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Trade Credit in Global Supply Chains*

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Abstract

This study examines how trade credit is utilized in global supply chains, using a unique dataset that includes information on firm-level supplier-customer relationships for major firms in the global economy. We focused on two potential factors of trade credit: firms' upstreamness in global supply chains and competition among suppliers, or similarly, the bargaining power of customers. Although recent literature found a positive correlation between upstreamness and trade credit, we find the correlation is insignificant when we control for competition among suppliers and the bargaining power of customers. The correlation between firms' upstreamness and trade credit is positive and significant only in Japan. In contrast, we find that the competition among suppliers and bargaining power of customers are positively and significantly correlated with trade credit in a robust manner. Because upstreamness and competition among suppliers are often positively correlated, our finding suggests the need to incorporate competition in the literature on trade credit and upstreamness.

Keywords: global supply chains, trade credit, upstreamness, bargaining power
JEL classification: L14, G35

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1. Introduction

Trade credit is inter-company credit from a seller to a customer with no bank intermediation (Auboin and Engemann 2014). When a firm sells goods or services that will be paid for later, trade credit is recorded as accounts receivable in the balance sheet of the firm (Amiti and Weinstein 2011). It is extensively used in both domestic and international transactions between suppliers of intermediate goods and their customers downstream in the supply chain (Antràs and Foley 2015, Cunat 2007). It has been suggested that trade credit is the most important source of short-term financing for firms (Petersen and Rajan 1997). Average accounts payable at the firm level are higher than debt in current liabilities in five of the Group of Seven countries (Rajan and Zingales 1995). In Japan, 78 percent of small and medium enterprises (SMEs) in the manufacturing sector utilize trade credit, and 34 percent rely more on transactions using trade credit than on immediate payments (Tokyo Shoko Research 2013).

Various theories have been proposed to explain the preference for trade credit over loans from financial institutions (Biais and Gollier 1997, Brennan, Maksimovic, and Zechner 1988, Burkart and Ellingsen 2004, Schwartz 1974, Smith 1987). These theories have also been tested empirically (Cunat 2007, Fabbri and Klapper 2016, Fisman and Raturi 2004, Giannetti, Burkart, and Ellingsen 2011, McMillan and Woodruff 1999, Mian and Smith 1992, Petersen and Rajan 1997). These studies found that suppliers may more effectively obtain the necessary information about their customers than financial institutions and use their traded products as collateral. Moreover, many of the empirical studies above have observed that suppliers provide more trade credit when customers are more creditworthy and suppliers have better access to financing.

More recently, the literature has examined two new factors of trade credit. First, Kim and Shin (2012) and Kalemli-Ozcan et al. (2014) theoretically argued that trade credit is provided to mitigate the moral hazard of suppliers. The two studies further argue that because moral hazard is accumulated upstream through supply chains and firms' production networks, more upstream firms are required to provide larger amounts of trade credit and hence hold additional working capital. If this description is accurate, such propagation mechanisms may magnify financial shocks and thus harm national economies if they are not moderated by adequate policies. Kalemli-Ozcan et al. (2014) and Gofman (2013) found empirical evidence of credit accumulation upstream, using firm-level data and measures of upstreamness at the industry and firm levels, respectively.

Second, some studies claim that competition among suppliers and, similarly, the bargaining power of customers over suppliers affects the provision of trade credit. According to an empirical analysis by McMillan and Woodruff (1999), more trade credit is provided when the competition among suppliers is weaker, because customers are more willing to repay trade credit under such relational contracting. In contrast, Fisman and Raturi (2004) argue the opposite: when a customer has many potential suppliers, suppliers are willing to provide more trade credit to prevent customers from switching to other suppliers. Fisman and Raturi (2004), Fabbri and Klapper (2016), and Demir and Javorcik (2017) present supporting

evidence at the firm-level that competition among suppliers and bargaining power of customers promotes the provision of trade credit.

However, these two new important factors, upstreamness and competition, have not been analysed simultaneously in the same models, so we do not know how they relate to each other and which may be dominant.

Using firm-level supply chain data for major global firms, the present study examines how trade credit is affected by upstreamness in supply chains and competition among suppliers. This extensive dataset enables us to simultaneously employ measures of both upstreamness in supply chains, similar to those of Gofman (2013), and of competition among suppliers, similar to those of Fisman and Raturi (2004) and Fabbri and Klapper (2016), in the same estimation.

This analysis contributes the following new findings to the literature on trade credit. First, we find that while upstreamness is positively correlated with trade credit, the correlation becomes insignificant when we include measures of competition among suppliers in the models. This is likely because upstream firms tend to be smaller and produce standardized products that are subject to fiercer competition. Our result implies that the positive correlation between upstreamness and trade credit found in Kalemli-Ozcan et al. (2014) and Gofman (2013) is overvalued because their estimations do not incorporate any measure of competition.

Second, we use the average number of suppliers of all customers of a particular firm as a proxy for the competition that the firm faces from other existing suppliers of their customers. The bargaining power of customers over suppliers is represented by the ratio of average assets of a firm's customers to its own assets. Both measures are similar to those employed in Fabbri and Klapper (2016). We find that the two measures, particularly the measure of bargaining power of customers, are significantly correlated with trade credit, confirming that competition among suppliers promotes the extension of trade credit to their customers.

Third, when we incorporate the share of foreign customers to represent competition in the global market, we find no significant effect of the foreign share, although the two measures of competition in general are still positively correlated with trade credit. This implies that exports are not necessarily associated with more trade credit than domestic transactions, although this has been theoretically implied due to the longer delivery time in international transactions (Amiti and Weinstein 2011). This comparison between domestic and cross-border transactions has not been examined in the extant literature.

Fourth, we examine heterogeneity across countries and find that more upstream suppliers provide larger amounts of trade credit in Japan, although the correlation is not significant in other countries. This is consistent with the empirical finding of Kim and Shin (2012) that Japan is different from most major countries in how much a firm’s accounts receivable translate into its accounts payable. The uniqueness of Japan may be related to its unique structure of supply chains, referred to as *keiretsu* (Aoki 1988, Dyer and Nobeoka 2000, Matous and Todo 2017), in which suppliers are closely and exclusively linked with their customers. This result implies that the applicability of the findings by Kim and Shin (2012) and Kalemli-Ozcan et al. (2014) may depend on the national institutional environment.

Although this study is primarily concerned with the determinants of trade credit, it is also related to a growing literature on the role of supply chains in the propagation of economic shocks (Acemoglu et al. 2012, Acemoglu, Akcigit, and Kerr 2016, Carvalho et al. 2016, Kashiwagi, Todo, and Matous 2018, Lu et al. 2017). The propagation of financial shocks through networks of financial institutions has also received attention since the global financial crisis (Elliott, Golub, and Jackson 2014). Kiyotaki and Moore (1997), Raddatz (2010), Jacobson and von Schedvin (2015), and Bigio and La'O (2016) argue that financial shocks and defaults can propagate through supply chains due to the presence of trade credit and be amplified into a large and persistent downturn in aggregate activities. If trade credit is accumulated upstream through supply chains, as argued by Kim and Shin (2012) and others, the indirect effect of a financial shock becomes larger as the shock spreads to more upstream firms that provide larger amounts of trade credit. However, our finding that upstreamness is not generally correlated with trade credit implies that financial shocks are not amplified as they propagate upstream. This implication is consistent with the finding of Bricongne et al. (2012) that during the global financial crisis, the effect of credit constraints on trade volume was limited.

