Trade credit, banking competition, and the joint effects of supplier and customer financial characteristics[+]

Jaideep Shenoy[a,*] and Ryan Williams[b]

[a] A.B. Freeman School of Business, Tulane University, New Orleans, LA, 70118
[b] Eller College of Management, University of Arizona, Tucson, AZ 85721

Abstract

We examine how access to bank credit affects trade credit in the supplier–customer relationships of U.S. public firms. For identification, we use exogenous liquidity shocks to supplier firms in the form of staggered changes to interstate bank branching laws. Using a variety of tests, we show that supplier firms with greater access to banking liquidity offer more trade credit to their customers. We also show that when bank branching restrictions are relaxed in the supplier's state, there is a higher likelihood of survival of supplier-customer relationships. Overall, our paper explores the real effects of banking competition on supplier–customer relationships of public firms.

Keywords: Trade credit, supplier–customer relationships, bank lines of credit, banking deregulation, contagion, financial distress

JEL Codes: G30, G32, G33

We also show that there is a higher likelihood of survival of supplier-customer relationships when bank branching restrictions are relaxed in the supplier's state.

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* Corresponding author: A.B. Freeman School of Business, Tulane University, New Orleans, LA 70118, USA. Tel: +1-504-865-5045; Fax: +1-504-862-8327.
** *E-mail addresses*: jshenoy@tulane.edu (Jaideep Shenoy), rwilliams@email.arizona.edu (Ryan Williams).

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Abstract

We examine how access to bank credit affects trade credit in the supplier–customer relationships of U.S. public firms. For identification, we use exogenous liquidity shocks to supplier firms in the form of staggered changes to interstate bank branching laws. Using a variety of tests, we show that supplier firms with greater access to banking liquidity offer more trade credit to their customers. We also document a higher likelihood of survival of supplier–customer relationships in states that relax bank branching restrictions. Overall, our paper explores the real effects of banking competition on supplier–customer relationships of public firms.

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1. Introduction

Trade credit is an important component of short-term financing for public companies. The median value of accounts receivables to total assets is 16% for non-financial U.S. public firms during 1980–2008. In addition, researchers argue that trade credit relationships can transmit credit contagion in U.S. industrial firms (e.g., Jorian and Zhang, 2009). Despite their importance, relatively little is known about the trade credit decisions of large public companies. In this paper, we use a sample of key supplier–customer relationships among public corporations to study how the availability of bank lines of credit for supplier and customer firms affects outstanding trade credit. The core of our analysis uses an identification strategy based on exogenous liquidity shocks for supplier firms arising from changes in interstate bank branching laws (e.g., Rice and Strahan, 2010). We also study how changes to these interstate bank branching laws affect the likelihood of survival of key supplier–customer relationships. Finally, we explore how supplier and customer financial strength affects trade credit outstanding.

Theory suggests that the availability of short-term bank financing for supplier and customer firms impacts the supplier firm's trade credit outstanding. Cunat (2007) argues that trade credit appears to be more expensive than bank credit as it includes a premium to provide insurance to the customer for a future lack of liquidity and due to the inherent riskiness of trade credit compared to bank credit. Ng, Smith, and Smith (1999) and Klapper, Laeven, and Rajan (2012) analyze the contract terms of trade credit and show that the interest rates on trade credit are typically much higher than what a bank might charge for comparable loans. We posit that suppliers with access to bank credit offer more trade credit to their customers at plausibly higher interest rates compared to what they would pay on their bank debt.[1] Accordingly, suppliers with access to a bank line of credit or those that borrow on their credit lines more aggressively would have more trade credit outstanding. On the other hand, customers with access to bank lines of credit are more likely to substitute short-term liquidity needs with plausibly cheaper bank credit

[1] In our empirical analyses, we cannot explicitly compare the costs of trade credit and bank credit for a firm due to the non-availability of data on the cost of trade credit.

instead of relying on trade credit. Therefore, we expect suppliers to have less trade credit outstanding when their customers have greater access to short-term bank financing.

One concern with the above empirical setup is that an omitted variable could spuriously drive the relation between supplier bank lines of credit and trade credit. To better identify a causal link between bank lines of credit and trade credit, we follow the approach in Johnson and Rice (2008) and Rice and Strahan (2010) and employ exogenous shocks to banking liquidity due to the implementation of the Interstate Banking and Branching Efficiency Act (IBBEA) in 1994. Specifically, we explore how the relaxation of interstate bank branching restrictions helps supplier firms headquartered in deregulating states to obtain bank financing. Subsequently, we investigate whether this increased likelihood of obtaining bank credit affects trade credit offered to key customers. We expect that supplier firms with headquarters in states that relax bank branching laws are more likely to obtain a bank line of credit. Furthermore, these supplier firms extend more trade credit to their principal customers because they expect better access to bank credit.

It is plausible that better access to credit markets due to a relaxation of interstate branching laws impacts the survival of the supplier–customer relationship itself. Previous literature shows that a relaxation of bank branching laws improves macroeconomic conditions in the deregulating states (e.g., Jayaratne and Strahan, 1996; Black and Strahan, 2002; Cetorelli and Strahan, 2006). In addition, suppliers whose liquidity positions improve due to better state-level credit market conditions are better positioned to help customers by providing trade credit (e.g., Peterson and Rajan, 1997). This is likely to enhance the probability of survival of supplier–customer relationships. Based on these arguments, we posit that the relaxation of bank branching laws in the state where the supplier firm is headquartered increases the probability of survival of supplier–customer relationships in the state.

In our empirical tests, we first study the relation between supplier and customer bank lines of credit and trade credit for a sample of non-financial firms on Compustat. Consistent with theory, we find that supplier firms with access to bank lines of credit or those that draw more aggressively on their bank lines of credit have higher outstanding trade credit. Furthermore, we find that supplier firms whose key customers have less access to bank lines of credit have higher amounts of outstanding trade credit. It therefore appears that supplier and customer banking liquidity affect trade credit.

We next examine how differences in state-level bank branching restrictions affect a supplier's access to bank credit and its trade credit outstanding. We document a negative relation between branching restrictions and the likelihood of obtaining a bank line of credit for firms with no prior access to bank financing. This finding indicates that when a state reduces barriers to interstate branching, supplier firms in that state without a pre-existing line of credit are more likely to gain access to one. We also document a negative relation between state-level branching restrictions and the supplier's outstanding trade credit, suggesting that easing branching restrictions in a state improves the ability of firms headquartered in that state to provide trade credit to their customers. This effect is limited to firms that did not *previously* have access to a credit line; firms that already have credit lines do not significantly adjust their accounts receivable in response to changes in bank branching restrictions. Next, we examine the product market impact of bank branching deregulation laws. We find consistent evidence that a relaxation of bank branching laws in the state where the supplier firm is headquartered increases the probability of survival of supplier–customer relationships.

Based on the above findings, we conjecture that better access to bank financing due to deregulation of branching laws helps firms to extend more trade credit and improve the survival of the customer-supplier relationships. To more formally investigate these arguments, we employ two-stage least squares (2SLS) estimations. In the first stage, we use differences in state-level bank branching restrictions as an instrument to predict the likelihood of firms obtaining access to a line of credit in the subsequent year. In the second stage, we use the predicted value of the likelihood of obtaining bank credit to estimate (i) the trade credit outstanding and (ii) the likelihood of survival of the supplier–customer relationship. In the first-stage estimation, we show that firms headquartered in states that deregulate interstate bank branching laws are more likely to obtain access to credit lines in the next year. In the second-stage estimations, we show that the predicted likelihood of obtaining a credit line for a supplier firm is positively related to its trade credit outstanding and the survival of supplier–customer relationships.

