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Real Driver of Trade Credit[†]

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Abstract

Employing unique data from a corporate survey, this paper examines whether changes in the amount of firms' trade debt are driven by real and/or financial measures taken by the firms in response to exogenous shocks. We find that firms that adopted real measures reduced their trade debt, while those that adopted financial measures increased it. We also find that real measures were more common than financial ones. These findings imply that changes in the amount of underlying real transactions, not changes in the terms of credit, are the *real driver* of changes in the amount of trade credit.

Keywords: Trade credit, Real driver, Means of financing, Means of payment, Real shock
JEL classification codes: G32, L14

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1. Introduction

Trade credit has dual roles. On the one hand, it is a means of payment, taking place only when there is an underlying real transaction between a buyer and a seller (supplier). On the other hand, trade credit is a means of financing for the buyer, postponing payment to a later date. The two roles are inseparably intertwined, and it is usually difficult to empirically distinguish them from each other.

In this paper, we disentangle these two roles using unique data from a corporate survey. We take advantage of a unique occasion where trade credit's two roles manifest in different ways: i.e., when firms are hit by an adverse real shock. Such firms are likely to desire to take one or both of two different types of measures vis-à-vis their suppliers, in order to cope with the shock. First, they want to adopt real measures, e.g., a reduction in the amount of purchases or the purchase price. Second, they want to take financial measures, e.g., the postponement of the payment or an increase in the ratio of credit in the payment.

These two types of measures are closely related to the two roles played by trade credit. On the one hand, the real measures are taken to respond to the shock by adjusting the terms of real transactions. If a firm manages to take these measures, it changes the amount to be paid, and so the amount of trade debt (as a means of payment) may also change. On the other hand, the financial measures change the terms of trade debt as a means of financing, so when the firm manages to take financial measures, the amount of trade debt automatically changes. It is important to note that the two types of measures have different impacts on the amount of trade debt that the firm owes to its suppliers. Ceteris paribus, the real measures, if adopted, result in a decrease in the firm's amount of

trade debt, while the financial measures, if taken, increase it. If we can identify whether a firm adopts real and/or financial measures in response to a shock, and quantify the measures' economic impacts on the change in the amount of the firm's trade debt, we can distinctively shed light on the dual roles of trade credit. This is what we do in this paper.

Distinguishing the two roles in this manner is not trivial, and has important implications for existing studies on trade credit. Many studies have examined why trade credit is used, but the majority of these focus only on the financing role. These studies ask why suppliers, rather than financial institutions, lend to customers (for a survey, see, e.g., Petersen and Rajan 1997 and Giannetti, Burkart and Ellingsen 2011).[1] Some studies go further to examine the relationship between trade credit and other financing sources, especially whether trade credit and bank loans are substitutes or complements, and find mixed evidence (e.g., Danielson and Scott 2004, Bougheas, Mateut and Mizen 2009, Atanasova and Wilson 2004, and Molina and Preve 2012). Examining that relationship is important from a policy standpoint, because depending on whether trade credit and bank loans are substitutes or complements, the effect of monetary policy might be amplified or attenuated (e.g., Gertler and Gilchrist 1993, Marotta 1997, Choi and Kim 2005, and Mateut, Bougheas and Mizen 2006).

However, these studies, especially those examining the relationship between trade credit and other financing sources, focus mostly on the role of trade credit as a means of

[1] There are also studies that explain the use of trade credit for non-financing purposes, e.g., 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, Mateut and Mizen 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, Maksimovic and Zechner 1998).

financing, and do not fully take into account its role as a means of payment. Since the amount of real transactions limits the use of trade credit, it may be inappropriate to blindly compare trade credit with other means of financing that are not, at least to a similar extent, subject to such a constraint. There are some studies that indirectly take into account the effect of the volume of real transactions by dividing the amount of trade credit/debt by a measure of the amount of real transactions, e.g., sales or cost of goods sold (e.g., Petersen and Rajan 1997, Nilsen 2002, Giannetti, Burkart and Ellingsen 2011, and Shenoy and Williams 2011).[2] However, these studies do not quantify the magnitude of the effect.

Employing unique data from a corporate survey in Japan, we examine the differential effects on the amount of trade debt of a firm's real and financial measures to cope with a real shock. The survey enables us to identify whether firms took real and/or financial measures vis-à-vis their suppliers to cope with the recession subsequent to the global financial crisis after September 2008 when Lehman Brothers failed.[3] We regress the change in the amount of trade debt (obtained from firms' balance sheets) on indicators of these real and financial measures, and examine whether these measures have the anticipated impacts, and compare the magnitudes of these impacts.

From our empirical analysis, we find that both the real and the financial measures have the anticipated impacts. For firms that reduced the quantity of purchases to respond to the shock, the amount of trade debt decreased in an economically significant manner,

[2] For example, Nilsen (2002), which uses a VAR model to study trade credit and the bank lending channel, states that he controls for "the transactions motive" (= almost identical to what we refer to as the "real constraint") by using the accounts payable / sales ratio, "since we expect a sales reduction at the onset of tight money to induce a reduction in AP" (p. 232).

[3] The failure of Lehman Brothers was a landmark event for the Japanese economy because the contraction in the economy began after the failure.

while for those that lengthened the period of accounts payable, the amount of trade debt increased. The decrease in trade debt due to the real measure is robust when we control for endogeneity by taking into account whether the firms were able to adopt real and/or financial measures. Furthermore, we find that the number of firms that took the financial measure is far smaller than the number that took the real measure, and that the economic impact of the real measure was significant for many firms. On balance, the real measures are the primary driver of the change in the amount of trade debt in this crisis period. These findings suggest that the real constraint tightly binds the amount of trade debt.