This study is also related to the growing body of research on trade credit in international transactions. Despite its prevalence, economists have paid little attention to the role of trade credit in exports. Only recently, Antràs and Foley (2015) used transaction data of one US firm, including exports to more than 140 countries, and found that the quality of governance in the importers' countries and the characteristics of relationships between exporters and importers determined financing terms in each transaction, for example, whether to use trade credit or bank credit. Using detailed international trade data for Turkey, Demir and Javorcik (2017) found that an increase in competitive pressures from globalization leads exporters to provide more trade credit. The present study uses data for global supply chains and examines trade credit in international transactions from a different perspective, that is, how exports affect exporters' trade credit.

Finally, this study also contributes to the policy-making arena. In practice, extensive use of trade credit is a large burden, particularly for SMEs, as they bear the risk of customer default and therefore need to maintain significant amounts of working capital. Because of this problem, the Japanese government recently requested that customers pay immediately in transactions with SMEs (Small and Medium Enterprise Agency of Japan 2016). The present study can better inform such policies.

The rest of the paper is organized as follows. The next section explains empirical methodologies, whereas Section 3 describes data. Section 4 provides the results and discussion. Section 5 concludes.

2. Empirical Methodologies

2.1 Conceptual Framework and Research Hypotheses

The determinants of trade credit have been theoretically proposed and empirically tested in the literature. Among these, the present study focuses on the following two in particular.

Upstreamness

Kim and Shin (2012) and Kalemli-Ozcan et al. (2014) theoretically show that avoiding moral hazard is one reason for the utilization of trade credit. Customers can mitigate the moral hazard problem that

suppliers will provide products of inadequate quality by delaying their payments until the products have been delivered and tested. Furthermore, Kim and Shin (2012) and Kalemli-Ozcan et al. (2014) argue that the moral hazard problem accumulates upstream through supply chains and therefore more upstream suppliers need to hold larger amounts of working capital to provide greater trade credit to their customers. For a simple explanation, suppose that there are three firms: One is a final assembler, another is a first-tier supplier to the final assembler, and the third is a second-tier supplier of material to the first-tier supplier. The final assembler delays its payment to the first-tier supplier and receives trade credit. Then, because of a lack of finances, the first-tier supplier needs to further delay its payment to the second-tier supplier and receive a larger amount of trade credit. Accordingly, we obtain the following key hypothesis to be empirically tested in this study.

Hypothesis 1. Suppliers in higher upstream positions in global supply chains provide more trade credit, or hold larger accounts receivable than downstream firms.

Kalemli-Ozcan et al. (2014) find empirical evidence supporting this hypothesis, using firm-level data and a measure of upstreamness at the industry level based on input-output tables developed in Antràs and Chor (2013) and Antràs et al. (2012). Using firm-level data for the US taken from Capital IQ of Standard & Poor's that include information on major suppliers for each publicly listed firm, Gofman (2013) defines measures of upstreamness at the firm level from the full supply-chain network of 2,735 sample firms as the minimum and average number of steps of supplier-customer relationships from final-good producers linked to the particular firm. He finds that trade credit is positively associated with these upstreamness measures, confirming this hypothesis. The present study extends the firm-level measures of upstreamness of Gofman (2013) to global supply chains to examine this hypothesis beyond national boundaries.

Competition

Competition among suppliers may increase or decrease the amount of trade credit that a supplier offers to its customer. McMillan and Woodruff (1999) argue that when the customer cannot easily find an alternative supplier, the customer is locked in and thus is more willing to repay its trade credit because otherwise the customer would lose the supplier. Knowing that the customer will repay trade credit under relational contracting, the supplier provides more trade credit to the customer. Using firm-level data from Vietnam, McMillan and Woodruff (1999) empirically found that the share of a bill paid by customers after delivery, a measure of trade credit provided by a particular supplier, is negatively related to the number of similar suppliers, confirming their theoretical argument.

In contrast, Fisman and Raturi (2004) predict the exact opposite. Fisman and Raturi (2004) suggest that when a customer has many potential suppliers, suppliers are willing to provide more trade credit to prevent the customer from switching to other suppliers. Using firm-level data from five sub-Saharan African countries, Fisman and Raturi (2004) found support for their prediction. Fabbri and Klapper (2016) also found that suppliers are more likely to provide trade credit when suppliers have greater bargaining power, in other words, when their largest customer has more suppliers and the market of their product is less monopolistic.

Demir and Javorcik (2017) examined the same issue from the perspective of international economics. Based on Schmidt-Eisenlohr (2013) and Antràs and Foley (2015), Demir and Javorcik (2017) theoretically derived that exporters would be expected to provide more trade credit in more competitive environments. Taking the end of the Multi-Fibre Arrangement (MFA) as an exogenous shock that increases competitive pressure in Turkey, Demir and Javorcik (2017) found that after the elimination of the MFA, the share of exports in which trade credit was used increased for products formerly protected by the MFA. The empirical results of Fisman and Raturi (2004), Fabbri and Klapper (2016), and Demir and Javorcik (2017) consistently support the argument that competition among suppliers promotes trade credit to avoid customer switching, while they oppose the argument of McMillan and Woodruff (1999) that monopoly generates relational contracting between suppliers and customers and promotes trade credit.

We approximate the degree of competition among suppliers by the number of suppliers of customers of a particular firm and formulate the following hypothesis based on the studies reviewed above. Because these studies do not reach a consensus in terms of the effect of competition on trade credit, we leave the result whether competition increases or decreases competition to empirical investigation.

Hypothesis 2. Suppliers provide more (or less) trade credit to customers with a larger number of suppliers.

Another related hypothesis considers the relative size of customers to suppliers as a measure of customers' bargaining power over suppliers. Demir and Javorcik (2017) theoretically argue that to attract customers, suppliers are more likely to provide trade credit to customers with more outside options. In practice, customers have more outside options when they are larger in scale and reach and have more information about and better access to a larger number of potential suppliers. In addition, large customers are more likely to receive favourable trade credit terms from their smaller suppliers due to their greater market power (Giannetti, Burkart, and Ellingsen 2011) and product quality warranty (Antràs and Foley 2015). Accordingly, our third hypothesis is as follows.

Hypothesis 3. Suppliers provide more trade credit to customers who are larger relative to the suppliers.

Finally, similar to customers' size, the degree of internationalization may also affect the utilization of trade credit, because importers are more likely to have more outside options and greater market power than domestic customers. Moreover, because transportation takes longer in international transactions, suppliers are likely to provide longer term trade credit to international customers (Amiti and Weinstein 2011). Therefore, our fourth hypothesis is as follows.

Hypothesis 4. Suppliers provide more trade credit to overseas customers than to domestic customers.

