	Dummy = 1 if the industry classification is Manufacturing.	1941	0.251	0.000	0.434	0.000	1.000
Industry Dummy (Wholesales and retails)	Dummy = 1 if the industry classification is Wholesales and retails.	1941	0.303	0.000	0.460	0.000	1.000

Table 3 Descriptive statistics for the real and the financial measures

This table shows the descriptive statistics for the real and the financial measures that firms use to cope with adverse shocks.

Variable	Definition	(1) All firms			(2) Small firms			(3) Large firms		
		Obs	=1	=0	Obs	=1	=0	Obs	=1	=0
AS_Red_Q	Dummy = 1 if the firm reduced the quantity of purchases from any supplier to cope with the recession	1908 (100%)	319 (16.7%)	1589 (83.3%)	949 (100%)	159 (17%)	790 (83%)	959 (100%)	160 (17%)	799 (83%)
AS_Dec_P	Dummy = 1 if the firm decreased the price of purchase goods from any supplier to cope with the recession	1908 (100%)	517 (27.1%)	1391 (72.9%)	949 (100%)	269 (28%)	680 (72%)	959 (100%)	248 (26%)	711 (74%)
AS_Length_AP	Dummy = 1 if the firm lengthened the sight [= duration] of accounts payable for the payment to any supplier to cope with the recession	1908 (100%)	22 (1.2%)	1886 (98.8%)	949 (100%)	17 (2%)	932 (98%)	959 (100%)	5 (1%)	954 (99%)
AS_Length_BP	Dummy = 1 if the firm lengthened the sight [= duration] of promissory bills payable for the payment to any supplier to cope with the recession	1908 (100%)	9 (0.5%)	1899 (99.5%)	949 (100%)	7 (1%)	942 (99%)	959 (100%)	2 (0%)	957 (100%)
AS_Inc_TPratio	Dummy = 1 if the firm increased the ratio of trade payables (account + promissory bills payables) to total payments to any supplier to cope with the recession	1908 (100%)	35 (1.8%)	1873 (98.2%)	949 (100%)	24 (3%)	925 (97%)	959 (100%)	11 (1%)	948 (99%)
PS_Red_Q	Dummy = 1 if the firm reduced the quantity of purchases from the main supplier to cope with the recession	1941 (100%)	294 (15.1%)	1647 (84.9%)	971 (100%)	147 (15%)	824 (85%)	970 (100%)	147 (15%)	823 (85%)
PS_Dec_P	Dummy = 1 if the firm decreased the price of goods purchased from the main supplier to cope with the recession	1941 (100%)	503 (25.9%)	1438 (74.1%)	971 (100%)	263 (27%)	708 (73%)	970 (100%)	240 (25%)	730 (75%)
PS_Length_AP	Dummy = 1 if the firm lengthened the sight [= duration] of accounts payable for payment to the main supplier to cope with the recession	1941 (100%)	19 (1.0%)	1922 (99.0%)	971 (100%)	15 (2%)	956 (98%)	970 (100%)	4 (0%)	966 (100%)
PS_Length_BP	Dummy = 1 if the firm lengthened the sight [= duration] of promissory bills payable for the payment to the main supplier to cope with the recession	1941 (100%)	8 (0.4%)	1933 (99.6%)	971 (100%)	6 (1%)	965 (99%)	970 (100%)	2 (0%)	968 (100%)
PS_Inc_TPratio	Dummy = 1 if the firm increased the ratio of payments by promissory bills or on account to total payments to the main supplier to cope with the recession	1941 (100%)	30 (1.5%)	1911 (98.5%)	971 (100%)	21 (2%)	950 (98%)	970 (100%)	9 (1%)	961 (99%)
OS_Red_Q	Dummy = 1 if the firm reduced the quantity of purchases from the other suppliers to cope with the recession	1908 (100%)	277 (14.5%)	1631 (85.5%)	949 (100%)	135 (14%)	814 (86%)	959 (100%)	142 (15%)	817 (85%)
OS_Dec_P	Dummy = 1 if the firm decreased the price of purchase goods from the other suppliers to cope with the recession	1908 (100%)	443 (23.2%)	1465 (76.8%)	949 (100%)	222 (23%)	727 (77%)	959 (100%)	221 (23%)	738 (77%)
OS_Length_AP	Dummy = 1 if the firm lengthened the sight [= duration] of accounts payable for the payment to the other suppliers to cope with the recession	1908 (100%)	16 (0.8%)	1892 (99.2%)	949 (100%)	11 (1%)	938 (99%)	959 (100%)	5 (1%)	954 (99%)
OS_Length_BP	Dummy = 1 if the firm lengthened the sight [= duration] of promissory bills payables for the payment to the other suppliers to cope with the recession	1908 (100%)	4 (0.2%)	1904 (99.8%)	949 (100%)	3 (0%)	946 (100%)	959 (100%)	1 (0%)	958 (100%)
OS_Inc_TPratio	Dummy = 1 if the firm increased the ratio of payments by promissory bills or on account to total payments to the other suppliers to cope with the recession	1908 (100%)	27 (1.4%)	1881 (98.6%)	949 (100%)	20 (2%)	929 (98%)	959 (100%)	7 (1%)	952 (99%)