Finally, we examine how measures of financial strength for supplier and customer firms impact trade credit. We find that supplier firms with a higher probability of financial distress (measured by the Altman Z-score) or greater financial constraints (measured by the Hadlock and Pierce (2010) index) have lower amounts of trade credit outstanding. Furthermore, we find that supplier firms have higher amounts of outstanding trade credit when their key customers face a higher probability of financial distress or greater financial constraints. These results support the view that suppliers value the implicit equity stake in their continuing customers and will offer trade credit to support their financially weak customers (e.g., Petersen and Rajan, 1997; Wilner, 2000; Frank and Maksimovic, 2005; Cunat, 2007).

Our paper makes the following contributions. First, we test how access to bank lines of credit for publicly traded supplier firms and their key customers affects trade credit. This builds upon the earlier work on trade credit that uses small firm data from the National Survey of Small Business Finance (NSSBF) survey (e.g., Petersen and Rajan, 1997; Gianetti, Burkart, and Ellingsen, 2011).[2] Second, we document real effects of banking competition on supplier-customer relationships of public firms. In particular, we show that exogenous changes in bank branching laws affect the ability of public firms to access lines of credit and extend trade credit to customers. These findings complement the work in Rice and Strahan (2010), who study the effect of interstate branching laws on small firms covered by the NSSBF survey. We also show that the better access to credit markets due to a relaxation of interstate branching laws increases the likelihood of survival of supplier–customer relationships. This finding builds upon previous literature, which shows that the relaxation of bank branching laws in the 1970s and 1980s led to beneficial product market effects, such as higher rates of new firm incorporations as well as an increase in the number of firms in operation (e.g., Black and Strahan, 2002; Cetorelli and Strahan, 2006).

[2] Some studies on trade credit use international data (e.g., Van Horen, 2007; Uchida, Udell, and Watanabe, 2013). Their results are not generalizable to the U.S. as there are cross-country differences in financial development (e.g., Fisman and Love, 2003; Acemoglu, Johnson, and Mitton, 2009) and bankruptcy codes (e.g., Kaiser, 1996).

Third, our study is related to the literature on the role of bank credit lines in corporate liquidity management (e.g., Houston and James, 2001; Sufi, 2009; Campello, Giambona, Graham, and Harvey, 2011) and the literature on the causes and consequences of contagion in financial and product markets (e.g., Lang and Stulz, 1992; Calomiris, Himmelberg, and Wachtel, 1995; Kohler, Britton, and Yates, 2000; Nilsen, 2002; Choi and Kim, 2005; Hertzel, Li, Officer, and Rodgers, 2008; Cohen and Frazzini, 2008; Duchin, Ozbas, and Sensoy, 2010; Hertzel and Officer, 2012; Houston, Lin, and Zhu, 2012; Boissay and Gropp, 2013). Finally, a contemporaneous paper by Garcia-Appendini and Montoriol-Garriga (2013) uses cash holdings as a liquidity measure and shows that more liquid suppliers offered higher trade credit to less liquid customers during the 2007–2008 crisis. In contrast, our liquidity variables use data on bank lines of credit, which play a different role in liquidity management (e.g., Lins, Servaes, and Tufano, 2010; Acharya, Almeida, Ippolito, and Perez, 2014). Taken together, the two papers complement each other by showing how cash and credit lines collectively shape trade credit decisions.

We proceed as follows. In Section 2, we describe data on suppliers and their key customers. We also describe the measures of bank financing and the index of branching restrictions. In Section 3, we present the ordinary least squares (OLS) estimation results. We also discuss and present results for our identification strategy based on interstate bank branching laws. We conclude the paper in Section 4.

2. Data and Sample Description

2.1. Data sources

We begin by identifying all firms with non-missing assets in the Compustat database from 1980 to 2008. Using the Compustat segment tapes, we identify the key customers of these firms.[3] We manually link the customer names as reported by the firms to their corresponding Compustat GVKEY using a methodology similar to that of Fee and Thomas (2004), Fee, Hadlock, and Thomas (2006), and Kale and Shahrur (2007). After identifying a firm's key customers, we obtain financial statement information for

[3] The identities of these customers are reported in accordance with the SFAS 14 and SFAS 131 guidelines from the Financial Accounting Standards Board that require public firms to report key customers that account for at least 10% of annual sales. We further note that constraint of 10% does not appear to be binding, since 36% of firms report customers who account for less than 10% of sales in our sample.

each customer firm by merging with the Compustat database. The above sample selection criteria yield a sample of 62,337 supplier–customer pairs during 1980–2008 for which we are able to identify financial information.

We aggregate each supplier firm's data on customers into firm–year observations by weighting the key customer-level variables by the percentage of supplier sales accounted for by each customer. The resulting database is organized by supplier firm–year and contains sales-weighted customer characteristics. We obtain a final sample of 37,917 supplier firm–years for which we are able to obtain weighted customer characteristics. This sample consists of 7,144 unique supplier firms and 2,855 unique customer firms during 1980–2008. Due to data availability restrictions on lines of credit and the interstate bank branching laws outlined below, the majority of our analysis uses the fiscal years 1996–2008.

2.2. Index of state bank branching restrictions

Rice and Strahan (2010) argue that the interstate branching provisions in the Interstate Banking and Branching Efficiency Act (IBBEA) of 1994 granted states the right to remove barriers that prohibit competition from out-of-state banks. We create a branching restriction index (*R-Index*) based on Rice and Strahan (2010) to measure the state-level banking environment for each firm–year. The value of *R-Index* increases by one for each of the following regulations a state puts in place: (i) the minimum age of the target institution, (ii) de novo interstate branching, (iii) the acquisition of individual branches, and (iv) a state-wide deposit cap. Thus, *R-Index* would take a value of zero for a state with none of these regulations in place (least regulated) and four for a state with all four regulations in place (most regulated).

We obtain values of *R-Index* for 1994–2005 from Johnson and Rice (2008) and Rice and Strahan (2010).[4] To fully use our line of credit data, which ends in 2008, we hand-collect data on changes to state-level interstate branching deregulation during 2005–2008. We follow the data collection methodology outlined by Johnson and Rice (2008) and search for amendments to the interstate banking code of each state in the United States between 2005 and 2008. If we identify changes to any of the four provisions, we

[4] Rice and Strahan (2010) collect data on changes to branching restrictions during 1994–2005. For 1993, we treat the value of *R-Index* as four (the most regulated) for all states, since the first deregulation under IBBEA occurred only in 1994 or later.

update the value of *R-Index* for that state. We find three states where the interstate bank branching restrictions were further amended by 2008. In 2005, Montana allowed interstate de novo branching by out-of-state banks. In 2006, Mississippi allowed interstate branching through the acquisition of single branches or other portions of an institution and through de novo branching. Finally, in 2008, South Dakota eliminated the minimum age requirement for out-of-state banks' acquisitions of in-state financial institutions from five to zero years. We update the *R-Index* values of these states based on the amendments outlined above. More details on these amendments are summarized in Appendix 1.