Because we only consider a recession period (in which real transactions are volatile), we cannot necessarily generalize our findings to the ordinary (i.e., non-recession) environment. However, our findings urge caution for existing studies that solely focus on the financing role of trade credit. Much of the fluctuation of trade credit might be due to fluctuations in the amount of real transactions. For example, a reduction in the volume of real transactions, which decreases the amount of trade debt, might also decrease the demand for short-term bank loans, because the firm shrinks its operations. Alternatively, the reduction in the volume of real transactions might instead increase the demand for bank loans, because the firm needs to finance inventory. Thus, positive or negative statistical correlations between trade credit and bank loans found by existing studies might not represent the true substitutability or complementarity of the two alternative financing sources, and instead might simply be spurious correlations.

The reminder of this paper proceeds as follows. In section 2, we introduce our data, and section 3 explains our variables and methodology. Section 4 reports the results. In

section 5, we check the robustness of the results. The final section concludes the paper.

2. Data

2.1 Data source

The main data source for this paper is a corporate survey conducted in Japan on February 2009 by the Research Institute of Economy, Trade, and Industry (RIETI), called the *Survey on the Status of Transactions between Businesses and Financial Institutions following the Financial Crisis* in February 2009 (hereafter the RIETI 2009 survey)[4]. This survey aims to measure the status of firms' financing after the impact of the recession due to the global financial crisis.

The failure of Lehman Brothers on September 2008 was a landmark event for the Japanese economy, because it was after this failure that the effect of the financial crisis in the U.S. and Europe was transmitted to Japan. Thus, the survey asks questions about the measures taken by firms to cope with the exogenous real shocks that followed September 2008. The survey asks separately about measures taken vis-à-vis suppliers, customers, and banks. In this paper we focus on those taken vis-à-vis suppliers.[5]

We can also link the survey data with the financial statement of each responding firm that was compiled by Tokyo Shoko Research inc. (TSR). TSR is one of the largest credit bureaus in Japan. We use the statements for years 2008 and 2009.

[4] Uesugi et al.(2009) report the summary statistics and include the survey questionnaire.
[5] Ogawa and Tanaka (2012).examine different measures and types of shocks.

2.2 Sample selection

The RIETI 2009 survey is a follow-up survey to the survey conducted on February 2008 (the RIETI 2008 survey), which asked firms about their characteristics and their relationships with their suppliers, customers, and banks.[6] The original 2008 survey targeted 17,018 firms that were chosen from among the firms that had already 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 36.0%), 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%).

From among these 4,103 firms, we first eliminate those that did not identify their main supplier, or those that answered that the identity of their main supplier had changed between 2008 and 2009. From among the remaining 3,165 firms, we further eliminate firms whose financial statement information is not available for either 2008 or 2009, and those that did not answer the questions about the measures taken vis-à-vis the main suppliers to respond to the recession. As a result of this sample selection process, our baseline sample consists of 1,638 firms, although the number of observations is smaller in the regression analyses due to the non-availability of some variables.

[6] See Uesugi et al.(2009).

3. Methodology

3.1 Regression and the dependent variable

We run the following regression for firm *i* (=1, ... ,N):

$$Trade\ debt\ change_{i,2009-2008} = a_0 + a_1 \cdot Measures_{i,2009.2} + a_2 \cdot Controls_{i,2008} + \varepsilon_i . \quad (1)$$

The dependent variable, $Trade\ debt\ change_{i,2009-2008}$, is the change in the amount of trade debt from 2008 to 2009. The vector $Measures_{i,2009.2}$ represents our main independent variables, constructed from the survey, which indicate the real and the financial measures taken by the firm to cope with the adverse shock. The vector $Controls_{i,2008}$ represents control variables, and ε_i is an ordinary error term.

We are interested in the signs and the magnitudes of the coefficients in the vector a_1, which represent the economic impacts of the real and the financial measures taken vis-à-vis suppliers. We take these measures as given (i.e., we do not take into account when the firms were able to take the measures), and we examine the impacts of the measures after they were actually adopted. This is because our interest is in the quantification of the impact of the measures. However, as we will show in a later section, our main findings are robust to possible endogeneity in the real and financial measures taken by firms.

For the amount of trade debt, we use the sum of accounts payable and promissory bills payable on the firms' balance sheets. In Japan buyers ordinarily settle payments by bank

transfer (wire transfer) or by sending checks when accounts payable are due, but a non-negligible number of firms issue paper-based promissory bills (tegata); in this case the sellers' banks collect the bills at maturity. There are some differences between payments by bank transfer or checks and payment by promissory bills, e.g., the length of duration, but both are common methods of credit payment in Japan.[7]

We use two alternative measures for the dependent variable. First, DTP/Asset is the one-year difference in the level of trade payables normalized by total assets. Second, DTP is a non-normalized one-year difference in the level of trade payables. The use of the first measure allows us to control for the difference in the magnitudes of the impacts of independent variables that depend on firm size, but we use the second measure as well because we are also interested in the gross impact of independent variables.[8] Using these variables, we examine whether taking measures to cope with the recession lead to an increase or decrease in the amount of trade debt.[9]

3.2 Measures to cope with adverse shock

The main independent variables are dummy variables representing real and/or financial measures taken by the responding firms. In the RIETI 2009 survey, there is a question about firms' responses to the global financial crisis and the subsequent recession.