Other factors

Besides the two key novel factors of trade credit, we also consider the traditional determinants of trade credit that are commonly used in the literature. Petersen and Rajan (1997) argue that when suppliers have access to internal and external financing, they are more likely to provide trade credit to their customers. Petersen and Rajan (1997) utilize firm size measured by the value of assets, firm age, and the ratio of profits to sales as proxies for the credit worthiness of suppliers. They found a positive correlation between the value of assets and firm age and the ratio of suppliers' accounts receivable to sales. These variables were also used by Fabbri and Klapper (2016) and Giannetti, Burkart, and Ellingsen (2011).

Besides suppliers' access to financing, customers' credit quality also affects the trade credit they can obtain. Petersen and Rajan (1997) utilize customers' credit quality measured by customers' assets, profit margins, and age, finding mostly positive correlations with customers' purchases on account divided by assets. Cunat (2007) argues that the level of liquid assets and collateral of customers is negatively correlated with their accounts payable because customers with a high level of liquid assets and collateral can rely on lending from financial institutions rather than trade credit. Using the amounts of cash and bank deposits and of land and fixed assets, both divided by total assets, to represent the level of liquid assets and collateral, respectively, Cunat (2007) confirms a negative correlation of the ratio of accounts payable to total assets. Petersen and Rajan (1997), Cunat (2007), and Giannetti, Burkart, and Ellingsen (2011) theoretically argue that firms receive more trade credit from their suppliers rather than from financial institutions when the link between suppliers and customers is tighter because of suppliers' informational advantages over financial institutions. Some studies find empirical support for this prediction, although it is often difficult to measure the strength of links between suppliers and customers.

2.2 Estimation Methods

To test the hypotheses above, we estimate the following equation:

$$TradeCredit_{ijc} = \alpha + \beta_1 Upstream_{ijc} ++ \beta_2 Competition_{ijc} + \gamma X_{ijc} + \mu_{jc} + e_{ijc}, \quad (1)$$

where $TradeCredit_{ijc}$ is a measure of trade credit provided by firm i in industry j located in country c to its customers, $Upstream_{ijc}$ is a measure of the upstreamness of firm i in global supply chains, and $Competition_{ijc}$ represents a measure of the degree of competition among suppliers. X_{ijc} represents control variables taken from the literature described above, including firm i's age, total assets, and profit rate. In addition, we control for country-industry fixed effects μ_{jc}. Details of the definition of the variables used in the estimations are explained in the following section.

We estimate equation (1) using ordinary least squares (OLS) estimations. To incorporate possible correlation of errors within the same country and industry, we use robust standard errors clustered at the country-industry level. One possible source of bias in the OLS estimations is endogeneity arising from, for example, unobserved firm characteristics that affect both trade credit and some key independent variables. We minimize the possible biases by including a standard set of controls as well as country-industry dummies. Previous studies have mostly relied on OLS, logit, probit, or tobit estimations without fully incorporating

endogeneity issues (Fabbri and Klapper 2016, Fisman and Raturi 2004, Giannetti, Burkart, and Ellingsen 2011, Gofman 2013, Kalemli-Ozcan et al. 2014, McMillan and Woodruff 1999, Petersen and Rajan 1997), while some employed firm fixed-effects (Fisman and Raturi 2004) and generalized method of moments (GMM) estimations (Cunat 2007) or utilize a natural experiment (Demir and Javorcik 2017). Following this methodological approach, we mostly rely on OLS estimations using cross-sectional data. However, to test the robustness of the results, we also experiment with firm fixed-effects estimations using panel data for two years, although the coverage of the panel data is substantially lower than that of the cross-sectional data.

3. Data

3.1 Description of Data

We utilize a unique dataset constructed from two firm-level datasets. First, information on transaction relationships is taken from FactSet Revere's LiveData. FactSet Revere collects information from public sources, including financial reports and websites of firms in the world, and confirms the reliability of the information by human eyes. Because LiveData relies on public sources, it includes mostly publicly listed firms. The information in LiveData includes supply chain relationships, enabling us to identify the supplier and customer in each relationship. Using this detailed information, we can map global supply chains among major firms in the world and construct measures of their position in the network, such as upstreamness, for each firm.

Although LiveData are available from 2003, firms outside the US are not widely covered until 2015. Table 1 shows the number of supply-chain links in LiveData and the share of US suppliers in the total links from 2011 to 2015. The number of links increased from 37 thousand in 2011 to 77 thousand in 2014 to 96 thousand in 2015, whereas the share of US suppliers declined from 58 percent to 37 percent during the same period. We believe that the drastic increase in the number of links and the drastic decrease in the US share do not reflect an actual change in transactions but are due to expansion of the coverage of non-US firms in the dataset. Therefore, this study mostly focuses on supply-chain data for 2015, where the coverage of non-US firms is large enough to minimize bias. However, to check the robustness of our results, our alternative estimations also use data for 2014 and 2015 to control for firm fixed effects.

Second, detailed financial information at the firm level, including information on sales, assets, trade credit (e.g., accounts receivable and payable), and working capital is taken from Osiris, a global database of publicly listed companies collected by Bureau van Dijk Electronic Publishing. Osiris also targets mostly publicly listed firms.

We combine the two datasets using the International Security Identification Number (ISIN), creating a unique dataset for firms in 34 countries around the world. We exclude firms in the finance, insurance, real estate, and public administrations sector (according to North American Industry Classification System [NAICS] 2012 at the 2-digit level), because firms in these industries are less likely to be involved in global supply chains. We keep firms in other service sectors, such as the wholesale, retail, logistics, and information industries, because they may be part of global supply chains. After matching the two datasets and cleaning the data, our dataset consists of 7,924 firms and 55,655 supply chain ties. The third and fourth columns of

Table 2 show the distribution of firms in our sample by country. The last column indicates the number of publicly listed firms for reference. Note that our sample is smaller than the whole population of listed firms in the world, mostly because our analysis utilizes only firms whose supplier or customer is identified in LiveData. In the sample, 58 percent of firms are in the manufacturing sector, while 11 percent are in the mining, utilities, and construction sector. The rest of the firms are in service sectors, such as wholesale, retail, and information industries.

3.2 Definition of Key Variables

We construct three sets of variables to test our hypotheses: variables regarding firms' trade credit, measures of upstreamness and competition, and control variables. The level of trade credit is defined as the ratio of accounts receivable to total assets, a measure often used in the literature, such as Cunat (2007) and Giannetti, Burkart, and Ellingsen (2011). We also experiment with the ratio of accounts receivable to sales or revenue used in Petersen and Rajan (1997) and Kalemli-Ozcan et al. (2014). Because the results are similar, the rest of this study focuses on the ratio to total assets.