We use the augmented *R-Index* data (ending in 2008) in all estimations. For each supplier firm–year observation, the index is calculated based on the state in which the supplier firm's headquarters are located and the staggered changes in these laws in the state over time.[5]

2.3. Measure of trade credit and firm-specific characteristics

Our main dependent variable of interest is the outstanding trade credit of suppliers. We calculate the trade credit outstanding (*AR/Sales*) as the ratio of accounts receivable to net sales (e.g., Petersen and Rajan, 1997). Because there is evidence that firms "match" the maturities of short-term assets with short-term liabilities (e.g., Deloof and Jegers, 1999), we also control for the amount of trade credit used by a firm. We calculate a firm's use of trade credit (*AP/COGS*) as the ratio of accounts payable to the cost of goods sold. If firms do match the maturities of short-term assets and liabilities, we expect a positive relation between *AR/Sales* and *AP/COGS*.

We also include a number of additional control variables in our estimations. Researchers show that the suppliers of differentiated goods and service goods have more outstanding trade credit (e.g., Mian and Smith, 1992; Blazenko and Vandezande, 2003; Giannetti, Burkart, and Ellingsen, 2011). We control for the type of supplier output by creating the variable *Differentiated Goods* (*Services Goods*), which takes a value of one if the supplier industry output is differentiated (a service) and zero otherwise. Furthermore, researchers argue that customers with a higher market share command more bargaining

[5] Consistent with the literature, we obtain the location of firm headquarters from the Compustat database (e.g., Amore, Schneider, and Zaldokas, 2013).

power and are able to demand more trade credit (e.g., Wilner, 2000; Klapper, Laeven, and Rajan, 2012). We include *Market Share* and *Customer Market Share* to control for supplier and customer market power. Finally, in all estimations, we include firm-specific variables such as return on assets, cash holdings, firm size, Tobin's Q, sales intensity, and book leverage. We winsorize all continuous variables at 1% and 99% to reduce the influence of outliers on our results. We exclude financial firms by eliminating firms with Standard Industrial Classification (SIC) codes between 6000–6999. In Appendix 2, we provide the key variable names and details pertaining to their computation. Summary statistics for all variables are provided in Table I.

2.4. Bank lines of credit for supplier and customer firms

Our key measure of short-term liquidity is the existence of a bank line of credit. Credit lines are frequently used by firms for short-term financing (e.g., Sufi, 2009). We use a combination of automated and manual techniques to collect information on the bank lines of credit for our sample firms during 1996–2008. Specifically, using search words identical to Sufi's (2009), we conduct a textual analysis of 10-K filings looking for words indicating the existence of a line of credit. After identifying firms that disclose a line of credit in their 10-K filings, we read the 10-K statements and manually collect data on the total amount of the line and the total borrowings on it for all our sample firms. Our dataset contains information on the line of credit status for 12,926 supplier firm–years and 13,826 sales-weighted customer portfolios during 1996–2008.

We then create a binary variable *Line of Credit* to classify each supplier firm as having access to a line of credit or not. The variable *Customer Line of Credit* is composed of all of a supplier firm's key customers' line of credit indicator variables, weighted by the percentage of the firm's sales to that customer. We also create a continuous variable *LOC Drawn*, which measures the total borrowings on a supplier's line of credit divided by the book value of total assets. It is set to zero if the firm has no credit line or if it reports a line of credit but no information on the amount borrowed. Finally, *LOC Limit* measures a supplier's total credit limit on its line of credit divided by the book value of total assets.

3. Results

3.1. Relation between trade credit outstanding and supplier and customer lines of credit

In this section, we investigate the relation between *AR/Sales* and supplier/customer access to bank credit lines. We estimate the empirical model from Equation (1). The dependent variable *AR/Sales* is measured at the end of current year *t* for supplier firms in our sample. *Line of Credit* and *Customer Line of Credit* are measures of supplier and customer liquidity, respectively, in year *t*. The results for these estimations are presented in Models 1-4 of Table II. To control for time invariant omitted variables at the industry level, we include two-digit SIC industry fixed effects. All specifications include year fixed effects. The reported *t*-statistics are based on robust standard errors that are clustered at the firm level.[6]

$$AR/Sales = \beta_1 \, x \, Line \, of \, Credit + \beta_2 x \, Customer \, Line \, of \, Credit + \sum_{i=3}^{n} \beta_i \, x \, Controls_i + u_i \qquad (1)$$

In Model 1 of Table II, we find a positive and significant relation between *AR/Sales* and *Line of Credit*. This is consistent with our expectation that suppliers with access to bank financing extend more trade credit to customers at plausibly higher interest rates than what they pay on their bank credit. Furthermore, in Model 2, we document that the supplier's outstanding trade credit is negatively related to *Customer Line of Credit*, suggesting that customers may substitute cheaper bank financing for expensive trade credit when possible.[7] In Models 3 and 4, we include both *Line of Credit* and *Customer Line of Credit* in the same specification and obtain similar inferences as in Models 1 and 2. The effects of supplier and customer lines of credit on trade credit are economically significant. The regression coefficients in Model 4 imply that an average supplier without a line of credit issues 14.6% of its sales as accounts receivable, compared to roughly 16.4% for an average supplier with a bank line of credit. In dollar amounts, this represents a difference of $18.62 million in outstanding accounts receivables for the average supplier in our sample. Furthermore, a one standard deviation increase in *Customer Line of*

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[6] As a robustness test, we cluster standard errors based on the state of the headquarters location and find qualitatively similar results.

[7] In a related literature, Burkart and Ellingsen (2004) show that suppliers are more willing to lend trade credit to customers who do not have access to bank credit since it is typically more costly for an opportunistic borrower to divert inputs. Biais and Gollier (1997) show that customer firms obtain trade credit to act as a signal of quality to bank lenders especially when information asymmetry with bank lenders is high.

Credit is associated with a decrease of around $6.9 million in trade credit annually. We note that *Line of Credit* is likely to be serially correlated and is unlikely to be a good candidate for an estimation including firm fixed effects (e.g., Zhou, 2001). Therefore, we next employ a continuous variable for supplier liquidity that is less likely to be serially correlated than the dummy variable *Line of Credit*.

In Models 5 – 8 of Table II, we present the results using *LOC Drawn,* which is a continuous variable that measures the percentage usage of the line of credit instead of the indicator variable *Line of Credit*. We estimate an equation similar to Equation (1), where we replace *Line of Credit* with *LOC Drawn*. We include two-digit SIC industry fixed effects (Model 5) and supplier firm fixed effects (Models 6 - 8). All models include year fixed effects and robust standard errors clustered at the firm level are used to compute *t*-statistics. In Model 5, we document a significantly positive relation between *LOC Drawn* and *AR/Sales*. In Models 6 - 8, when we use supplier firm fixed effects, we document a positive and significant relation between *LOC Drawn* and *AR/Sales*. Furthermore, in all models (Models 5 – 8), we find a negative and significant relation between *AR/Sales* and *Customer Line of Credit*. Overall, we document a positive relation between *AR/Sales* and *LOC Drawn* and a negative relation between *AR/Sales* and *Customer Line of Credit,* and show that our results are robust to the usage of continuous measures of liquidity and firm fixed effects. We find that the documented effects are economically significant. The coefficients in Model 8 imply that a one standard deviation increase in the extent of line usage (*LOC Drawn*) is associated with an increase of roughly $1.84 million in additional trade credit. Similarly, a one standard deviation increase in *Customer Line of Credit* is associated with an annual decrease of around $4.8 million in trade credit.