Table 4 Correlation between real and financial measures for any suppliers and for main banks

This table shows the correlation coefficients among the dummy variables indicating the real and financial measures taken vis-à-vis any suppliers (AS_Red_Q-05) and those vis-à-vis main banks (B_Red_Q-02). B_Red_Q takes a value of one if the firm borrowed from its top lending bank (the bank that lends the most) to cope with the recession, and B_Dec_P takes a value of one if the firm lengthen the repayment of the borrowing from its top lending bank to cope with the recession. ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level.

	AS_Red_Q	AS_Dec_P	AS_Length_AP	AS_Length_BP	AS_Inc_TPratio	B_Borrow	B_Postpone
AS_Red_Q	1.000						
AS_Dec_P	0.242***	1.000					
AS_Length_AP	0.070***	0.045*	1.000				
AS_Length_BP	0.092***	-0.008	0.064***	1.000			
AS_Inc_TPratio	0.033	0.057**	0.132***	0.162***	1.000		
B_Borrow	0.120***	0.136***	0.028	0.038	0.084***	1.000	
B_Postpone	0.095***	0.041*	0.202***	0.036	0.126***	0.033	1.000

Table 5 Regression results: Baseline results

This table shows the results for the effect of the real and the financial measures used to cope with the recession on the amount of firms' trade credit. The dependent variable is a year-over-year difference in trade payables. The main independent variables are the dummies indicating that the firm took measures to respond to the recession (see Table 3). The variables labeled with AS_ indicate the measure used for any suppliers, those with PS_ indicate the measures for the primary suppliers, and those with OS_ respectively indicate the measures for the other suppliers. The variables with Red_Q in its label indicate that the firm reduced the quantity of purchases from the relevant supplier(s), and those labeled with Dec_P indicate that the firm decreased the price of purchase goods from the relevant supplier(s). These two dummies represent real measures. The variables labeled with Length_AP and Length_BP respectively indicate that the firm lengthened the duration of accounts payable and promissory bills payable for payment to the relevant supplier(s), and those labeled with Inc_TPratio indicate that the firm increased the ratio of payments by promissory bills or on account to total payments to the relevant supplier(s). For more detailed definition of these and other variables, see Tables 2 and 3. ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)	(2)	(3)
Dependent variable	DTP	DTP	DTP
Firm size	All	All	All
AS_Red_Q	-77.8012**		
	(32.9705)		
AS_Dec_P	-7.2387		
	(24.3613)		
AS_Length_AP	-14.0733		
	(97.0222)		
AS_Length_BP	99.3079		
	(70.5146)		
AS_Inc_TPratio	-4.7746		
	(56.0922)		
PS_Red_Q		-56.1960*	
		(32.1123)	
PS_Dec_P		-23.4681	
		(24.1545)	
PS_Length_AP		78.9525***	
		(27.9346)	
PS_Length_BP		42.8557	
		(72.6854)	
PS_Inc_TPratio		-45.1941	
		(62.5644)	
OS_Red_Q			-81.1981**
			(35.4568)
OS_Dec_P			-26.1529
			(25.9755)
OS_Length_AP			-49.4417
			(136.9249)
OS_Length_BP			-7.0184
			(81.3639)
OS_Inc_TPratio			52.8743
			(41.7803)
DAsset	0.0630	0.0633	0.0632
	(0.0634)	(0.0623)	(0.0636)
DLeverage	-147.3225	-148.5310	-136.0000
	(99.0729)	(97.5610)	(99.7116)
DScore	-0.1436	0.0173	-0.2250
	(5.9050)	(5.7846)	(5.9542)
DROA	-76.8392	-87.2428	-82.0629
	(73.7025)	(71.3827)	(73.3954)
Accounting month dummies	yes	yes	yes
Industry fixed effects	yes	yes	yes
Observations	1,908	1,941	1,908
R-squared	0.060	0.059	0.061