The second set of variables measures the firm's upstreamness in global supply chains, as defined in Gofman (2013). Using the supply-chain information for major firms in the global economy, we can construct and analyse the complex networks of interactions among these firms. One useful network measure is the mean of the shortest paths from the focal firm to all final purchasers, or firms without any customer in our dataset, that may be accessed by one or more steps in the global supply-chain network downstream from the focal firm. Another measure is the number of steps in the longest of the shortest paths to each final purchaser accessible from the focal firm downstream in the global network. These upstreamness measures are constructed from the raw LiveData for supply-chain relationships before being merged with Osiris for financial information and omitting firms with missing information. To incorporate possible nonlinear relationships with trade credit, we add one to each upstreamness measure and take a log. The correlation coefficient of the two upstreamness measures is 0.992, indicating that the two are closely correlated.

The level of competition among suppliers is measured in three ways, based on the theoretical argument in Section 2.1. First, we employ the average number of suppliers of all customers of the focal firm. When customers of a supplier are trading with other suppliers, the supplier can be considered as being in a competitive market, rather than creating a relational contract with its customers. The second measure is the ratio of average assets of customers of the focal firm to its own assets. This also represents the bargaining power of customers over their suppliers. When customers are large relative to their supplier, the supplier may be less secure in maintaining the link with customers and thus be more willing to provide more trade credit. The third measure is the share of foreign customers in the total number of customers of the focal firm, representing the degree of competition in the global market. It should be noted that the first two variables were not used in Fabbri and Klapper (2016), and to our knowledge, the share of foreign customers has not been used in previous research on trade credit, probably because of the difficulty of obtaining this information.

Control variables consist of two categories: one for attributes of the focal firm, and the other for attributes of its customers. The first category includes standard variables used in the literature, such as firm age in log, total assets in log, and profit margins. Another variable rarely used in research on trade credit, but used in Fabbri and Klapper (2016), is the number of customers in log. The second category of control variables includes the ratio of the average profit margins of customers of the focal firm to its own profit margins and the ratio of the average current assets of its customers to its own current assets. The former represents the credit quality of customers, while the latter indicates the customers' level of collateral. Finally, we include country-industry dummies in all estimations, defining industries at the NAICS two-digit level. The definitions of the key variables are summarized in Table 3.

3.3 Descriptive Statistics

Table 4 shows descriptive statistics of the key variables. In 2015, the mean of the ratio of accounts receivable to assets was 15.16 percent, which is comparable to ratios reported in previous research (Jacobson and von Schedvin 2015, Kalemli-Ozcan et al. 2014). The mean of the mean and maximum paths to final purchasers is 3.92 and 8.64, respectively, implying the existence of long and complex supply chains in our data. The average number of customers is 7.02. This average number may sound relatively small, but it should be emphasized that our data cover only major transactions between firms for which information is publicly disclosed. The average number of suppliers of customers of each firm is 45.8, which is much larger than the average number of customers. This is because suppliers are more likely to be connected with customers that have many links and therefore each hub firm contributes a high number of suppliers to a high number of clients in this count. It also means that the level of competition among suppliers is generally high. The average ratio of customers' average assets to own assets is 2.61. This indicates that customers are generally larger than their suppliers or, in other words, firms in a more upstream position in global supply chains are likely to be smaller. The means of the variables in 2014 are shown in the last column in Table 4, which are not very different from those in 2015.

Table 5 provides the 2015 means of the key variables by 2-digit industry. The mean of upstreamness is higher for firms in the manufacturing sector (NAICS code 31-33) than for firms in the wholesale (42), retail (44-45), health care (62), and accommodation (72) sectors. Trade credit is generally larger in the construction (23), wood, paper, and chemical (32), and metal and machinery (33) industries than in the wholesale, retail, and transportation (48) industries.

Table 6 provides the 2015 means of the key variables by country. In highly technologically advanced countries such as the US and Germany, the upstream measures are large and the numbers of customers are also large. In contrast, upstreamness is low in India, a less advanced country. This finding suggests that firms in less advanced countries assemble parts and components produced in more advanced countries. The level of trade credit is highest in Japan.

4. Results

4.1 Results of the Cross-Sectional Analysis

Table 7 presents the results from our benchmark specifications. The dependent variable is the ratio of accounts receivable to assets. As a measure of upstreamness, we use the average path length from final purchasers indirectly linked with the firm through global supply chains in the odd-numbered columns and the maximum path length in the even-numbered columns. We start with the estimation using only the upstream variables and controls and no measure of competition in columns (1) and (2). We then introduce each of the three competition measures individually in columns (3)-(8) to avoid possible multicollinearity among the three. Finally, the model is estimated with the full set of all three measures of competition in columns (9) and (10).

Columns (1), (2), (7), and (8) of Table 7 indicate that the upstream measures of suppliers are positively correlated with the trade credit they provide to their customers at the 10- or 5-percent levels of significance. The results are consistent with the theoretical prediction of Kim and Shin (2012) and empirical support by Kalemli-Ozcan et al. (2014) and Gofman (2013) that trade credit is accumulated upstream through supply chains. However, when we incorporate two of the measures of competition among suppliers, that is, the average number of suppliers of each firm's customers and/or its customers' assets relative to its own assets, in columns (3)-(6), (9), and (10), neither of the two upstream measures is significantly correlated with trade credit. This is probably because the upstreamness measures and the two competition measures are closely correlated. The correlation coefficient between the mean upstreamness measure and the average number of suppliers of customers and between the same upstreamness measure and customers' relative assets is 0.772 and 0.564, respectively. The correlation coefficients for the maximum upstream measures with the two competition measures are 0.802 and 0.593. These positive and large correlation coefficients indicate that upstream firms in supply chains are more likely to be small relative to their customers and are exposed to competition among similar suppliers. Therefore, the positive and significant correlation of upstreamness with trade credit in the specifications without the two competition measures may capture the correlation between competition and trade credit. Because the empirical analysis of Kalemli-Ozcan et al. (2014), Kim and Shin (2012), and Gofman (2013) do not incorporate competition among suppliers, their finding that upstreamness is positively correlated with trade credit may have been overestimated.

In addition, two of the measures of competition among suppliers, the average number of suppliers of customers of the firm and customers' assets relative to the firm's own assets, are positively correlated with trade credit, as shown in columns (3)-(6), (9), and (10). Although the two measures are closely correlated (the correlation coefficient is 0.743), the correlation between either of the two and trade credit is highly significant even when both are included in columns (9) and (10). That is, the correlations are quite robust. Moreover, the magnitude of the correlation, particularly that between customers' assets and trade credit, is substantial. Applying the standard deviations of the variables in Table 4 to the coefficients in column (9) of Table 7, we find that an increase in the average number of customers' suppliers and the ratio of customers' assets to own assets of one standard deviation leads to an increase in the ratio of accounts receivable to assets

by 7 and 93 percent of its standard deviation, respectively. Thus, we conclude that competition among suppliers and bargaining power of customers require suppliers to provide significantly more trade credit. In contrast, the share of foreign customers, a specific measure of the degree of competition in the global market, is consistently insignificantly correlated with trade credit in columns (7)-(10). This result indicates that the specific degree of competition in the global market does not play a role different from competition in general.