In sum, the results in this section are consistent with the hypothesis that supplier firms with access to plausibly cheaper short-term bank financing offer more of the relatively expensive trade credit to their customers. Likewise, the results support the view that customer firms use less trade credit if they have access to cheaper short-term bank financing.

3.2. Identification using differences-in-differences estimations of the effects of banking deregulation on access to bank lines of credit and trade credit

Although our above tests include models using firm fixed effects, they do not fully rule out the possibility of an omitted variable spuriously driving the observed relation between trade credit and bank lines of credit. In this section, we present differences-in-differences estimations that examine how exogenous liquidity shocks due to changes in interstate branching laws affect access to bank credit and trade credit outstanding. Changes in state-level bank branching restrictions are beyond the control of any firm or manager and are exogenous shocks to the available banking liquidity for non-financial firms in that state. We expect that supplier firms with no prior access to bank credit are more likely to obtain new credit lines after deregulation. Additionally, the anticipated increase in liquidity would enable them to provide more support to their customers via trade credit. For firms with pre-existing lines of credit, the effects of increased bank competition upon deregulation might not be as pronounced. Since their liquidity positions are already strong, any entry from out-of-state banks is unlikely to be more beneficial. Therefore, for firms with pre-existing credit lines, we do not expect a change in trade credit outstanding.

We construct three measures to capture changes in access to bank financing. To measure a gain in access to bank credit, we create *Get LOC,* which is equal to one when the supplier firm had no pre-existing line of credit in current year *t* but obtained access to one in year *t* +1. To measure loss of access to a bank line of credit, we create *Lose LOC*, which is equal to one when the supplier firm had access to a line of credit in current year *t* but lost access in year *t* + 1. Finally, we create the continuous variable *Delta LOC Limit*, which is measured as the change in the borrowing limit on the credit line from year *t* to year *t* + 1 divided by the book value of assets.[8] The branching restriction index (*R-Index*) is a proxy for state-level banking regulation and is measured based on the state of the supplier firm's headquarters in year *t*. The variable *AR/Sales* for the supplier firm is measured at the end of year *t*. We estimate Equations (2)

[8] We examine the relation between trade credit and these three measures capturing changes in liquidity positions. We find that *Get LOC (Lose LOC)* is positively (negatively) related to *AR/Sales* and that *Delta LOC Limit* is positively related to *AR/Sales*. We report these results in an Internet appendix.

and (3) to examine the effect of *R-Index* on *Get LOC* and *AR/Sales*, respectively. Similar to Equation (2), we also run estimations to examine the relation of *R-Index* on *Lose LOC and Delta LOC Limit.*

$$Get\ LOC = \beta_1\ x\ R - Index + \sum_{i=2}^{n} \beta_i\ x\ Controls_i + v \qquad (2)$$

$$AR/Sales = \gamma_1 x\ R - Index + \sum_{i=2}^{n} \gamma_i\ x\ Controls_i + u \qquad (3)$$

In Table III, we present the estimation results of equations (2) and (3). All models include firm and year fixed effects to control for time-invariant omitted variables. We use robust standard errors that are clustered by the state of the supplier's headquarters in all difference-in-differences estimations (e.g., Bertrand, Duflo, and Mullainathan, 2004; Rice and Strahan, 2010; Amore, Schneider, and Zaldokas, 2013).[9] In Panel A, we report the estimations of *R-Index* on *Get LOC*, *Lose LOC*, and *Delta LOC Limit*. For firms without prior access to a line of credit (Models 1 and 2), we document a negative and significant relation between *R-Index* and *Get LOC*. Therefore, state-level banking deregulation increases the likelihood that firms headquartered in those states gain access to a line of credit. However, for firms that already have a line of credit (Models 3 - 6), we document an insignificant relation between *R-Index* and *Delta LOC Limit* (*Lose LOC*). This finding shows that changes to interstate branching laws do not significantly affect firms that already had access to a line of credit, both in terms of the likelihood that they might lose access to the credit line and the total borrowing limit on the credit line. Overall, the results in Panel A are consistent with the empirical tests of Rice and Strahan (2010) using small-firm data; banking deregulation enhances *access* to credit but does not appear to affect the amount of borrowing.

Next, in Panel B of Table III, we consider the effect of *R-Index* on *AR/Sales*. In Model 1, we analyze the whole sample of firms and find that *R-Index* is insignificantly related to *AR/Sales*. However, we show in Panel A that firms without access to a line of credit are more likely to obtain one after branching restrictions are relaxed but firms that already have access to a line of credit do not seem to be impacted by state-level deregulation. As a result, we also include *Line of Credit* and *R-Index x Line of Credit* in Model 2. We document a negative relation between *R-Index* and *AR/Sales.* Therefore, after we

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[9] Bertrand, Duflo, and Mullainathan (2004) show that state-clustered standard errors lead to consistent estimates in difference-in-differences estimations that employ staggered state-level variations in laws.

control for the status of a firm's line of credit, banking deregulation in the supplier's state does enhance the supplier's accounts receivables. We also find a positive and significant sign for *R-Index x Line of Credit*, indicating that the effect is almost offset when the firm has a pre-existing line of credit. We study this effect further in Models 3 and 4 by re-estimating Model 1 on subsamples of firms with and without pre-existing credit lines, respectively. In Model 3, we analyze firms with an existing line of credit and document an insignificant relation between *R-Index* and *AR/Sales*. This finding is consistent with the earlier result in Panel A, that firms with existing lines of credit do not experience a change in their borrowing when the state deregulates interstate branching laws. In contrast, when we analyze firms with no prior access to a line of credit in Model 4, we document a negative and significant relation between *R-Index* and *AR/Sales*. This result shows that there is a positive relation between interstate banking deregulation and trade credit for supplier firms with no pre-existing access to bank financing.

3.3. Identification using 2SLS estimations of the effect of banking deregulation on trade credit

In this section, we use a 2SLS estimation methodology to jointly examine the relation between banking deregulation, bank lines of credit, and trade credit. The endogenous variable is *Get LOC*, which is set to one if a firm with no line of credit in current year *t* obtained one in year *t* + 1 and zero otherwise.[10] We use *R-Index* in year *t* as an instrumental variable in the first-stage estimation. Specifically, in the first stage, we estimate a linear probability model as in Equation (2), where we use *R-Index* to predict *Get LOC*. We believe that *R-Index* is likely to be a relevant instrument in our setting, as researchers have documented that banking deregulation improves the credit market conditions in the state, creating banking liquidity for firms headquartered there (e.g., Rice and Strahan, 2010). Further, *R-Index* is likely to meet the exclusion restriction, since a state-level banking deregulation shock should affect suppliers through their links to the banking system, implying that any effect of banking deregulation on supplier accounts receivables should occur through the supplier's ability to access bank credit. In the

[10] We do not consider the effect of *R-Index* on *Lose LOC* or *Delta LOC Limit* in these tests, since the relation is found to be insignificant in Table III.

second stage, we use the predicted value of *Get LOC* based on the first-stage estimation to explain the *AR/Sales* at the end of year *t*. The second-stage estimation is reported in equation (4) below.

$$AR/Sales = \beta_1 \, x \, \widehat{GetLOC} + \sum_{i=2}^{n} \beta_i \, x \, Controls_i + u \qquad (4)$$

The second-stage results from the 2SLS estimations are reported in Table IV. The first-stage models are equivalent to those in Panel A of Table III and are omitted for brevity. All models include firm and year fixed effects to control for time-invariant omitted variables. Consistent with Section 3.2, we use robust standard errors that are clustered at the headquarters state of the supplier firm. In Model 1, we present the second-stage estimation results when no control variables are included. In Models 2 and 3, we present the second-stage estimation results when we include a different set of control variables. In all three estimations, we find that the predicted value of *Get LOC* is positively related to the supplier's accounts receivables, *AR/Sales*. This suggests that supplier firms provide more trade credit to their key customers when they expect better access to bank credit due to a deregulation of interstate banking laws. The coefficient in Model 3 implies that an increase in one standard deviation of *Get LOC* increases the supplier's outstanding trade credit by 6.02% of sales.