[7] See Uchida et al.(2010) for more information.
[8] In both cases, to exclude outliers, we eliminate those sample firms whose DTP is less than the 1% percentile or more than the 99% percentile. Also, to focus on the change in the dependent variables due to the firms' measures adopted after September 2008 (the Lehman shock) and February 2009 (when the survey was conducted), we also eliminate sample firms whose accounting year does not start on March through September.
[9] The main results reported below are qualitatively unchanged even if we take the natural logarithm of DTP to account for a non-linear impact.

It reads: "*How did you respond to the financial crisis and the recession? From the list below, choose all the sentences that explain actual measures you took after September 2008.*" Responding firms are provided with seven options to choose from regarding measures taken vis-à-vis suppliers (multiple answers allowed):

1. Reduced the quantity of purchases
2. Decreased the price of purchase goods
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

In this question, the measures vis-à-vis the main suppliers and those vis-à-vis the other (non-main) suppliers are asked separately. The main supplier is defined as the largest supplier(s), or the supplier(s) from which the firm purchases the most. The question is limited to purchases of products or goods, with purchases of services or commission sales (purchases) excluded in advance.

Among the seven options above, we call options 1 and 2 *real* measures. This is because choosing these options means that the firm coped with the recession by directly changing the quantity or price of real transactions, not by changing the method by which payments were made. On the other hand, we call options 3-5 *financial* measures. This is because the choice of these options means that the firm coped with the recession by changing

(easing) the terms of trade credit payments.[10]

Based on these answers, we create five dummy variables to represent the real or financial measures taken to cope with the recession. A dummy variable S_MEASUREMEASURE01 takes a value of unity if option 1 is chosen vis-à-vis the main supplier. The other four dummies S_MEASUREMEASURE02-05 are similarly defined. We also create dummy variables OS_MEASUREMEASURE01-05 in a similar manner using the answer vis-à-vis the other (non-main) suppliers. Furthermore, we create dummy variables AS_MEASUREMEASURE01-05 that take a value of unity if, respectively, S_MEASUREMEASURE01-05 and/or OS_MEASUREMEASURE01-05 equal one. These AS dummies indicate that the respective measures are taken vis-à-vis any supplier. The variables labeled with 01 and 02 are dummies indicating real measures, and those with 03-05 indicate financial measures.

If buyers responded to the recession by real measures, by definition the amount of purchases decreased. This tightens the *real constraint* on the amount of trade debt, because the purchase amount is the upper limit of trade debt that the buyer firm can obtain from its suppliers. If the real constraint is binding, we would expect to find that the coefficient for the dummy labeled with 01 or 02 is negative. However, the coefficient might be insignificant, because the constraint might not be binding for a variety of reasons. For example, firms might reduce only the amount of outright (i.e., non-credit) payment, and not the amount of credit payment, when the amount of purchases decreases. Also,

[10] Note that these financial measures do not imply the validity of financial theories of trade credit as opposed to non-financial ones (see footnote 1). That is, both the financial and the non-financial theories can explain the adoption of the financial measures that we define here.

the magnitude of the real measures, e.g., the reduction in the purchase price, might be economically small.

As for the financial measures, they postpone credit payments, which directly increases the amount of trade debt as long as the impact of these measures is economically significant. The expected signs of these dummies are therefore positive. However, we may find that these dummies are insignificant to the extent that the magnitudes of the financial measures are economically small, e.g., the delay is only one or two days out of a much longer duration.

In panel (A) of Table 1, we report the descriptive statistics for our dummies representing real or financial measures. Regardless of which suppliers we focus on (i.e., "main," "others," or "any"), we find that real measures are far more frequent than financial ones. More than 23% of the responding firms answer that they "2. Decreased the price of purchase goods" to cope with the recession. The next most frequently taken measure is also a real measure: around 15% of the firms answered that they "1. Reduced the quantity of purchases." Compared with these, the financial ones (i.e., those labeled with 03-05) are less frequently taken. These findings suggest that the impact of real constraints is significant, although we are not yet sure whether these measures actually reduced the amount of trade debt.

It is worthwhile to note that if the responding firms want to adopt financial measures to cope with the shock, they tend to (or can) do so vis-à-vis banks rather than suppliers. As explained above, the RIETI 2009 survey also asks whether the firms took measures vis-à-vis banks. Among our sample firms, 31.0% answered that they borrowed money

from their top lending bank to cope with the adverse shock. This 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 in the recession period. The responding firms had another option to choose as a financial measure vis-à-vis top lending banks, which is that the firms postponed repayment to their top lending bank. Only 2.8 % of the sample firms took this measure.

In Table 2, we report the correlation coefficient matrix of the measure dummies vis-à-vis top lending banks and those vis-à-vis main suppliers. In this table, B_MEASURE01 is a dummy indicating that the firm borrowed money from its top lending bank to cope with the shock, and B_MEASURE02 is a dummy indicating that the firm postponed repayment to the top lending bank. We find that the two measures vis-à-vis top lending banks are generally positively associated with the financial measures vis-à-vis main suppliers. This might imply that borrowing from main banks and taking out trade debt from main suppliers are complementary activities. However, because the two measures also have a positive correlation with the real measures taken vis-à-vis main suppliers, these findings might simply imply that firms try to take as many measures as possible to cope with an adverse shock.