Table 6 Regression results: Size split

This table shows the results for the effect of the real and the financial measures on the amount of firms' trade credit, when we split the sample firms into small firms (columns (1) through (3)) and large firms (columns (4) through (6)). Small (large) firms are those with asset below (above) its median. The variables are the same as those used in Table 5 (see Tables 2 and 3 for more detailed definitions). ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	DTP	DTP	DTP	DTP	DTP	DTP
Firm size	Small	Small	Small	Large	Large	Large
AS_Red_Q	-3.8973			-146.2166**		
	(5.0335)			(63.8660)		
AS_Dec_P	-1.3099			-0.6318		
	(4.2580)			(48.6504)		
AS_Length_AP	3.8322			-263.1686		
	(9.4141)			(406.4784)		
AS_Length_BP	-58.8610			86.6852		
	(37.2753)			(258.6069)		
AS_Inc_TPratio	5.1648			-34.9284		
	(10.2905)			(162.1945)		
PS_Red_Q		-4.1809			-99.2900	
		(4.9544)			(63.1624)	
PS_Dec_P		-1.8757			-26.1744	
		(4.1867)			(48.5994)	
PS_Length_AP		2.4609			241.5603***	
		(10.0397)			(85.1940)	
PS_Length_BP		-76.3079*			-145.3761	
		(39.8380)			(121.8671)	
PS_Inc_TPratio		1.9948			-192.7583	
		(10.9672)			(180.9971)	
OS_Red_Q			-7.1491			-150.0191**
			(5.3995)			(68.2178)
OS_Dec_P			2.7981			-24.4031
			(4.1933)			(51.5236)
OS_Length_AP			15.6086**			-344.7144
			(6.8653)			(483.0385)
OS_Length_BP			-69.3373			240.6480
			(71.0824)			(552.9137)
OS_Inc_TPratio			4.5216			67.5939
			(12.6482)			(160.1981)
DAsset	-0.0481	-0.0532*	-0.0438	0.0669	0.0671	0.0659
	(0.0319)	(0.0316)	(0.0316)	(0.0659)	(0.0646)	(0.0663)
DLeverage	6.3184	7.7483	-1.9976	-630.9491	-689.4357	-612.6145
	(20.0753)	(19.7546)	(21.8990)	(458.6446)	(451.9805)	(459.7976)
DScore	-0.2351	-0.3018	-0.2932	-5.9980	-5.7058	-5.9856
	(0.7105)	(0.7016)	(0.7153)	(10.8982)	(10.7373)	(11.0639)
DROA	-2.3066	-2.6387	-1.2714	-247.8327	-132.3734	-278.9018
	(14.5063)	(14.3077)	(14.7365)	(391.9430)	(379.4909)	(394.4928)
Accounting month dummies	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes
Observations	949	971	949	959	970	959
R-squared	0.068	0.074	0.067	0.075	0.072	0.076