The Angrist–Pischke F-statistic is significant in all first-stage models, suggesting that the instrument *R-Index* is relevant in the first-stage estimation. The Andersen–Rubin F-statistic is found to be significant, showing that the endogenous variable *Get LOC* is relevant in the second-stage estimation. We also document significance for the endogeneity test statistic, suggesting that the 2SLS approach is appropriate, given the chosen instrument.

3.4. Banking deregulation and the survival of supplier–customer relationships

In this section, we consider how interstate banking deregulation affects the survival of supplier–customer relationships. As argued above, the better access to credit markets after interstate branching deregulation enables suppliers to support their customers by offering trade credit. This effect could plausibly prolong the survival of supplier-customer relationships. We investigate this idea by exploring how changes to *R-Index* in the supplier's state affect the probability of an existing supplier–customer relationship continuing the next year. We posit that a decrease in interstate branching restrictions in the supplier state should increase the probability of survival of customer–supplier relationships in the state. This would predict a negative relation between *R-Index* and the probability of survival of the relationship.

To empirically test this hypothesis, we disaggregate our primary supplier-year dataset into supplier-customer-year pairs. This allows us to differentiate between customers who continue to buy from the supplier the subsequent year versus those customers who drop out. We then estimate logit estimations based on Equation (5) to model the likelihood that a supplier-customer pair continues in the subsequent period.[11] The dependent variable is *Retained* which is equal to one if a customer in current year *t* is also a customer in year *t* + 1 and zero if the customer is no longer retained in *t* + 1. *R – Index* is measured based on the state of headquarters of the supplier firm in year *t*. As control variables, we include the percentage of a firm's sales accounted for by each customer (*Percent Sales*), the customer likelihood of financial distress measured by the Altman Z-score (*Customer Z-Score*), and customer investment opportunities measured by Tobin's Q (*Customer Tobin's Q*), all of which are measured in year *t*. The sample period for this analysis is 1993–2008. To control for unobserved heterogeneity in the supplier-customer pairs, we include fixed effects at the supplier-customer pair level. We also include calendar year dummies.

$$Retained = \beta_1 x\, R - Index + \sum_{i=2}^{n} \beta_i\, x\, Controls_i + u \qquad (5)$$

We report the results for these estimations in Table V. In Models 1–5, we document a negative and significant relation between *R-Index* and *Retained*. This finding is consistent with our expectation that when the supplier's state becomes more open to out-of-state banks, we should observe a higher probability of survival of supplier–customer relationships. We also find a significantly positive relation between *Percent Sales* and *Retained*. Since customers that account for a larger percentage of a supplier's sales are likely to be more material customers, this result is consistent with the idea that relationships involving important customers are more likely to survive. Further, we observe a positive and significant

[11] Note that we can only observe whether a relationship was terminated but not whether it was the supplier or the customer who made the decision to terminate the relationship.

relation between *Customer Tobin's Q* and *Retained,* suggesting that customers with superior future investment opportunities are more likely to continue in supplier–customer relationships.[12]

In Models 6 and 7, we estimate a 2SLS model similar to the setup in Table IV. Specifically, in the first stage, we estimate a linear probability model where we use lagged *R-Index* measured in year *t* - 1 as an instrumental variable to predict *Get LOC* in year *t*. In the second stage, we then use the predicted value of *Get LOC* based on the first-stage estimation to explain *Retained* at the end of year *t* + 1 (as defined above for Models 1 -5). Equations (6) and (7) provide the empirical models for the first- and second-stage estimations, respectively. We note again that *R-Index* is likely to be a relevant instrument and meet the exclusion restrictions in this setup for reasons similar to those outlined in Section 3.3.

$$Get\ LOC = \delta_1\ x\ R - Index + \sum_{i=2}^{n} \delta_i\ x\ Controls_i + v \qquad (6)$$

$$Retained = \alpha_1\ x\ \widehat{GetLOC} + \sum_{i=2}^{n} \alpha_i\ x\ Controls_i + u \qquad (7)$$

In Model 6, we document a negative relation between *R-Index* and *Get LOC,* suggesting that state-level banking deregulation increases access to bank financing for firms with no prior access a line of credit. In Model 7, we find that the predicted value of *Get LOC* is positively related to *Retention*. This finding suggests that supplier–customer relationships are more likely to survive when the supplier firms expect better access to bank credit due to a deregulation of interstate banking laws. The documented effects are economically significant. The coefficient in Model 7 implies that a one standard deviation increase in *Get LOC* increases the likelihood of survival by 33.72%.

Finally, the Angrist–Pischke F-statistic is found to be significant, suggesting that the instrument *R-Index* is relevant in the first-stage estimation. The Andersen–Rubin F-statistic is significant, showing that the endogenous variable *Get LOC* is relevant in the second-stage estimation. We further document a statistically significant endogeneity test statistic, suggesting that the 2SLS approach is appropriate given the chosen instrument. Overall, we provide evidence of another channel through which bank branching deregulation can impact non-financial firms.

[12] Our results are unaffected by the reporting threshold of 10% discussed in Section 2. In unreported results, we drop supplier–customer pairs where the customer accounts for 8% to 12%, 10% to 12%, and 10% to 15% of supplier sales and obtain qualitatively similar results.

3.5. Robustness tests: Alternate variables for liquidity

In this section, we consider the effect of two additional liquidity measures on trade credit. The two measures are Altman's (1968) Z-score of financial distress modified by excluding leverage, as in Mackie-Mason (1990) and Sufi (2009), and the index of financial constraints from Hadlock and Pierce (2010). Our estimation model is similar to Equation (1), except that we replace the line of credit variables with Altman Z-Score (*Z-Score* and *Customer Z-Score*) or the Hadlock–Pierce index (*HP Index* and *Customer HP Index*). In all specifications, we include supplier firm fixed effects and year fixed effects.

We report results from these estimations in Table VI. The positive coefficient on *Z-Score* (in Models 1, 2, and 4) indicates that suppliers that have a higher probability of bankruptcy provide less trade credit to their customers. The negative coefficient on *Customer Z-Score* (in Models 1, 3, and 4) suggests that the supplier's outstanding trade credit is higher when its customers have a higher probability of financial distress. This result supports of the implied equity stake hypothesis of Petersen and Rajan (1997). Under this hypothesis, suppliers have an implied equity stake in their customers as part of the supplier's value is determined by the discounted future cash flows of its customers. Therefore, suppliers extend trade credit to their financially distressed customers to protect the value of the implied equity stake.

The positive coefficient on *Customer HP Index* (Models 5, 7, and 8) indicates that the greater the degree of financial constraints faced by the customer, the higher the supplier's outstanding trade credit. The negative sign on *HP Index* (Model 5) indicates that the more constrained the supplier firm, the lower the amount of trade credit outstanding. Finally, the coefficient on *Differentiated Goods* and *Service Goods* is positive and significant, indicating that suppliers of differentiated and service goods offer more trade credit than suppliers of homogeneous goods. These results are consistent with the evidence of Fabbri and Menichini (2010) and Giannetti, Burkart, and Ellingsen (2011).