3.3 Control variables

Because we take one-year differences in the dependent variables, we do not need control variables to represent time-invariant factors such as firm fixed effects. We include control variables whose one-year differences might affect the dependent variables:

the one-year change in total assets (DAsset/Asset in the DTP/Asset regression, and DAsset in the DTP regression), the change in firm leverage (DLeverage), the change in TSR's score of the firm (DScore), and the change in ROA (DROA=difference in Operating income/Assets).[11,12] The impact of these measures on the dependent variable might differ depending on when the accounting year of the firms starts. We thus add accounting month dummies to control for such differences.

We do not use industry dummies, because less than 1 percent of the responding firms changed their industry. Also, we do not use variables for suppliers. This is because we have already eliminated firms for which the main suppliers changed. For non-main suppliers, we have no available information to use as a control.

Panel (B) of Table 1 reports the descriptive statistics for independent variables other than those shown in panel (A). We find that more than half of the firms decreased their amount of trade debt in the period from 2008 to 2009.

4. Results

Table 3 reports our main results. Column (1) through (3) show the results when we use DTP/Asset as the dependent variable, and column (4) through (6) show those when we use DTP. The main independent variables are the real and the financial measures taken

[11] Because we find extreme values in DAsset, we eliminate those sample firms whose DAsset is less than the 1% percentile or more than the 99% percentile.

[12] 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, e.g., their own risk management. It takes a value between 0 and 100, with 50 meaning 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%).

vis-à-vis the main supplier in columns (1) and (4), those vis-à-vis the non-main suppliers in columns (2) and (5), and those vis-à-vis any supplier in column (3) and (6). Some of the control variables consistently have the predicted impacts across all specifications. For example, an increase in asset size increases the amount of trade debt, and in the first three columns the decrease in the TSR score reduces it.

Focusing on the variables of our primary interest, we consistently find that MEASUREMEASURE01 dummies (i.e., S_MEASUREMEASURE01, OS_MEASUREMEASURE01, or AS_MEASUREMEASURE01) have significant impact on the amount of trade debt in all specifications. As we explained above, each MEASUREMEASURE01 dummy indicates that the responding firms reduced the quantity of purchases from the main supplier, from the other suppliers, or from either, to cope with the recession. Consistent with the prior prediction, this measure results in a decrease in the amount of trade debt. These findings suggest that the real constraint on the amount of trade debt binds in an economically significant manner. However, MEASUREMEASURE02 dummies are insignificant, so the decrease in purchase prices does not lead to an observable reduction in the amount of trade debt. This suggests that the decrease in the purchase price might be small and/or that the buyer firms might only reduce the amount of *non*-credit payment in return for the price decrease.

Another finding that is also consistent across different specifications is that MEASURE03 dummies (i.e., S_MEASURE03, OS_MEASURE03, or AS_MEASURE03) have significant and positive coefficients, regardless of which suppliers we focus on. These are the dummy variables that indicate that in response to the recession, the firm

lengthened the duration of accounts payable for payment to the main supplier, other (non-main) suppliers, or any supplier(s). Thus, our findings indicate that firms' trade debt tends to increase due to this postponement of payments. This suggests that changing the terms of credit payment is also an important driver of the change in the amount of trade debt, although the number of firms that adopted this financial measure is small (see Table 1). However, the dummy variables for other financial measures are insignificant. This might be because the magnitudes of these measures are economically small.

We can compare the relative magnitude of the economic impacts of real versus financial measures. From column (4), we find that if a firm decreased the purchase quantity from the main supplier (i.e., if S_MEASURE01 = 1), this on average reduced the amount of trade debt by 65 million yen.[13] On the other hand, if the firm lengthened the duration of accounts payable, it resulted in an increase in the amount of trade debt by 112 million yen. Thus, for those firms that took both measures, i.e., a reduction in the quantity of purchases as well as the lengthening of the duration of accounts payable, the overall amount of trade debt increased, ceteris paribus.

Because the number of firms that took the first measure (S_MEASURE01=1) is far larger than the number of those that took the third (S_MEASURE03=1) (see Table 1), the overall economic impact of the real measure on the amount of trade debt is larger than that of the financial measure. If we add up the impacts for the whole sample of firms, the reduction in the quantity of purchases decreases the total amount of trade debt by 16.91

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

billion yen (=-64.92* 15.9% * 1638 firms), while the lengthening of the maturity of accounts payable increases the total amount of trade debt by 2.12 billion yen (= 111.57 * 1.16% * 1638 firms). To put it differently, changes in the amount of trade debt for our sample firms is driven primarily by the tightened real constraint, and not by adjustments of the terms of trade credit.

On balance, we find that a non-negligible fraction of the change in the amount of trade debt is driven by the change in the amount of underlying real transactions. This finding suggests that the real constraint for trade credit is binding, and is severe, at least in the crisis period. This finding urges caution when interpreting changes in trade credit merely as the result of an adjustment of terms of trade credit as a means of financing.

5. Robustness checks

5.1 Accounts payable and promissory bills payable

This section provides some robustness checks on our findings. First, we decompose our dependent variables, i.e., trade payables, into accounts payable and promissory bills payable, and analyze them separately. As explained in section 3,2 the RIETI 2009 survey separately asks about financial measures with respect to accounts payable (indicated by MEASURE03 dummies) and to promissory bills payable (indicated by MEASURE04 dummies.) Thus, the impact of these dummies might change if we split up the dependent variable in the same manner.