Table 7 Regression results: Industry split

This table shows the results for the effect of the real and the financial measures on the amount of firms' trade credit, when we split the sample firms into Construction (columns (1) through (3)), Manufacturing (columns (4) through (6)), and Wholesales and retails firms (columns (7) through (9)). The variables are the same as those used in Table 5 (see Tables 2 and 3 for more detailed definitions). ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	DTP	DTP	DTP	DTP	DTP	DTP	DTP	DTP	DTP
Industry	Construction	Construction	Construction	Manufacturing	Manufacturing	Manufacturing	Wholesales and retails	Wholesales and retails	Wholesales and retails
AS_Red_Q	1.2896			-168.7033**			-21.4847		
	(29.9944)			(73.3050)			(47.9669)		
AS_Dec_P	-19.6401			-50.8537			27.5749		
	(21.4336)			(66.7325)			(47.7941)		
AS_Length_AP	48.2494*			232.9783***			80.3377**		
	(27.2244)			(81.6736)			(34.6632)		
AS_Length_BP	-73.1711			483.7535***			131.4733		
	(57.9420)			(87.1941)			(106.2480)		
AS_Inc_TPratio	-0.7530			-97.8956			116.3610*		
	(42.7144)			(261.2109)			(63.6713)		
PS_Red_Q		12.7648			-154.5838**			4.1971	
		(26.1329)			(74.4336)			(35.3442)	
PS_Dec_P		-14.5628			-71.5189			10.4362	
		(22.4450)			(69.2496)			(47.0221)	
PS_Length_AP		46.5679*			293.6170***			76.3668**	
		(25.4325)			(92.8791)			(38.5713)	
PS_Length_BP		-71.3083			464.6369***			234.6404***	
		(59.3518)			(89.7216)			(87.7252)	
PS_Inc_TPratio		0.3505			-146.6267			93.7743	
		(41.0897)			(288.7401)			(68.9311)	
OS_Red_Q			-19.0899			-170.3654**			-14.9941
			(34.7602)			(75.4857)			(53.5837)
OS_Dec_P			-13.9772			-86.0459			4.4235
			(21.7048)			(72.4989)			(50.0607)
OS_Length_AP			67.2033**			218.8949**			78.4625*
			(32.2569)			(105.8827)			(41.3905)
OS_Length_BP			-116.8377			(omitted)			-141.6229
			(71.8292)						(89.1915)
OS_Inc_TPratio			-26.6472			276.5220***			149.7945**
			(60.9746)			(66.0617)			(63.2800)
DAsset	0.0194	0.0191	0.0207	-0.1851	-0.1877	-0.1871	0.1719	0.1759	0.1734
	(0.0522)	(0.0522)	(0.0527)	(0.1638)	(0.1637)	(0.1624)	(0.1195)	(0.1193)	(0.1194)
DLeverage	-54.1603	-61.4521	-59.7967	-42.8540	-14.4594	-73.2323	-344.4767	-338.0063	-313.1630
	(61.7999)	(60.4558)	(62.4361)	(309.3157)	(295.0192)	(313.9957)	(314.1370)	(327.3284)	(305.9257)
DScore	2.8839	2.7143	2.5856	26.4715*	26.9238**	27.3439**	-25.5323**	-25.3933**	-25.9053**
	(5.3487)	(5.2747)	(5.4474)	(13.5270)	(13.4517)	(13.4709)	(11.2059)	(10.9046)	(11.3288)
DROA	-71.0469	-68.6989	-71.5067	-163.0718	-174.5095	-227.3174	219.0517	261.7507	202.9197
	(55.3035)	(54.5243)	(55.2802)	(302.3641)	(302.6246)	(302.2015)	(249.1560)	(252.0826)	(250.6585)
Accounting month dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	no	no	no	no	no	no	no	no	no
Observations	498	510	498	480	487	480	582	589	582
R-squared	0.030	0.028	0.030	0.118	0.116	0.122	0.065	0.065	0.064