Other control variables are mostly consistent with previous findings in the literature. For example, firm age, which is possibly related to the supplier's access to financing, has a positive correlation with trade credit in all columns of Table 7, as found in Petersen and Rajan (1997) and Cunat (2007). The negative relationships between suppliers' assets (representing firm size) and trade credit and also between profit rate (representing credit worthiness) and trade credit are not easy to interpret, but have sometimes been found in studies such as Petersen and Rajan (1997) and Giannetti, Burkart, and Ellingsen (2011). This is possibly because the number of customers is included as an independent variable and is positively and significantly correlated with trade credit in any specification, so firm size and credit worthiness are fully captured by this variable. Finally, the ratio of customers' current assets to the supplier's own assets is negatively associated with trade credit. As Cunat (2007) argues, when customers have a large amount of collateral, they can rely on credit from financial institutions, not on credit from suppliers. The negative relationship between customers' current assets and trade credit may capture this effect.

4.2 Results of the Panel Analysis

As mentioned in Section 3.1, we mostly rely on cross-sectional data for 2015 because supply-chain information is substantially restricted in earlier years (Table 1). However, we also construct a panel dataset for the two years of 2014 and 2015 to incorporate firm fixed effects and thus minimize biases due to time-invariant unobserved firm characteristics that affect both trade credit and upstreamness. We use a balanced panel in which each firm has information in both 2014 and 2015. We do not use data before 2014, because the coverage of the dataset in and before 2013 is less than 60 percent of the coverage in 2015 (Table 1).

The results from fixed-effects estimations are provided in Table 8. As is often the case, some of the statistically significant coefficients in OLS estimations (Table 7) become insignificant after controlling for firm fixed effects. However, significance for some variables survives. Most notably, customers' relative assets are significantly correlated with the ratio of accounts receivable to assets, confirming that the competition among suppliers and bargaining power of customers promote provision of trade credit. Moreover, the correlation between the upstreamness measures and trade credit is insignificant in all specifications, confirming our conclusion that after controlling for competition among suppliers and the bargaining power of customers, upstreamness does not necessarily determine trade credit.

4.3 Heterogeneity across Countries

The relationships between upstreamness and trade credit and between competition and trade credit may vary across countries due to their institutional characteristics. To see possible heterogeneity across countries, we estimate equation (1) for suppliers in each of the top six countries, the US, China, Japan, South Korea,

Taiwan, and the United Kingdom, in our data shown in Table 6 with industry dummies, rather than country-industry dummies. The results from OLS estimations using data in 2015 are presented in Table 9. The OLS results for the US in panel (A) are similar to those for all countries in Table 7. That is, while the upstream measures are positively and significantly correlated with trade credit, the significance disappears when the competition measures are incorporated. As Gofman (2013) used data from the US and found a significantly positive correlation between upstreamness and trade credit without controlling for competition among suppliers, our results are consistent with those of Gofman (2013) and further provide new evidence. One notable finding from the results for the six countries is that customers' assets consistently show a positive and significant correlation with trade credit, confirming our finding in Tables 7 and 8. More importantly, another finding is that the upstream measures are positively and significantly correlated with trade credit for Japanese suppliers in a consistent manner (panel C). The magnitude of the correlation is substantial, because an increase in the mean upstreamness by one standard deviation (0.79 for Japan) leads to an increase in the ratio of accounts receivable to assets by 1.65 (= 0.79 * 2.087), which is 13.7 percent of one standard deviation of the measure of trade credit.

We further utilize the panel data for 2014 and 2015 and run fixed-effects estimations. The results shown in Table 10 are quite different from those in Table 9 using OLS estimations, possibly because of a small number of observations for each country. Thus, we depend less on the results from the fixed-effects estimations, but it should be emphasized that the positive correlation between upstreamness and trade credit for Japanese suppliers survives after controlling for firm fixed effects (panel C), indicating that the correlation is quite robust.

4.4 Discussion

The results above lead to four important implications. First, upstreamness of suppliers in global supply chains is not necessarily correlated with trade credit, despite the theoretical and empirical findings of Kim and Shin (2012), Kalemli-Ozcan et al. (2014), and Gofman (2013). A major difference between the present study and previous ones is that we incorporate measures of competition among suppliers and bargaining power of customers into the empirical analysis together with measures of upstreamness, which previous studies did not do. Suppliers in more upstream positions in global production networks tend to be smaller firms that provide standardized parts and components. The most likely interpretation is that because these smaller upstream suppliers face more severe competition from other similar suppliers and their customers' stronger bargaining power, they are forced to provide more trade credit to their customers. This uncovered systematic trend in a large global dataset supports numerous anecdotal complaints reported in popular media of large powerful companies using smaller suppliers as their 'banks' (Courtenay 2016, Ryan 2017). This finding also implies that the positive correlation between upstreamness and trade credit found in existing empirical studies may have been overvalued and perhaps general worries about the 'domino effect' of accumulated debt might have been overstated (Innes 2017).

Second, although the effect of upstreamness on trade credit is not observed in general, the effect is positive, significant, and robust particularly for Japanese suppliers even after controlling for the

competition effect and firm fixed effects. This is consistent with the empirical finding of Kim and Shin (2012) using firm-level data for OECD countries that the correlation between accounts payable and accounts receivable is substantially larger in magnitude for Japan than for the US, the UK, and South Korea. Their finding implies that in Japan, a firm's accounts receivable from its customers is largely translated into its accounts payable to its suppliers, resulting in a more substantial role of upstreamness in explaining trade credit. Supply chains in Japan, particularly those in the automobile industry and its supporting industries, are peculiar in that suppliers are tightly and often exclusively connected to their customers with long-term relationships, known as *keiretsu* (Dyer and Nobeoka 2000, Aoki 1988). Webs of stable reciprocated relationships among Japanese firms are arguably more instrumental in Japanese business than a competitive strategy (Lincoln and Gerlach 2004). Under such conditions, competition among suppliers is less important in determining trade credit, and suppliers are willing to provide trade credit to sustain the relationship with their customers. Because of that, trade credit in supply chains accumulates upstream.

Third, we find that when the degree of competition among suppliers and the bargaining power of customers over suppliers are larger, suppliers are required to provide more trade credit to their customers to prevent switching of customers to other suppliers. This interpretation is consistent with the theoretical and empirical findings of Fisman and Raturi (2004) and Fabbri and Klapper (2016). However, our result goes against the argument of McMillan and Woodruff (1999) that under relational contracting between a customer and its exclusive supplier, the supplier is willing to provide trade credit because the customers can be trusted to repay the debts. However, our study describes mainly the core of the global production network capturing the main global players and the most important connections among them. In this sample of mostly publicly listed global firms, relational contracting may be less important in most countries than competitive pressures. Although this result has already been found in Fisman and Raturi (2004) and Fabbri and Klapper (2016), our contribution is that we confirm their result in global supply chains.

Finally, we incorporated the share of foreign customers among all customers to represent the supplier's exposure to competition in the global market in particular and found no significant correlation of this variable with trade credit. Because we control for other competition measures that show a positive correlation with trade credit, we interpret this result as competition in export markets likely affecting provision of trade credit in a way similar to competition in local markets.