4. Conclusions and Discussion

Despite the importance of trade credit to public firms, there is limited empirical evidence on the factors that govern trade credit decisions of these companies. We fill this gap in the literature by using hand-collected data on supplier–customer relationships as well as bank lines of credit for publicly traded firms. For identification, we use exogenous shocks to bank liquidity due to staggered passage of state-level bank branching deregulations under the IBBEA Act of 1994 (e.g., Rice and Strahan, 2010).

We find that supplier firms with access to a bank line of credit or that borrow more on their line of credit have higher outstanding trade credit to their customers. We also find that supplier firms have more outstanding trade credit when their customers have less access to a bank line of credit. Furthermore, we show that supplier firms headquartered in states that relax bank branching restrictions are more likely to subsequently obtain lines of credit and extend more trade credit to customers. We also document this channel more formally using an instrumental variables analysis, where banking deregulation exogenously improves access to bank credit and this improved access enhances trade credit. Finally, we find that the improved access to bank financing for supplier firms located in states that deregulate bank branching laws increases the probability of survival of supplier–customer relationships.

Our study makes several contributions. First, we show that the availability of bank lines of credit for large publicly traded suppliers and their key customers affects outstanding trade credit in the relationship (Petersen and Rajan, 1997). Further, we extend the literature on state-level bank branching deregulation by showing that policies that promote banking competition affect the trade credit decisions of industrial firms through their improved ability to access bank credit (e.g., Black and Strahan, 2002; Cetorelli and Strahan, 2006; Rice and Strahan, 2010). Finally, we are the first to document that state-level bank branching deregulation affects real product market outcomes for public companies, such as the survival of supplier–customer relationships.

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Appendix 1: Extension of *R-Index*, 2005–2008

This appendix updates Table 1 from Johnson and Rice (2008). We research the state banking codes indexed in Appendix A from Johnson and Rice and document any changes during the 2005–2008 sample period. We then use these changes to extend the *R-Index* from Rice and Strahan (2010) from 2005 through 2008 in our data.

State	Post-Enactment Changes	Year of Law Change
Mississippi	Allows interstate branching by the acquisition of single branches or other portions of an institution, allows de novo branching.	2006
Montana	Allows de novo branching.	2005
South Dakota	Lowers the minimum age requirement of the target institution (from 5 years to 0)	2008

Appendix 2: Variable Construction

Variable	***Meaning***	***Calculation Based on Compustat Data Items***
Supplier level variables		
AR/Sales	Accounts receivables to sales	*RECTR/REVT*, zero if *RECTR* is missing
Line of Credit	Supplier line of credit	Dummy variable set to 1 if the supplier firm has access to a bank line of credit and 0 otherwise
LOC Drawn	Supplier line of credit drawn	Total borrowing on the supplier firm's line of credit divided by total assets
LOC Limit	Supplier credit line limit	Total borrowing limit on supplier's line of credit divided by total assets
R-Index	Branching restriction index	Bank branching restriction index based on the supplier firm's headquarters location
Get LOC	Gain in access to credit line	Set to 1 if supplier firm had no access to a credit line in year *t* but gained access to one in year *t* + 1
Lose LOC	Loss of access to credit line	Set to 1 if supplier firm had access to a credit line in year *t* but lost access in year *t* + 1
Z-Score	Supplier's Altman Z-Score	*3.3 * (EBIT/AT) + (REVT/AT) + 1.4 * (RE/AT) + 1.2 * ((ACT – LCT)/AT)*
HP-Index	Supplier's financial constraints	*-0.737*Size + 0.043*Size*Size – 0.04*Age; Size* is the inflation-adjusted value of *AT* and *Age* is the number of years firm is listed on *CRSP* database. Approach based on Hadlock and Pierce (2010).
AP/COGS	Accounts payables to COGS	*AP/COGS*
Firm ROA	Return on assets	*NI AT*
Log[Total Assets]	Natural logarithm of total assets	*Log(AT)*
Tobin's Q	Firm Tobin's Q	*(AT + CSHO * PRCC_F - SEQ + TXDB)/AT*
Sales Intensity	Firm's sales intensity	*REVT/AT*
Book Leverage	Book value of leverage	*(DLC + DLTT)/AT*
Cash/Total Assets	Cash holdings	*CH/AT*
Differentiated Goods (Services Goods)	Differentiated goods	Set to 1 if the two-digit industry of the supplier is a differentiated (service) good and zero otherwise Definitions based on Rauch (1999) and Gianetti, Burkart, and Ellingsen (2011)
Market Share	Supplier market share	Supplier firm's revenues divided by the revenues of the primary three-digit SIC industry
Customer level variables		
Customer Line of Credit	Customer line of credit	Revenue-weighted line of credit across all key customers for a supplier firm
Customer Z-Score	Customer Altman Z-Score	Revenue-weighted Altman Z-score measure across all key customers for a supplier firm
Customer HP-Index	Customer Hadlock–Pierce index	Revenue-weighted Hadlock–Pierce index across all key customers for a supplier firm
Customer Market Share	Customer market share	Revenue-weighted market shares of customers in their respective primary three-digit SIC industries

Table I
Summary Statistics

This table provides summary statistics using Compustat firms with identifiable customer data from 1980 to 2008. Data on lines of credit is from 1996 to 2008. Financial firms are excluded. *AR/Sales* is accounts receivable divided by sales, *AP/COGS* is accounts payable divided by cost of goods sold, and *R-Index* is the bank branching restriction index from 1993 to 2008. The index takes a value ranging from zero to four, four indicating the most regulated states and zero the least regulated states. The variable *Cash/Total Assets* is cash divided by total book assets; *Firm ROA* is net income over total assets; *Total Assets* is the firm's book assets in millions of dollars; *Tobin's Q* is the market value over the book value of assets; *Sales Intensity* is net revenue over total assets; *Book Leverage* is the book value of debt over book value of assets; *Market Share* is a supplier firm's sales divided by total sales in the firm's primary three-digit SIC industry; *Differentiated Goods* (*Service Goods*) is a dummy variable equal to one if the supplier firm produces a differentiated good (services good) and zero otherwise; *Line of Credit* is equal to one if a supplier firm has a line of credit and zero otherwise; *LOC Drawn* is equal to the dollar amount borrowed on the line of credit over total assets; *LOC Limit* is equal to the dollar amount of the line of credit's borrowing limit divided by total assets; *Get LOC* is equal to one if a supplier firm with no access to a line of credit in the current year t acquired a line of credit in year $t + 1$, and zero otherwise; *Lose LOC* is equal to one if a supplier firm with access to a line of credit in current year t lost the line of credit in the year $t + 1$, and zero otherwise; *Z-Score* is the modified Altman Z-score used by Sufi (2009); *HP Index* is the Hadlock–Pierce measure of financial constraint; *Customer Line of Credit* is composed of all of a firm's key customers' *Line of Credit* indicator variables, weighted by the percentage of the firm's sales to that customer; *Customer Z-Score* is the weighted sum of a firm's key customers' Altman Z-scores, weighted by the percentage of the firm's sales to those customers; *Customer HP Index* is the weighted sum of a firm's key customers' *HP index*, where weights are the percentages of the firm's sales to that customer; and *Customer Market Share* is the weighted market shares of a firm's key customers. All continuous variables are winsorized at the 1% and 99% levels.