Table 8 Regression results: Financial constraint

This table shows the results for the effect of the real and the financial measures used to cope with the recession on the amount of firms' trade credit, when we exclude the sample firms that are not likely to suffer from financial constraint (firms that did not take any particular measure for the relevant supplier(s)). The variables are the same as those used in Table 5 (see Tables 2 and 3 for more detailed definitions). ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)	(2)	(3)
Dependent variable	DTP	DTP	DTP
Firm size	All	All	All
AS_Red_Q	-96.0001**		
	(38.7988)		
AS_Dec_P	-72.3412*		
	(38.8118)		
AS_Length_AP	-43.7206		
	(112.6698)		
AS_Length_BP	105.4493		
	(81.0301)		
AS_Inc_TPratio	-57.1626		
	(69.3485)		
PS_Red_Q		-97.2783***	
		(36.3448)	
PS_Dec_P		-82.8800**	
		(35.2233)	
PS_Length_AP		51.8965*	
		(31.3601)	
PS_Length_BP		19.2742	
		(73.2510)	
PS_Inc_TPratio		-75.2256	
		(60.9963)	
OS_Red_Q			-118.7120***
			(41.2354)
OS_Dec_P			-73.1267*
			(39.1076)
OS_Length_AP			-82.6258
			(136.9390)
OS_Length_BP			25.5496
			(76.6577)
OS_Inc_TPratio			6.1620
			(48.3583)
DAsset	-0.0197	-0.0146	-0.0082
	(0.0677)	(0.0644)	(0.0648)
DLeverage	-178.2169*	-165.9504*	-172.5386
	(106.2669)	(98.1155)	(110.1412)
DScore	-2.6145	-3.7762	-5.7563
	(6.1832)	(5.2647)	(7.4688)
DROA	-140.7770	-54.7872	-99.5411
	(140.4903)	(115.9060)	(135.5473)
Accounting month dummies	yes	yes	yes
Industry fixed effects	yes	yes	yes
Observations	658	760	699
R-squared	0.089	0.083	0.086