The results are reported in Table 4. In this estimation, the one-year differences in trade payables (DTP) used in Table 3 are replaced with differences in accounts payable

(DAP) (in columns (1) through (6)) or those in promissory bills payable (DPBP) (in columns (7) through (12)). The results are consistent with those found in Table 3. We consistently find that the MEASURE01 dummies have a negative impact on the respective dependent variables. Note that the statistical and/or economic impacts of the financial measures are weaker in this table. These findings lend support to our interpretation that the real constraint on trade credit significantly limits the change in the amount of trade debt.

5.2 Endogeneity

As another robustness check, we take into account the possible endogeneity in the choice of the real and/or financial measures. The estimation thus far might be biased due to endogeneity problems. For example, in the crisis period, suppliers with strong bargaining power might demand a reduction in the volume of transactions for their own sake (rather than for the sake of the buyers) *and* at the same time reduce the amount of credit that they grant. A similar problem might also bias the results for the financial measures. For example, risky firms are likely to experience difficulty in taking financial measures, because suppliers would be reluctant to ease trade credit terms to such firms. For the same reason, the suppliers might directly decrease the supply of trade credit to such firms.

To address such problems, we estimate a multinomial treatment effects model that explicitly takes into account the choice of the real and financial measures. The first stage of the estimation is a multinomial regression for the choice of the measures, and the

second stage is a regression for the change in the amount of trade debt (i.e. what we have taken as the dependent variable thus far).

Because the first-stage regression requires that the choices be nested, we reorganize the five measure-dummies into three. The first variable S_REALONLY indicates that the firm adopted at least one real measure, but no financial measure, vis-à-vis the main supplier; it is defined as taking a value of unity if S_MEASURE01=1 and/or S_MEASURE02 = 1 and if S_MEASURE03-05 are all zero. The second variable S_FINONLY indicates that the firm adopted one or more financial measures, but no real measures, vis-à-vis the main supplier, which is defined as taking a value of unity if S_MEASURE01-02 are both zero and if one of the dummy variables S_MEASURE03-05 takes a value of unity. The third and final variable, S_BOTH, that indicates that the firm adopted at least one real and one financial measure vis-à-vis the main supplier, which is defined as taking a value of unity if S_MEASURE01=1 and/or S_MEASURE02 = 1 and if at least one of the dummy variables S_MEASURE03-05 takes a value of unity. The default is no choice of any measures.

In the multinomial treatment model, we need an instrument that affects the first-stage dependent variables but not the second-stage one. We use several alternative instruments, all of which represent the relative bargaining power or the strength of relationships between the responding firms and their main suppliers, obtained from the RIETI 2008 survey: the fraction of purchases from the main supplier (S_PURCHASE_RATIO), the length (years) of transactional relationship with the main supplier (S_DURATION), and a dummy variable to indicate that the firm and the main

supplier have frequent contact with each other (more than once a week) (S_MEETING). These variables do not affect the second stage dependent variables, because we have already excluded firms that changed their main suppliers from 2008 to 2009 and so these variables represent firm fixed effects. We also use an industry dummy as an additional instrument; because the number of observations is small for many industries, we use a dummy variable for manufacturing firms (Manufacturing). As control variables, we also use ROA, leverage (LEVERAGE) and the TSR score (SCORE) (in 2008) in the first stage.

The results are shown in Table 5. From the first stage, we find that a firm with frequent contact with its main supplier tends to adopt both real and financial measures. We also find that manufacturing firms tend to adopt real measures more frequently, possibly because their purchases are large. Profitable firms (in terms of ROA) and highly-scored firms do not take financial measures, possibly because they do not need to do so. These findings are consistent with existing evidence showing that it tends to be less creditworthy firms that rely on trade credit (e.g., Petersen and Rajan 1997).

Our main focus is on the second stage. The results are consistent with our earlier ones. Even after controlling for the endogeneity, we still find that taking real measures does reduce the amount of trade debt. Thus, we can conclude that the real constraint on trade credit is binding, and is an economically significant driver of the change in the amount of trade credit.

6. Conclusion

Taking advantage of the uniqueness of the data from the crisis period, we disentangled the change in the amount of trade credit due to real versus financial measures taken to

cope with the recession. We thereby clarified the severity of the real constraint on trade credit. We find that both measures have an effect, but real measures are more important for a large number of firms. Our findings imply that the real constraint on trade credit is severe, and drives a non-negligible portion of the changes in the amount of trade debt. This urges caution for existing studies that do not explicitly take this constraint into account, especially those examining the substitutability and/or complementarity of trade credit and bank loans.

Note that our analysis deals with firms' responses to a real shock in the recession period. Thus, we cannot completely reject the possibility that the severity of the real constraint might be observed only in recessions, and that adjustment of the terms of trade credit as a means of financing might be more important in an ordinary economic environment. Investigation of the relative importance of the two roles of trade credit, i.e., payment versus financing, in different environments is an important issue for future research.