	Mean	Median	Std Dev	Observations
Supplier Characteristics				
AR/Sales	0.173	0.154	0.112	35,673
AP/COGS	0.218	0.122	0.361	36,519
R-Index	2.663	3.000	1.381	19,746
Cash/Total Assets	0.110	0.042	0.155	36,659
Firm ROA	-0.072	0.028	0.331	36,622
Total Assets (in $ millions)	876.000	80.310	2,635.769	36,659
Tobin's Q	1.920	1.328	1.857	36,659
Sales Intensity	1.158	1.030	0.818	36,624
Book Leverage	0.266	0.214	0.276	36,659
Market Share	0.028	0.002	0.091	36,665
Differentiated Goods	0.487	0.000	0.500	31,862
Service Goods	0.304	0.000	0.460	31,862
Liquidity measures and proxies				
Line of Credit	0.784	1.000	0.411	12,926
LOC Drawn	0.051	0.000	0.103	12,849
LOC Limit	0.228	0.161	0.247	9,955
Get LOC	0.228	0.000	0.419	1,668
Lose LOC	0.061	0.000	0.239	7,212
Z-Score	0.608	1.458	3.835	36,624
HP Index	-2.807	-2.866	0.927	33,603
Customer Characteristics				
Customer Line of Credit	0.223	0.160	0.212	13,826
Customer Z-Score	0.534	0.360	0.568	33,982
Customer HP Index	-0.848	-0.622	0.759	34,759
Customer Market Share	0.045	0.020	0.067	34,122

Table II
Supplier and Customer Lines of Credit and Trade Credit

This table provides the results based on OLS regressions using Compustat firms with identifiable customer data and line of credit data from 1996 to 2008. Financial firms are excluded. *AR/Sales* is calculated as accounts receivable divided by sales and is the dependent variable in all specifications; *Line of Credit* is equal to one if a supplier firm has a line of credit and zero otherwise; *LOC Drawn* is equal to the dollar amount borrowed on the line of credit divided by total assets; *Customer Line of Credit* is calculated based on the status of all of a firm's key customers' lines of credit, where the weights are the percentage of the firm's sales to that customer; *AP/COGS* is accounts payable divided by the cost of goods sold; *Cash/Total Assets* is cash divided by total book assets; *Firm ROA* is net income over total assets; *Log[Total Assets]* is the natural logarithm of total assets; *Sales Intensity* is net revenue divided by total assets; *Tobin's Q* is the market value of assets divided by the book value of assets; *Book Leverage* is the book value of debt divided by the total book value of assets; *Market Share* is a supplier firm's sales divided by the total sales in the firm's primary three-digit SIC industry; *Customer Market Share* is the weighted market shares of a firm's key customers; *Differentiated Goods* is a dummy variable equal to one if the supplier firm produces a differentiated good and zero otherwise; and *Service Goods* is a dummy variable equal to one if a firm's output is a service and zero otherwise. In the base case, a firm produces a homogeneous good. All three industry definitions are from Rauch (1999). Customer weights are not required to sum to one. Industry fixed effects are calculated at the two-digit SIC level. *t*-statistics in the parentheses are based on heteroskedasticity robust standard errors and are clustered by firm. All continuous variables are winsorized at the 1% and the 99% levels.

	Dependent Variable: *AR/Sales*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Line of Credit	0.0178***		0.0169***	0.0181***				
	(5.805)		(5.273)	(5.361)				
LOC Drawn					0.0262***	0.0239**	0.0238**	0.0176*
					(2.747)	(2.158)	(2.467)	(1.946)
Customer Line of Credit		-0.0189***	-0.0266***	-0.0331***			-0.0183***	-0.0231***
		(-3.002)	(-3.932)	(-3.549)			(-2.721)	(-2.618)
AP/COGS	0.0592***	0.0648***	0.0638***	0.0639***	0.0587***	0.0553***	0.0669***	0.0589***
	(6.012)	(7.569)	(5.377)	(4.167)	(5.888)	(4.448)	(4.345)	(3.083)
Cash/Total Assets	-0.0588***	-0.0569***	-0.0579***	-0.0629***	-0.0643***	-0.0534***	-0.0566***	-0.0633***
	(-6.246)	(-6.300)	(-5.944)	(-6.305)	(-6.789)	(-4.587)	(-5.820)	(-6.280)
Firm ROA	0.0149***	0.0167***	0.0160***	0.0190***	0.0168***	0.0112**	0.0180***	0.0219***
	(3.801)	(4.614)	(4.135)	(4.546)	(4.250)	(2.301)	(4.058)	(4.607)
Log[Total Assets]	-0.0026***	-0.0029***	-0.0030***	-0.0035***	-0.0021**	0.0055**	0.0033	0.0032
	(-2.713)	(-3.042)	(-2.981)	(-3.280)	(-2.142)	(2.014)	(1.212)	(1.064)

(continued)

Table II (continued)

	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
Sales Intensity	-0.0282***	-0.0282***	-0.0267***	-0.0294***		-0.0269***	-0.0370***	-0.0358***	-0.0362***
	(-15.939)	(-17.095)	(-14.115)	(-14.206)		(-15.530)	(-12.492)	(-11.301)	(-10.569)
Tobin's Q	-0.0000	-0.0012*	-0.0001	-0.0002		-0.0001	0.0024***	0.0023***	0.0024***
	(-0.064)	(-1.861)	(-0.185)	(-0.244)		(-0.123)	(3.315)	(3.141)	(3.037)
Book Leverage	-0.0101**	-0.0114***	-0.0101**	-0.0041		-0.0104**	-0.0043	-0.0047	-0.0005
	(-2.102)	(-2.626)	(-2.047)	(-0.791)		(-2.091)	(-0.649)	(-0.729)	(-0.078)
Market Share				0.0001					-0.0247**
				(0.010)					(-2.387)
Customer Market Share				0.0375					0.0032
				(1.531)					(0.142)
Differentiated Goods				-0.0631***					0.0048
				(-3.420)					(0.317)
Service Goods				-0.1407***					-0.0013
				(-8.699)					(-0.072)
Constant	0.2210***	0.2267***	0.2176***	0.2258***		0.2305***	0.1504***	0.1649***	0.1767***
	(14.130)	(15.941)	(13.367)	(12.343)		(14.800)	(8.472)	(8.871)	(7.067)
Industry fixed effects	Yes	Yes	Yes	Yes		Yes	No	No	No
Firm fixed effects	No	No	No	No		No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Adjusted R-squared	0.206	0.215	0.219	0.218		0.203	0.106	0.126	0.122
Observations	12,614	13,499	10,542	9,032		12,539	12,539	10,479	8,972

Table III
Banking Deregulation and Trade Credit

Results of the OLS regressions using Compustat firms with identifiable customer data and trade credit data from 1996 to 2008. Financial firms are excluded. The variable *Get LOC* is one if the firm had no line of credit in year *t* but acquired a line of credit in year *t* + 1 and zero otherwise; *Lose LOC* is equal to one if the supplier firm had access to a bank line of credit in year *t* but lost access to it in year *t* + 1 and zero otherwise; *Delta LOC Limit* is the change in *LOC Limit* from year *t* to year *t* + 1, normalized by total assets; and *R-Index* is the banking regulation index for the supplier firm's headquarters state in year *t*. The control variables are defined as in Appendix 2. *t*-statistics in the parentheses are based on heteroskedasticity robust standard errors and are clustered by state. All continuous variables are winsorized at the 1% and the 99% levels.