Table 9 Multinomial treatment effects model

This table shows the results for the effect of the real and the financial measures taken by the firm to cope with the recession on a firm's amount of trade credit. To control for endogeneity, we estimate a multinomial treatment effects model. The first stage of the estimation is a multinomial regression for the choice of the measures, real, financial, or both, that are respectively represented by the dummy variables REALONLY, FINONLY, and BOTH (for any supplier (AS_), the primary supplier (PS_), and the other suppliers (OS_)). The default is the choice of no such measures. For example, AS_REALONLY takes a value of unity if AS_Red_Q and/or AS_Dec_P = 1 and if AS_Length_AP, AS_Length_BP, and AS_Inc_TPratio are all zero (see Table 2 for the definition of these dummies), AS_FINONLY takes the value of unity if AS_Red_Q and AS_Dec_P are both zero and if at least one of the three dummy variables, AS_Length_AP, AS_Length_BP, and AS_Inc_TPratio, takes the value of unity, and AS_BOTH takes a value of unity if AS_Red_Q and/or AS_Dec_P = 1 and if at least one of the dummy variables AS_Length_AP, AS_Length_BP, and AS_Inc_TPratio takes the value of unity. The independent variables for the first stage are the ratio of purchases from the main supplier (PS_PURCHASE_RATIO), the natural logarithm of the length (years) of transactional relationship with the primary supplier (log(PS_DURATION)), a dummy to indicate that the firm and the main supplier have contact more than once a week (PS_MEETING), a dummy to indicate that the firm purchases the product that it purchases from the primary supplier only from the relevant supplier (DEPENDENCE), a dummy to indicate that the banks changed their lending attitude after September 2008 (BANK_ATTITUDE), dummies for manufacturing firms (Manufacturing), ROA, leverage (LEVERAGE) and the TSR score (SCORE). The dependent variable for the second stage is the year-over-year difference in trade payables (DTP). The control variables for the second stage are the same as those used in Table 5. ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)				(2)				(3)			
	1st stage			2nd stage	1st stage			2nd stage	1st stage			2nd stage
Dependent variable	AS_REAL ONLY	AS_FINO NLY	AS_BOTH	DTP	PS_REALO NLY	PS_FINON LY	PS_BOTH	DTP	OS_REAL ONLY	OS_FINO NLY	OS_BOTH	DTP
REALONLY				-58.3084				-74.8102**				-87.1153*
(AS_, PS_, or OS_)				(46.505)				(29.441)				(46.978)
FINONLY				140.3857				60.1974				135.3834
(AS_, PS_, or OS_)				(108.391)				(100.090)				(112.512)
BOTH				-32.3653				27.0587				-14.9482
(AS_, PS_, or OS_)				(95.087)				(87.753)				(129.150)
DAsset				-0.0106				-0.0098				-0.0103
				(0.022)				(0.021)				(0.022)
DLeverage				3.2900				-3.2072				7.9180
				(141.611)				(141.018)				(141.139)
DScore				3.7306				3.4355				3.5223
				(5.137)				(5.083)				(5.134)
DROA				-8.5745				-7.1806				-19.1767
				(186.694)				(184.853)				(186.599)
PS_PURCHASE_RATIO	-0.2413	-0.8636	-1.0474		-0.2227	-1.0855	-0.3624		-0.7873***	-1.5540	-1.0238	
	(0.296)	(1.125)	(1.004)		(0.292)	(1.200)	(1.012)		(0.300)	(1.300)	(1.392)	
DEPENDENCE	-0.5851***	0.1168	-0.2514		-0.4957**	0.4856	-1.3853		(omitted)	(omitted)	(omitted)	
	(0.198)	(0.712)	(0.677)		(0.195)	(0.682)	(1.062)					
log(PS_DURATION)	-0.0016	-0.0035	-0.0186		-0.0043	-0.0190	-0.0142		-0.0024	-0.0213	-0.0254	
	(0.005)	(0.018)	(0.016)		(0.005)	(0.020)	(0.016)		(0.005)	(0.021)	(0.023)	
PS_MEETING	-0.0642	-0.5725	1.1887**		0.0011	-0.7517	1.4001**		0.0966	-0.7389	0.9265	
	(0.142)	(0.550)	(0.518)		(0.141)	(0.583)	(0.582)		(0.143)	(0.585)	(0.708)	
BANK_ATTITUDE	1.0567***	1.0328*	0.8267		1.1339***	1.1481*	1.0629**		1.0234***	1.7034***	0.3672	
	(0.211)	(0.616)	(0.531)		(0.210)	(0.632)	(0.542)		(0.210)	(0.579)	(0.836)	
Manufacturing	0.4428***	-1.5446	-0.3617		0.4717***	-1.5218	-0.1228		0.4502***	-0.6616	-43.1714	
	(0.158)	(1.061)	(0.588)		(0.157)	(1.067)	(0.600)		(0.159)	(0.806)	(1.304e+09)	
ROA	0.0076	-3.1861	-0.1465		-0.4044	-3.6223	1.0776		-0.4082	-1.3219	-0.7020	
	(1.120)	(2.639)	(2.614)		(1.120)	(2.558)	(3.098)		(1.119)	(2.835)	(3.746)	
LEVERAGE	0.2545	0.1359	0.7049		0.2177	0.5949	-0.3437		0.3157	0.2977	-0.2016	
	(0.291)	(0.663)	(0.586)		(0.286)	(0.563)	(0.967)		(0.288)	(0.657)	(1.078)	
SCORE	0.0114	-0.1804***	-0.1428***		0.0192	-0.1616***	-0.1737***		0.0158	-0.1979***	-0.1415**	
	(0.014)	(0.058)	(0.046)		(0.013)	(0.060)	(0.051)		(0.014)	(0.064)	(0.067)	
Accounting month dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,361				0				1,361			
Log Likelihood	-11082				-11222				-11002			