5. Conclusions

This study examines how trade credit is utilized in global supply chains, using a unique dataset that includes information on firm-level supplier-customer relationships for major firms in the global economy. We focused on two potential factors of trade credit: firms' upstreamness in global supply chains and competition among suppliers, or similarly, the bargaining power of customers. Although recent studies such as Kim and Shin (2012), Kalemli-Ozcan et al. (2014), and Gofman (2013) found a positive correlation between upstreamness and trade credit, we find the correlation to be insignificant when we control for competition among suppliers and the bargaining power of customers. The correlation between firms' upstreamness and trade credit is significant only in Japan. In contrast, we find that competition among suppliers and bargaining

power of customers are positively and significantly correlated with trade credit in a robust manner. Because upstreamness and competition among suppliers are often positively correlated, our findings suggest the need for incorporating competition in the research on trade credit in supply chains.

Our results provide an important policy implication. Previous research suggests that when firms are linked through trade credit, financial shocks propagate quickly through supply chains (Kiyotaki and Moore 1997, Jacobson and von Schedvin 2015). If a firm in global supply chains is negatively affected by an economic shock and goes bankrupt, its suppliers can also be heavily affected because the suppliers cannot receive the delayed payments from the bankrupted customer. Our results suggest that in Japan, where trade credit is accumulated upstream due to recursive moral hazard, this propagation is more severe. To avoid the propagation of financial shocks through supply chains, the government should reduce the upstream accumulation of trade credit as propagation of financial shocks incurs externalities. The Japanese government has indeed tried to shrink trade credit provided by upstream SMEs by issuing an administrative notification that request customers to delay their payments as little as possible in 2016 (Small and Medium Enterprise Agency of Japan 2016). Although the notification is not a formal regulation, most of the automobile manufacturers, such as Toyota Motor Corporation, have eliminated delayed payments to their suppliers (Small and Medium Enterprise Agency of Japan 2017). In the light of the uniqueness of Japan identified in this study, this policy can be justified.

Finally, one caveat of this study should be noted. Our sample consists primarily of large and publicly listed firms in developed countries and excludes SMEs. Because upstream firms are more likely to be SMEs, further evidence, especially from developing countries, is needed to judge whether upstream SMEs in global supply chains are burdened by the accumulation of too much trade credit upstream and whether government interventions, similar to those implemented in Japan, would be recommended.

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Table 1.

	Total number of supply-chain links	The supplier is a US firm	Share of US suppliers
2011	37,472	21,862	0.583
2012	50,217	26,495	0.528
2013	59,075	28,623	0.485
2014	77,412	32,092	0.415
2015	95,722	35,019	0.366

Table 2: Firm Distribution by Country and Industry

	Raw data		After matching and cleaning		No. of publicly listed firms in 2015
Country	No. of firms	Percent	No. of firms	Percent	
US	10,234	17.74	1,498	18.9	4,381
China	4,690	8.13	1,211	15.28	2,827
Japan	3,445	5.97	954	12.04	3,504
UK	2,232	3.87	343	4.33	1,858
South Korea	1,572	2.72	674	8.51	1,948
India	1,555	2.70	138	1.74	5,835
Canada	1,436	2.49	266	3.36	3,799
Germany	1,300	2.25	205	2.59	555
Australia	1,155	2.00	232	2.93	1,989
Taiwan	941	1.63	566	7.14	875
Total	57,693	100.00	7,924	100	45,020

Sources: LiveData, World Federation of Exchanges database.

Table 3: Definition of variables

Variable name	Definition
Trade credit	
Receivable/assets	Accounts receivable/total assets (%)
Receivable/sales	Accounts receivable/sales (%)
Upstream measures	
Mean upstream (log)	ln(mean of shortest paths to most downstream firms + 1)
Max upstream (log)	ln(maximum shortest path to most downstream firms + 1)
Competition measures	
# suppliers of customers (log)	ln(average number of suppliers of customers of the focal firm + 1)
Customers' assets/own (log)	Average assets of customers/own assets (quasi log)
Share of foreign customers	Share of foreign customers in all customers (raw ratio)
Own characteristics	
# customers (log)	ln(number of customers + 1)
Age (log)	ln(firm age)
Assets (log)	ln(total assets + 1)
Profit rate	Profit/revenue (raw ratio)
Customers' characteristics	
Customers' profit rate	Average profit rate of customers
Customers' current assets/own (log)	Average current assets of customers/own current assets (quasi log)

Note: Following Burbidge, Magee, and Robb (1988), we use the inverse hyperbolic sine transformation, $\ln(x + x^2+1)^{1/2})$, rather than $\ln(x+1)$, for some variables.

Table 4: Descriptive Statistics

	2015				2014
Variable	Mean	S.D.	Min.	Max.	Mean
Trade credit					
Receivable/assets	15.16	12.48	0.00	261.44	16.04
Upstream measures					
Mean upstream	3.92	2.62	0.00	13.97	3.77
-- (log)	1.35	0.81	0.00	2.71	1.27
Max upstream	8.64	5.73	0.00	21.00	7.87
-- (log)	1.84	1.13	0.00	3.09	1.68
Competition measures					
# suppliers of customers	45.84	64.46	0.00	488.00	44.22
# suppliers of customers (log)	3.18	2.05	0.00	6.88	3.19
Customer assets/own	2.61	2.53	0.00	16.38	2.38
Share of foreign customer	0.40	0.41	0.00	1.00	0.37
Own characteristics					
# customers	7.02	13.76	0.00	340.00	7.13
# customers (log)	1.37	1.12	0.00	5.83	1.39
Age (log)	3.29	0.79	0.00	6.48	3.21
Assets (log)	13.64	1.82	2.82	19.86	13.58
Profit rate	0.05	0.17	-1.00	0.98	0.06
Sales (million US$)	3.43	12.27	0.00	265.80	3.13
Customers' characteristics					
Profit of customers	0.05	0.09	-0.99	0.67	0.05
Current assets of customers	2.47	2.39	0.00	15.41	2.22

Note: The number of observations is 7,924 in 2015 and 4,194 in ~~2014..~~2014.

Table 5: Means of Key Variables by 2-Digit Industry in 2015

	NICS code	N	Accounts receivable /assets (%)	Upstream (mean)	Upstream (max)	# of customers
Agriculture, Forestry, Fishing and Hunting	11	53	11.0	3.71	7.53	1.60
Mining, Quarrying, and Oil and Gas Extraction	21	391	7.3	3.98	8.93	6.37
Utilities	22	269	7.3	3.97	8.58	4.43
Construction	23	244	23.0	4.01	8.82	5.80
Food, Textile, Apparel Manufacturing	31	533	12.2	3.76	7.94	4.77
Wood, Paper, Printing, Chemical Manufacturing	32	1,219	13.6	4.28	9.04	5.65
Metal, Machinery Manufacturing	33	2,825	17.6	4.11	9.29	8.17
Wholesale Trade	42	369	23.3	3.39	7.43	4.44
Retail Trade	44, 45	296	8.0	2.25	4.63	2.46
Transportation	48	318	8.4	3.81	8.55	6.89
Warehousing	49	21	12.8	4.49	9.81	5.14
Information	51	524	13.8	3.85	8.54	11.13
Professional, Scientific, and Technical Services	54	515	20.5	4.22	9.43	11.05
Administrative and Support and Waste Management and Remediation Services	56	122	19.7	3.90	8.61	7.03
Educational Services	61	15	9.9	3.21	7.20	2.80
Health Care and Social Assistance	62	48	17.6	2.35	4.73	2.81
Arts, Entertainment, and Recreation	71	52	7.9	3.18	6.77	4.60
Accommodation and Food Services	72	95	6.0	2.02	4.15	4.56
Other Services (except Public Administration)	81	15	12.0	2.60	6.00	4.27