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Table 1 Descriptive statistics

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

Panel A

Variable	Definition	Obs	Mean	Median	Std. Dev.	Min	Max
S_MEASURE01	Dummy = 1 if the firm reduced the quantity of purchases from the main supplier to cope with the recession	1638	0.1587	(NA)	(NA)	0	1
S_MEASURE02	Dummy = 1 if the firm decreased the price of goods purchased from the main supplier to cope with the recession	1638	0.2613	(NA)	(NA)	0	1
S_MEASURE03	Dummy = 1 if the firm lengthened the sight [= duration] of accounts payable for payment to the main supplier to cope with the recession	1638	0.0116	(NA)	(NA)	0	1
S_MEASURE04	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	1638	0.0049	(NA)	(NA)	0	1
S_MEASURE05	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	1638	0.0147	(NA)	(NA)	0	1
OS_MEASURE01	Dummy = 1 if the firm reduced the quantity of purchases from the other suppliers to cope with the recession	1611	0.1508	(NA)	(NA)	0	1
OS_MEASURE02	Dummy = 1 if the firm decreased the price of purchase goods from the other suppliers to cope with the recession	1611	0.2353	(NA)	(NA)	0	1
OS_MEASURE03	Dummy = 1 if the firm lengthened the sight [= duration] of accounts payable for the payment to the other suppliers to cope with the recession	1611	0.0074	(NA)	(NA)	0	1
OS_MEASURE04	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	1611	0.0025	(NA)	(NA)	0	1
OS_MEASURE05	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	1611	0.0130	(NA)	(NA)	0	1
AS_MEASURE01	Dummy = 1 if the firm reduced the quantity of purchases from any supplier to cope with the recession	1611	0.1750	(NA)	(NA)	0	1
AS_MEASURE02	Dummy = 1 if the firm decreased the price of purchase goods from any supplier to cope with the recession	1611	0.2756	(NA)	(NA)	0	1
AS_MEASURE03	Dummy = 1 if the firm lengthened the sight [= duration] of accounts payable for the payment to any[supplier to cope with the recession	1611	0.0112	(NA)	(NA)	0	1
AS_MEASURE04	Dummy = 1 if the firm lengthened the sight [= duration] of promissory bills payable for the payment to any supplier to cope with the recession	1611	0.0056	(NA)	(NA)	0	1
AS_MEASURE05	Dummy = 1 if the firm increased the ratio of payments by promissory bills or on account to total payments to any supplier to cope with the recession	1611	0.0168	(NA)	(NA)	0	1

Panel B

Variable	Definition	Obs	Mean	Median	Std. Dev.	Min	Max
DTP/Asset	$(\text{Trade payables}_{2009} - \text{Trade payables}_{2008})/\text{Asset}_{2008}$	1638	-0.040	-0.020	0.097	-0.686	1.390
DTP	$\text{Trade payables}_{2009} - \text{Trade payables}_{2008}$ (in million yen)	1638	-144.045	-16.854	427.056	-4880.730	484.792
DAsset/Asset	$(\text{Asset}_{2008} - \text{Asset}_{2007})/\text{Asset}_{2007}$	1638	0.005	-0.007	0.162	-0.613	1.075
DAsset	$\text{Asset}_{2008} - \text{Asset}_{2007}$ (in million yen)	1638	-19.510	-4.572	487.056	-3752.150	2759.528
DLeverage	$(\text{Total debt/Asset})_{2008} - (\text{Total debt/Asset})_{2007}$	1638	-0.008	-0.008	0.079	-0.771	0.975
DScore	$\text{Score}_{2008} - \text{Score}_{2007}$	1638	-0.584	0.000	2.157	-12.000	9.000
DROA	$(\text{Operating income/Asset})_{2008} - (\text{Operating income/Asset})_{2007}$	1638	-0.004	-0.002	0.060	-0.485	0.484

Table 2 Correlation between real and financial measures vis-à-vis main suppliers and vis-à-vis main banks

This table shows the correlation coefficients among the dummy variables indicating the real and financial measures taken vis-à-vis main suppliers (S_MEASURE01-05) and those vis-à-vis main banks (B_MEASURE01-02). B_MEASURE01 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_MEASURE02 takes a value of one if the firm postponed 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.

	S_MEASURE01	S_MEASURE02	S_MEASURE03	S_MEASURE04	S_MEASURE05	B_MEASURE01	B_MEASURE02
S_MEASURE01	1.0000						
S_MEASURE02	0.2040***	1.0000					
S_MEASURE03	0.0563**	0.0227	1.0000				
S_MEASURE04	-0.0067	-0.0014	0.0722***	1.0000			
S_MEASURE05	0.0019	0.0774***	0.1718***	0.1374***	1.0000		
B_MEASURE01	0.1195***	0.1285***	0.0261	0.0288	0.0939***	1.0000	
B_MEASURE02	0.0774***	0.0175	0.1886***	0.0411*	0.1086***	0.0219	1.0000