Table 10 Binary treatment effects model

This table shows the results for the effect of the real and the financial measures taken by the firm to cope with the recession on a firm's amount of trade credit. To control for endogeneity, we estimate a binary treatment effects model. The first stage of the estimation is a regression for the choice of the real measure that are represented by the dummy variables AS_REALONLY, PS_REALONLY, or OS_REALONLY, respectively. These REALONLY variables take the value of unity if at least one of the corresponding Red_Q and Dec_P dummies takes the value of 1 and none of the corresnponding Length_AP, Length_BP, and Inc_TPratio dummies takes the value of zero (see Table 3 for the definition of these dummies). The independent variables for the first and the second stages are the same as those in Table 9. The independent variables for the second stage are DTP, the year-over-year change in the amount of trade payables (see Table 2). ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)		(2)		(3)	
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
Dependent variable	AS_REALONLY	DTP	S_REALONLY	DTP	OS_REALONLY	DTP
AS_REALONLY		-497.8828***				
		(91.274)				
PS_REALONLY				-500.3238***		
				(87.290)		
OS_REALONLY						-495.0259***
						(94.850)
DAsset		-0.0257		-0.0274		-0.0260
		(0.055)		(0.052)		(0.055)
DLeverage		14.3756		19.9811		28.5623
		(71.268)		(68.818)		(74.982)
DScore		4.4582		4.2874		4.0456
		(4.605)		(4.520)		(4.706)
DROA		-35.8413		-41.3720		-58.9106
		(89.301)		(87.851)		(89.550)
PS_PURCHASE_RATIO	-0.0934		-0.1211		-0.2581	
	(0.155)		(0.150)		(0.171)	
DEPENDENCE	-0.0610		-0.0149		(ommitted)	
	(0.089)		(0.086)			
log(PS_DURATION)	0.0026		0.0021		0.0019	
	(0.002)		(0.002)		(0.002)	
PS_MEETING	-0.0058		0.0155		0.0497	
	(0.059)		(0.060)		(0.062)	
BANK_ATTITUDE	0.4308***		0.4518***		0.4268***	
	(0.135)		(0.137)		(0.131)	
Manufacturing	0.2695***		0.2841***		0.2912***	
	(0.077)		(0.077)		(0.077)	
ROA	-0.1021		-0.1934		-0.3002	
	(0.437)		(0.436)		(0.465)	
LEVERAGE	0.3365***		0.3026***		0.3580***	
	(0.107)		(0.103)		(0.111)	
SCORE	0.0323***		0.0327***		0.0326***	
	(0.006)		(0.006)		(0.006)	
Accounting month dummies	yes	yes	yes	yes	yes	yes
Industry fixed effects	no	yes	no	yes	no	yes
Observations	1,361		1,383		1,361	
Log Likelihood	-10900		-11056		-10873	

Table 11 Regression results: Trade receivables

This table shows the result for the effect of the real and the financial measures by firms to cope with the recession. The dependent variable is a year-over-year difference in trade receivables. The main independent variables are dummy variables indicating that the firm took the real and the financial measures for customers to respond to the recession. The variable Inc_Q indicates that the firm increased the quantity of sales to customers and the variable Inc_P indicates that the firm increased the sales price. These two dummies represent the real measures used for customers. The variables Short_AP and Short_BP respectively indicate that the firm shortened the sight [= duration] of accounts receivable or of promissory bills receivable for the collection, and Change_to_cash indicates that the firm changed the collection from customers from receivables to cash. Column (1) reports the results for the whole sample, and columns (2) and (3) respectively report the results when we split the sample into smaller and larger firms by the sample median of firm asset. ***, **, and * respectively indicate that the coefficient is statistically significant at 1%, 5%, and 10% level of significance. Robust standard errors are in parentheses.

	(1)	(2)	(3)
	DTR	DTR	DTR
Firm size	All	Small	Large
Inc_Q	48.4910**	7.8318*	78.7678*
	(23.0308)	(4.6174)	(46.0639)
Inc_P	34.9999	3.8514	37.9130
	(27.8009)	(5.0401)	(61.2124)
Short_AR	-103.1760*	-7.1696	-82.8143
	(58.2882)	(8.4203)	(79.0571)
Short_BR	-64.8243	-7.9396	-113.0116
	(65.9661)	(9.9296)	(104.4312)
Change_to_cash	-51.4104	-5.0365	-87.2512
	(51.5529)	(6.0411)	(100.9577)
DAsset	0.0528	-0.0420	0.0499
	(0.0518)	(0.0332)	(0.0570)
DLeverage	18.8593	14.0425	19.3455
	(69.0749)	(18.8354)	(344.5474)
DScore	1.0025	-0.1875	-6.9870
	(5.2841)	(0.7618)	(9.0078)
DROA	-79.9160	11.0734	-306.1938
	(87.9426)	(17.1757)	(501.5846)
Observations	1914	956	943
R-squared	0.056	0.066	0.071