Table 6: Means of Key Variables by Country in 2015

Country	N	Accounts receivable /assets	Upstream (mean)	Upstream (max)	# of customers
US	1,498	14.4	4.23	9.67	13.11
China	1,211	13.7	4.24	8.81	3.06
Japan	954	20.8	3.97	8.61	4.26
UK	343	12.2	3.76	8.58	10.22
South Korea	674	19.8	4.01	8.94	5.70
India	138	15.2	2.97	6.65	5.78
Canada	266	9.3	3.44	7.53	6.33
Germany	205	17.5	4.09	9.30	10.91
Australia	232	12.0	3.80	8.21	6.67
Taiwan	566	15.8	3.76	7.93	3.57

Table 7: Determinants of Trade Credit: Cross-Sectional Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Mean upstream (log)	0.476*		-0.129		0.274	
	(0.253)		(0.308)		(0.240)	
Max upstream (log)		0.466**		0.0210		0.282
		(0.188)		(0.226)		(0.179)
# suppliers of customers (log)			0.777***	0.737***		
			(0.165)	(0.166)		
Customers' assets/own (log)					4.691***	4.682***
					(0.323)	(0.325)
Share of foreign customers						
# customers (log)	0.961***	0.899***	0.694***	0.677***	0.583***	0.543**
	(0.216)	(0.219)	(0.214)	(0.215)	(0.210)	(0.215)
Age (log)	1.223***	1.217***	1.201***	1.199***	1.201***	1.198***
	(0.231)	(0.231)	(0.230)	(0.230)	(0.217)	(0.216)
Assets (log)	-1.885***	-1.903***	-2.083***	-2.085***	-1.565***	-1.577***
	(0.191)	(0.190)	(0.195)	(0.196)	(0.167)	(0.167)
Profit rate	-1.294*	-1.284*	-1.240	-1.234	-1.401*	-1.394*
	(0.751)	(0.752)	(0.754)	(0.754)	(0.793)	(0.794)
Customers' profit rate	3.773***	3.738***	3.662***	3.591***	1.477	1.453
	(1.268)	(1.268)	(1.293)	(1.290)	(1.462)	(1.461)
Customers' current assets/own (log)	-0.473***	-0.504***	-0.841***	-0.843***	-5.092***	-5.103***
	(0.128)	(0.130)	(0.144)	(0.145)	(0.308)	(0.307)
Country-industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	7,924	7,924	7,924	7,924	7,924	7,924
R2	0.284	0.284	0.287	0.287	0.314	0.314

Table 7: Determinants of Trade Credit: Cross-Sectional Analysis (continued)

	(7)	(8)	(9)	(10)
Mean upstream (log)	0.500*		0.0299	
	(0.283)		(0.303)	
Max upstream (log)		0.490**		0.109
		(0.214)		(0.227)
# suppliers of customers (log)			0.432***	0.404**
			(0.163)	(0.163)
Customers' assets/own (log)			4.581***	4.583***
			(0.320)	(0.321)
Share of foreign customers	-0.185	-0.233	-0.657	-0.673
	(0.463)	(0.467)	(0.443)	(0.444)
# customers (log)	0.975***	0.915***	0.492**	0.474**
	(0.216)	(0.218)	(0.209)	(0.211)
Age (log)	1.224***	1.219***	1.194***	1.192***
	(0.232)	(0.231)	(0.217)	(0.217)
Assets (log)	-1.882***	-1.899***	-1.669***	-1.671***
	(0.192)	(0.191)	(0.168)	(0.169)
Profit rate	-1.292*	-1.281*	-1.362*	-1.357*
	(0.752)	(0.753)	(0.793)	(0.793)
Customers' profit rate	3.812***	3.791***	1.610	1.572
	(1.262)	(1.261)	(1.454)	(1.452)
Customers' current assets/own (log)	-0.470***	-0.500***	-5.176***	-5.181***
	(0.127)	(0.129)	(0.319)	(0.318)
Country-industry fixed effects	Yes	Yes	Yes	Yes
N	7,924	7,924	7,924	7,924
R2	0.284	0.284	0.315	0.315

Notes: The dependent variable is the ratio of accounts receivable to assets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Standard errors in parentheses are clustered at the country-industry level.

Table 8: Determinants of Trade Credit: Panel Analysis

	(1)	(2)	(3)	(4)
Mean upstream (log)	0.141		0.107	
	(0.0947)		(0.103)	
Max upstream (log)		0.106		0.0801
		(0.0894)		(0.0947)
# suppliers of customers (log)			0.0237	0.0254
			(0.0936)	(0.0943)
Customers' assets/own (log)			0.492**	0.492**
			(0.196)	(0.194)
Share of foreign customers			0.0393	0.0421
			(0.347)	(0.345)
# customers (log)	0.154	0.151	0.110	0.106
	(0.180)	(0.191)	(0.172)	(0.178)
Age (log)	0.0438	0.0545	0.0810	0.0899
	(1.780)	(1.777)	(1.774)	(1.771)
Assets (log)	-1.109	-1.108	-1.057	-1.057
	(1.103)	(1.102)	(1.108)	(1.108)
Profit rate	0.713	0.713	0.617	0.618
	(0.799)	(0.799)	(0.793)	(0.793)
Customers' profit rate	0.214	0.227	0.0895	0.0986
	(0.722)	(0.723)	(0.724)	(0.724)
Customers' current assets/own (log)	-0.115***	-0.117***	-0.614***	-0.617***
	(0.0386)	(0.0376)	(0.189)	(0.192)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	8,922	8,922	8,922	8,922
R2	0.0456	0.0459	0.0601	0.0604

Notes: The dependent variable is the ratio of accounts receivable to assets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Standard errors in parentheses are clustered at the industry level.