Table 3 Regression results

This table shows the results for the impact on the amount of firms' trade debt of the real and the financial measures taken to cope with the recession. The dependent variables are one-year differences in trade payables, normalized by asset (DTP/Asset in column (1)-(3)) or not (DTP in column (4)-(6)). The main independent variables are those labeled with "MEASURE"; these are dummies indicating that the firm took measures to respond to the recession. The variables labeled with S_ indicate the measure taken vis-à-vis main suppliers, those with OS_ indicate the measures vis-à-vis the other suppliers, and those with AS_ respectively indicate the measures vis-à-vis any suppliers. The variables with 01 indicate that the firm reduced the quantity of purchases from the relevant supplier(s), and those labeled with 02 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 03 indicate that the firm lengthened the duration of accounts payable for payment to the relevant supplier(s), those labeled with 04 indicate that the firm lengthened the duration of promissory bills payable for payment to the main supplier, and those labeled with 05 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 Table 1. ***, **, 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/Asset	DTP/Asset	DTP/Asset	DTP	DTP	DTP
S_MEASURE01	-0.0217***			-64.9186**		
	(0.0061)			(30.0861)		
S_MEASURE02	-0.0039			-17.4676		
	(0.0059)			(25.5456)		
S_MEASURE03	0.1104*			111.5727***		
	(0.0660)			(27.0461)		
S_MEASURE04	-0.1158**			48.8761		
	(0.0497)			(54.4797)		
S_MEASURE05	0.0509			-36.3013		
	(0.0502)			(76.4896)		
OS_MEASURE01		-0.0247***			-96.8011***	
		(0.0063)			(34.7923)	
OS_MEASURE02		0.0030			-23.0175	
		(0.0059)			(27.6817)	
OS_MEASURE03		0.0709*			104.2835***	
		(0.0373)			(27.9577)	
OS_MEASURE04		-0.0407			19.9814	
		(0.0440)			(74.2184)	
OS_MEASURE05		0.0240			55.0957	
		(0.0192)			(45.5204)	
AS_MEASURE01			-0.0218***			-87.9538***
			(0.0058)			(32.1877)
AS_MEASURE02			0.0008			-1.0991
			(0.0055)			(25.7623)
AS_MEASURE03			0.0440			103.4223***
			(0.0289)			(25.9050)
AS_MEASURE04			-0.0727*			99.9735*
			(0.0436)			(56.7390)
AS_MEASURE05			0.0148			-11.8206
			(0.0173)			(67.8830)
DAsset/Asset	-0.0849***	-0.0700***	-0.0734***			
	(0.0239)	(0.0220)	(0.0216)			
DAsset				0.0263	0.0250	0.0246
				(0.0578)	(0.0603)	(0.0600)
DLeverage	0.0148	0.0255	0.0387	-50.0505	-33.8814	-44.0068
	(0.0559)	(0.0536)	(0.0510)	(89.9787)	(93.5228)	(92.0674)
DScore	-0.0004	-0.0007	-0.0007	-2.2164	-2.3445	-2.2065
	(0.0011)	(0.0011)	(0.0011)	(5.5426)	(5.7387)	(5.6767)
DROA	0.0081	0.0466	0.0473	-27.3100	-41.7921	-30.0718
	(0.0577)	(0.0473)	(0.0471)	(78.7937)	(80.9541)	(81.3802)
Accounting month dummies	yes	yes	yes	yes	yes	yes
Observations	1,638	1,611	1,611	1,638	1,611	1,611
R-squared	0.052	0.032	0.032	0.032	0.037	0.035

Table 4 Accounts payables and promissory bills payables

This table shows the results for the impact on a firm's amount of trade debt of the real and the financial measures taken to cope with the recession. The dependent variables are one-year differences in accounts payable (normalized by asset (DAP/Asset in column (1)-(3)) or not (DAP in column (4)-(6)) and in promissory bills payable, normalized by asset (DPBP/Asset in column (1)-(3)) or not (DPBP in column (4)-(6)). The independent variables are the same as those in 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)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	DAP/Asset	DAP/Asset	DAP/Asset	DAP	DAP	DAP	DPBP/Asset	DPBP/Asset	DPBP/Asset	DPBP	DPBP	DPBP
S_MEASURE01	-0.0093**			-51.9422**			-37.8099***			-0.0129***		
	(0.0043)			(25.4565)			(12.7635)			(0.0037)		
S_MEASURE02	-0.0024			-9.7005			-12.0279			-0.0011		
	(0.0046)			(20.3798)			(10.0605)			(0.0034)		
S_MEASURE03	0.0926			60.0971***								
	(0.0660)			(15.2186)								
S_MEASURE04							6.7444			-0.0306		
							(34.8580)			(0.0238)		
S_MEASURE05	0.0479			7.3791			-25.0045			-0.0007		
	(0.0486)			(31.0348)			(51.2247)			(0.0103)		
OS_MEASURE01		-0.0104**			-57.2116**			-50.8307***			-0.0139***	
		(0.0044)			(27.2675)			(14.3732)			(0.0041)	
OS_MEASURE02		0.0029			-13.9645			-18.7062*			-0.0004	
		(0.0044)			(21.9354)			(10.7355)			(0.0035)	
OS_MEASURE03		0.0483			55.4017***							
		(0.0375)			(19.4828)							
OS_MEASURE04								-37.6354			-0.0781**	
								(56.0399)			(0.0362)	
OS_MEASURE05		0.0127			37.3194			37.1368**			0.0189*	
		(0.0161)			(33.1879)			(14.5320)			(0.0104)	
AS_MEASURE01			-0.0099**			-54.8739**			-41.6126***			-0.0123***
			(0.0042)			(25.1198)			(13.0101)			(0.0037)
AS_MEASURE02			0.0030			0.7438			-11.4335			-0.0021
			(0.0041)			(20.3067)			(9.7875)			(0.0034)
AS_MEASURE03			0.0272			54.2827***						
			(0.0276)			(15.1636)						
AS_MEASURE04									35.3406			-0.0306
									(37.5913)			(0.0222)
AS_MEASURE05			0.0081			26.5019			-16.4539			0.0043
			(0.0133)			(29.3676)			(45.1630)			(0.0092)
DAsset/Asset	-0.0424**	-0.0322*	-0.0323*							-0.0392***	-0.0384***	-0.0395***
	(0.0210)	(0.0183)	(0.0183)							(0.0146)	(0.0146)	(0.0148)
DAsset				-0.0136	-0.0159	-0.0165	0.0091	0.0098	0.0092			
				(0.0413)	(0.0428)	(0.0428)	(0.0210)	(0.0219)	(0.0218)			
DLeverage	-0.0164	0.0120	0.0131	6.4827	14.5876	15.5736	-21.2487	-14.6646	-18.4054	0.0170	0.0142	0.0186
	(0.0578)	(0.0507)	(0.0507)	(44.5109)	(46.1261)	(46.2263)	(41.4905)	(43.0563)	(42.3033)	(0.0261)	(0.0251)	(0.0263)
DScore	-0.0009	-0.0012	-0.0013	-1.5705	-1.4400	-1.3845	2.6478	2.4972	2.6172	0.0007	0.0006	0.0007
	(0.0009)	(0.0008)	(0.0008)	(2.8095)	(2.9062)	(2.8903)	(2.2879)	(2.3483)	(2.3289)	(0.0006)	(0.0006)	(0.0006)
DROA	0.0030	0.0411	0.0420	25.2087	22.2114	28.7468	-58.4585	-67.6293	-62.7330	0.0046	0.0068	0.0052
	(0.0509)	(0.0369)	(0.0369)	(48.4026)	(49.7312)	(50.1119)	(41.4454)	(42.5049)	(42.4263)	(0.0286)	(0.0295)	(0.0296)
Accounting month dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,658	1,631	1,631	1,658	1,631	1,631	1,658	1,631	1,631	1,658	1,631	1,631
R-squared	0.045	0.024	0.022	0.036	0.037	0.036	0.018	0.024	0.020	0.028	0.032	0.029