Table A1 Accounts payables and promissory bills payables

This table shows the results for the effect of the real and the financial measures used to cope with the recession on the amounts of accounts payable and promissory bills payable. The dependent variable is a year-over-year difference in accounts payable (DAP) in columns (1) through (3), and the difference in promissory bills payable (DPBP) in columns (4) through (6). The independent variables are the same as those in Table 5. ***, **, and * respectively indicate that the coefficient is statistically significant at the 1%, 5%, and 10% level. Robust standard errors are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	DAP	DAP	DAP	DPBP	DPBP	DPBP
AS_Red_Q	-45.0757*			-30.7736***		
	(23.7909)			(11.7181)		
AS_Dec_P	-2.4472			-9.0795		
	(18.5150)			(8.8571)		
AS_Length_AP	-73.0923					
	(100.8594)					
AS_Length_BP				23.2001		
				(37.0421)		
AS_Inc_TPratio	23.2376			-8.9988		
	(27.5468)			(34.7507)		
PS_Red_Q		-45.9344*			-22.0468*	
		(24.8194)			(11.4748)	
PS_Dec_P		-11.6770			-10.6377	
		(18.3440)			(9.1927)	
PS_Length_AP		32.4542**				
		(15.0809)				
PS_Length_BP					-0.0878	
					(36.7903)	
PS_Inc_TPratio		-13.5175			-18.4623	
		(26.2524)			(40.7352)	
OS_Red_Q			-40.5962			-40.4245***
			(24.8367)			(13.0068)
OS_Dec_P			-19.3559			-9.5301
			(19.6403)			(9.3511)
OS_Length_AP			-113.6530			
			(141.0450)			
OS_Length_BP						-42.9688
						(51.8693)
OS_Inc_TPratio			40.7748			28.8406**
			(32.5251)			(12.3129)
DAsset	0.0313	0.0314	0.0317	0.0058	0.0061	0.0056
	(0.0328)	(0.0321)	(0.0327)	(0.0130)	(0.0128)	(0.0131)
DLeverage	-74.3413	-77.9390	-73.6909	-14.7435	-17.3954	-11.7719
	(51.3142)	(50.1254)	(51.1327)	(34.4394)	(34.0314)	(34.6472)
DScore	-1.3315	-1.2076	-1.3362	4.2501*	4.2301*	4.2074*
	(3.4661)	(3.3984)	(3.4759)	(2.5159)	(2.4796)	(2.5318)
DROA	-0.1480	-15.2005	-5.2088	-61.3588*	-58.5826*	-61.1203*
	(46.7574)	(44.7909)	(46.7889)	(34.3396)	(33.6956)	(34.0352)
Accounting month	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes
Observations	1,904	1,937	1,904	1,886	1,919	1,886
R-squared	0.052	0.052	0.052	0.042	0.040	0.045

Appendix A: Accounts payable and promissory bills payable

To check the robustness of our findings, this appendix reports the results by separating trade payables into accounts payable and promissory bills payable. In Japan, buyers ordinarily settle payments by bank transfer (wire transfer) or by sending checks when the accounts payable are due. In this case, trade credit (before settlement) is recorded as accounts payable in the firms' books. However, a non-negligible number of firms in Japan settle payments by issuing paper-based *promissory bills* ("tegata" in Japanese) that promise payment at a *future* date. Once the promissory bill is issued, the relevant trade credit is turned to "promissory bills payable" on the buyer's book. There are some differences between payments using bank transfers or checks and those using promissory bills, for example, the duration (see Uchida et al. 2015 for more information).

To take into account any difference in the two forms of trade credit, we split the dependent variable into the changes in the amount of accounts payable and of promissory bills payable. Through this analysis, we can check the robustness of our findings by separately examining the effects of the two measures that correspond to the two types of trade credit: the Length_AP dummies (lengthening of the duration of account payable) and the Length_DP dummies (lengthening of the duration of promissory bills payable).

The results are reported in Table A1, where the dependent variable used in Table 4 (DTP) is replaced with the differences in accounts payable (DAP) (in columns (1) through (3)) or with the differences in promissory bills payable (DPBP) (in columns (4) through (6)). The results are mostly consistent with those in Table 4. We find that the Red_Q dummies have a negative effect on the respective dependent variables, with weaker effects for account payables. The positive effect of the third (financial) measure for the main supplier is found for account payables. In spite of these differences, the overall findings lend support to our

interpretation that the real driver of trade credit has a more significant effect.[28]

[28] When we split the sample based on the median asset size, the results for the large firms are very similar to those in Table 6 with even weaker effects of the first measure. For the small firms, the measure dummies are all statistically insignificant. These results are available from the authors upon request.