Table 9: Heterogeneity across Countries: Cross-sectional Analysis

Panel (A): United States

	(1)	(2)	(3)	(4)
Mean upstream (log)	1.069*		-0.217	
	(0.601)		(0.673)	
Max upstream (log)		0.939*		-0.0829
		(0.469)		(0.481)
# suppliers of customers (log)			0.649*	0.620*
			(0.337)	(0.318)
Customers' assets/own (log)			4.056***	4.052***
			(0.477)	(0.474)
Share of foreign customers			-0.180	-0.201
			(1.430)	(1.440)
Industry fixed effects	Yes	Yes	Yes	Yes
N	1,498	1,498	1,498	1,498
R2	0.197	0.198	0.233	0.233

Panel (B): China

	(1)	(2)	(3)	(4)
Mean upstream (log)	0.374		0.188	
	(0.485)		(0.488)	
Max upstream (log)		0.275		0.0645
		(0.303)		(0.289)
# suppliers of customers (log)			0.469	0.482
			(0.302)	(0.300)
Customers' assets/own (log)			4.838***	4.833***
			(0.672)	(0.663)
Share of foreign customers			-1.320	-1.332
			(0.809)	(0.802)
Industry fixed effects	Yes	Yes	Yes	Yes
N	1,211	1,211	1,211	1,211
R2	0.162	0.162	0.195	0.195

Panel (C): Japan

	(1)	(2)	(3)	(4)
Mean upstream (log)	1.935***		2.087***	
	(0.665)		(0.528)	
Max upstream (log)		1.494***		1.667***
		(0.449)		(0.348)
# suppliers of customers (log)			0.384	0.345
			(0.358)	(0.374)
Customers' assets/own (log)			5.898***	5.938***
			(1.128)	(1.133)
Share of foreign customers			-3.093	-3.130
			(1.928)	(1.923)
Industry fixed effects	Yes	Yes	Yes	Yes
N	954	954	954	954
R2	0.361	0.362	0.396	0.396

Table 9: Heterogeneity across Countries: Cross-sectional Analysis (continued)

Panel (D): South Korea

	(1)	(2)	(3)	(4)
Mean upstream (log)	1.056		0.511	
	(1.400)		(2.205)	
Max upstream (log)		0.892		0.416
		(1.080)		(1.702)
# suppliers of customers (log)			-0.198	-0.205
			(1.124)	(1.117)
Customers' assets/own (log)			6.864***	6.850***
			(1.333)	(1.360)
Share of foreign customers			1.117	1.137
			(1.076)	(1.088)
Industry fixed effects	Yes	Yes	Yes	Yes
N	674	674	674	674
R2	0.167	0.167	0.204	0.204

Panel (E): Taiwan

	(1)	(2)	(3)	(4)
Mean upstream (log)	-0.301		-1.186**	
	(0.590)		(0.411)	
Max upstream (log)		-0.0155		-0.649*
		(0.446)		(0.328)
# suppliers of customers (log)			1.685***	1.575***
			(0.339)	(0.341)
Customers' assets/own (log)			5.167***	5.276***
			(1.075)	(1.082)
Share of foreign customers			-1.726	-1.706
			(1.056)	(1.057)
Industry fixed effects	Yes	Yes	Yes	Yes
N	566	566	566	566
R2	0.187	0.187	0.242	0.240

Panel (F): United Kingdom

	(1)	(2)	(3)	(4)
Mean upstream (log)	-0.834		-2.716	
	(1.225)		(1.839)	
Max upstream (log)		-0.501		-1.792
		(0.981)		(1.413)
# suppliers of customers (log)			0.838	0.772
			(0.483)	(0.478)
Customers' assets/own (log)			3.339***	3.315**
			(1.142)	(1.160)
Share of foreign customers			2.172	1.805
			(2.660)	(2.576)
Industry fixed effects	Yes	Yes	Yes	Yes
N	343	343	343	343
R2	0.298	0.297	0.330	0.327

Notes: The dependent variable is the ratio of accounts receivable to assets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Standard errors in parentheses are clustered at the country-industry level. Other controls used in Table 7 are also included, but the results are not presented for brevity.

Table 10: Heterogeneity across Countries: Panel Analysis

Panel (A): United States

	(1)	(2)	(3)	(4)
Mean upstream (log)	0.193		0.0438	
	(0.288)		(0.299)	
Max upstream (log)		0.145		0.0540
		(0.313)		(0.330)
# suppliers of customers (log)			-0.192	-0.195
			(0.322)	(0.336)
Customers' assets/own (log)			1.031	1.028
			(0.644)	(0.629)
Share of foreign customers			1.828**	1.827**
			(0.821)	(0.809)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	2,592	2,592	2,592	2,592
R2	0.0473	0.0474	0.0568	0.0569

Panel (B): China

	(1)	(2)	(3)	(4)
Mean upstream (log)	-0.0517		-0.0689	
	(0.126)		(0.136)	
Max upstream (log)		-0.0665		-0.0779
		(0.108)		(0.113)
# suppliers of customers (log)			0.206	0.209
			(0.120)	(0.120)
Customers' assets/own (log)			0.293	0.296
			(0.456)	(0.453)
Share of foreign customers			-0.901***	-0.895***
			(0.277)	(0.273)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	1,188	1,188	1,188	1,188
R2	0.0345	0.0347	0.0368	0.0370

Panel (C): Japan

	(1)	(2)	(3)	(4)
Mean upstream (log)	0.222*		0.261**	
	(0.116)		(0.0932)	
Max upstream (log)		0.140		0.168**
		(0.0816)		(0.0651)
# suppliers of customers (log)			-0.0706	-0.0660
			(0.117)	(0.118)
Customers' assets/own (log)			0.626	0.618
			(0.393)	(0.398)
Share of foreign customers			-0.0802	-0.0603
			(0.521)	(0.518)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	882	882	882	882
R2	0.00748	0.00751	0.00544	0.00544

Table 10: Heterogeneity across Countries: Panel Analysis (continued)

Panel (D): South Korea

	(1)	(2)	(3)	(4)
Mean upstream (log)	-0.225		-0.457**	
	(0.173)		(0.207)	
Max upstream (log)		-0.159		-0.330***
		(0.146)		(0.107)
# suppliers of customers (log)			0.444	0.434*
			(0.256)	(0.231)
Customers' assets/own (log)			0.318	0.320
			(0.377)	(0.368)
Share of foreign customers			-0.656	-0.679
			(1.123)	(1.130)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	920	920	920	920
R2	0.0114	0.0115	0.0101	0.0102

Panel (E): Taiwan

	(1)	(2)	(3)	(4)
Mean upstream (log)	0.266**		0.370***	
	(0.111)		(0.0934)	
Max upstream (log)		0.192*		0.252**
		(0.0975)		(0.0840)
# suppliers of customers (log)			-0.306***	-0.295***
			(0.0806)	(0.0782)
Customers' assets/own (log)			0.933***	0.919***
			(0.112)	(0.112)
Share of foreign customers			-0.0487	-0.0585
			(0.197)	(0.191)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	750	750	750	750
R2	0.0138	0.0138	0.0146	0.0147

Panel (F): United Kingdom

	(1)	(2)	(3)	(4)
Mean upstream (log)	0.577		1.154	
	(1.106)		(0.898)	
Max upstream (log)		0.387		0.732
		(0.791)		(0.606)
# suppliers of customers (log)			-0.552**	-0.527**
			(0.239)	(0.233)
Customers' assets/own (log)			-0.686	-0.594
			(0.419)	(0.389)
Share of foreign customers			-0.859	-0.659
			(1.313)	(1.345)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	212	212	212	212
R2	0.0949	0.0953	0.0927	0.0936

Notes: The dependent variable is the ratio of accounts receivable to assets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Standard errors in parentheses are clustered at the industry level. Other controls used in Table 7 are also included, but the results are not presented for brevity.