Table 5 Multinomial treatment effects model

This table shows the results for the impact on a firm's amount of trade debt of the real and the financial measures taken by the firm to cope with the recession. 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 represented by the dummy variables S_REALONLY, S_FINONLY, and S_BOTH, respectively. The default is the choice of no such measures. S_REALONLY takes a value of unity if S_MEASURE01 and/or S_MEASURE02 = 1 and if S_MEASURE03-05 are all zero (see Table 1 for the definition of these S_MEASURE dummies). S_FINONLY takes a value of unity if S_MEASURE01-02=0 are both zero and if one of the dummy variables S_MEASURE03-05 takes a value of unity. S_BOTH takes a value of unity if S_MEASURE01 and/or S_MEASURE02 = 1 and if one of the dummy variables S_MEASURE03-05 takes a value of unity. The independent variables for the first stage are the ratio of purchases from the main supplier (S_PURCHASE_RATIO), the natural logarithm of the length (years) of transactional relationship with the main supplier (log(S_DURATION)), a dummy to indicate that the firm and the main supplier have contact more than once a week (S_MEETING), dummies for manufacturing firms (Manufacturing), ROA, leverage (LEVERAGE) and the TSR score (SCORE). The dependent variables for the second stage are the one-year difference in trade payables, normalized by asset (DTP/Asset in column (1)) or not normalized (DTP in column (2)). The independent variables for the second stage are the same as those used in 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)			
	1st stage			2nd stage	1st stage			2nd stage
Dependent variable	S_REALONLY	S_FINONLY	S_BOTH	DTP/Asset	S_REALONLY	S_FINONLY	S_BOTH	DTP
S_REALONLY				-0.0335***				-79.9994**
				(0.009)				(33.789)
S_FINANCIALONLY				0.1056***				163.8185*
				(0.025)				(93.053)
S_BOTH				-0.0079				4.1880
				(0.022)				(84.241)
DAsset/Asset								0.0175
								(0.021)
DAsset				-0.0652***				
				(-0.017)				
DLeverage				-0.0555				-2.9944
				(0.037)				(134.098)
DScore				-0.0009				3.5475
				(0.001)				(4.867)
DROA				0.0223				-50.4839
				(0.046)				(176.700)
S_PURCHASE_RATIO	-0.3788	-0.2210	-0.6743		-0.3777	-0.2379	-0.6480	
	(0.282)	(1.076)	(0.998)		(0.284)	(1.066)	(0.985)	
log(S_DURATION)	-0.0030	-0.0247	-0.0133		-0.0038	-0.0244	-0.0135	
	(0.004)	(0.020)	(0.016)		(0.004)	(0.020)	(0.016)	
S_MEETING	0.0374	-0.6080	1.5439***		0.0529	-0.6545	1.5164***	
	(0.138)	(0.548)	(0.581)		(0.139)	(0.550)	(0.580)	
Manufacturing	0.4633***	-1.5469	-0.2323		0.4818***	-1.5663	-0.2447	
	(0.154)	(1.062)	(0.593)		(0.157)	(1.061)	(0.593)	
ROA	-0.5177	-4.1285*	0.5657		-0.7311	-4.1197*	0.6765	
	(1.116)	(2.429)	(3.060)		(1.109)	(2.447)	(3.071)	
LEVERAGE	0.4860*	0.3337	-0.1319		0.3519	0.4045	-0.1469	
	(0.282)	(0.568)	(0.893)		(0.281)	(0.556)	(0.895)	
SCORE	0.0110	-0.1785***	-0.1742***		0.0109	-0.1746***	-0.1740***	
	(0.013)	(0.059)	(0.052)		(0.013)	(0.058)	(0.051)	
Accounting month dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations			1,381				1,381	
Log Likelihood			231.9				-11172	