Panel A

Dependent Variable	*Get LOC*		*Lose LOC*		*Delta LOC Limit*	
	(1)	(2)	(3)	(4)	(5)	(6)
R-Index	-0.0640***	-0.0632**	-0.0075	-0.0098	0.0021	0.0013
	(-2.764)	(-2.683)	(-1.136)	(-1.619)	(1.038)	(0.608)
AP/COGS		0.0390		0.0191		0.0077
		(1.185)		(0.629)		(0.808)
Cash/Total Assets		-0.0962		0.1099**		0.0001
		(-1.464)		(2.602)		(0.010)
Firm ROA		0.0230		-0.0222*		0.0300**
		(0.432)		(-1.693)		(2.476)
Log[Total Assets]		-0.0110		0.0090		-0.0174***
		(-0.317)		(0.797)		(-4.689)
Sales Intensity		-0.0418		0.0107		-0.0138*
		(-0.679)		(0.709)		(-1.787)
Tobin's Q		0.0013		-0.0119***		0.0018
		(0.253)		(-3.653)		(1.306)
Book Leverage		-0.1241**		-0.0057		-0.0337**
		(-2.514)		(-0.236)		(-2.356)
Market Share		0.9471***		-0.0177		-0.0038
		(3.813)		(-0.362)		(-0.206)
Customer Market Share		-0.5071*		0.0529		0.0156
		(-1.956)		(1.133)		(0.466)
Constant	0.2720***	0.4088*	0.0523**	0.0098	0.0328***	0.1437***
	(4.003)	(1.748)	(2.149)	(0.131)	(4.092)	(4.788)
Observations	1,610	1,558	7,024	6,823	6,203	6,033
Adjusted R-squared	0.044	0.056	0.004	0.009	0.019	0.028
Firm and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

(continued)

Table III (continued)

Panel B

	Dependent Variable: *AR/Sales*			
	(1)	(2)	(3)	(4)
	Whole Sample		LOC Firms Only	Non-LOC Firms Only
R-Index	-0.0007	-0.0067***	0.0000	-0.0155*
	(-0.541)	(-2.759)	(0.030)	(-1.721)
Line of Credit		-0.0118*		
		(-1.722)		
R-Index X Line of Credit		0.0067***		
		(2.957)		
AP/COGS	0.0626***	0.0626***	0.0820***	0.0413
	(5.514)	(5.473)	(5.607)	(1.426)
Cash/Total Assets	-0.0561***	-0.0563***	-0.0620***	-0.0596***
	(-4.722)	(-4.817)	(-4.659)	(-2.773)
Firm ROA	0.0162***	0.0161***	0.0208***	0.0036
	(4.017)	(4.052)	(2.890)	(0.442)
Log[Total Assets]	0.0059***	0.0059***	0.0037	0.0196***
	(2.772)	(2.847)	(1.394)	(2.995)
Sales Intensity	-0.0361***	-0.0363***	-0.0372***	-0.0283**
	(-11.902)	(-12.106)	(-13.360)	(-2.177)
Tobin's Q	0.0023***	0.0023***	0.0021**	0.0041**
	(3.992)	(4.036)	(2.339)	(2.474)
Book Leverage	-0.0067	-0.0072	0.0012	-0.0331
	(-1.040)	(-1.133)	(0.155)	(-1.566)
Constant	0.1776***	0.1887***	0.1887***	0.1201***
	(13.322)	(12.224)	(13.439)	(2.796)
Observations	11,500	11,500	9,046	2,454
Adjusted R-squared	0.111	0.112	0.160	0.057
Firm and year fixed effects	Yes	Yes	Yes	Yes

Table IV
Banking Deregulation and Trade Credit: 2SLS Estimations

The results of 2SLS estimations using Compustat firms with identifiable customer data and trade credit data from 1996 to 2008. Financial firms are excluded. Only second-stage estimates are reported, since first-stage estimates are equivalent to those in Panel A of Table III. The dependent variable in the first stage (unreported), *Get LOC*, is equal to one if the supplier firm had no access to a credit line in year *t* but acquired one in year *t* + 1 and zero otherwise. The instrument *R-Index* is the banking regulation index for the supplier firm's headquarters state in year *t*. The dependent variable in the second stage, *AR/Sales*, is accounts receivables over sales for year *t*. The variable $\widehat{Get\ LOC}$ is the predicted value of *Get LOC* from the first-stage estimation; *AP/COGS* is accounts payable over the cost of goods sold; *Cash/Total Assets* is cash over total book assets; *Firm ROA* is net income over total assets; *Log[Total Assets]* is the logarithm of total assets; *Sales Intensity* is sales over total assets; *Tobin's Q* is the market value to the book value of assets; and *Book Leverage* is the book value of debt over total assets. The Angrist–Pischke F-statistic and the Andersen–Rubin F-statistic test the relevance of the instrument in the first- and second-stage estimations, respectively. An endogeneity test examines if the endogenous variable is exogenous to the outcome variable in the second stage. *t*-statistics in the parentheses are based on heteroskedasticity robust standard errors and are clustered by state. All continuous variables are winsorized at the 1% and the 99% levels.

	Dependent Variable: *AR/Sales*		
	(1)	(2)	(3)
$\widehat{Get\ LOC}$	0.1047**	0.1597**	0.1436**
	(2.211)	(2.518)	(2.350)
AP/COGS		0.0160	0.0251
		(0.581)	(0.814)
Cash/Total Assets		-0.0874***	-0.0832***
		(-3.199)	(-2.731)
Firm ROA		0.0057	0.0017
		(0.318)	(0.099)
Log[Total Assets]		0.0271	0.0273*
		(1.582)	(1.670)
Sales Intensity		-0.0290	-0.0333
		(-0.855)	(-0.999)
Tobin's Q		0.0061***	0.0065***
		(3.359)	(3.699)
Book Leverage		0.0070	0.0050
		(0.356)	(0.239)
Market Share			-0.1313**
			(-2.296)
Customer Market Share			0.0827
			(0.631)
Observations	1,101	1,101	1,059
Angrist–Pischke F-statistic	4.47**	4.27**	3.45*
Andersen–Rubin F-statistic	4.23**	6.27**	3.90*
Endogeneity test statistic	3.28*	3.42*	3.55*
Firm and year fixed effects	Yes	Yes	Yes

Table V
Banking Deregulation and Survival of Supplier-Customer Relationships

This table provides results for fixed-effect logit estimations (models 1 – 5) and fixed-effect 2SLS estimations (models 6 – 7). Financial firms are excluded. The dependent variable in the logit estimates is *Retained*, which is equal to one if a customer in year *t* is retained in year *t*+1, zero otherwise. *R-Index* is the banking restrictions index for the supplier firm's headquarters state in year *t*, ranging from zero to four. *Percent Sales* is the percentage of supplier sales that the customer accounted for in year *t*. *Customer Z-Score* is the customer Altman Z-score, *Customer Profitability* is the customer's return on assets for year *t*, and *Customer Tobin's Q* is the customer's Tobin's Q. In the 2SLS estimations, we use lagged *R-Index* (measured in year *t*-1) as the instrument in the 1st stage. We use this instrument to predict *Get LOC* which equals one if the supplier firm with no access to a credit line in year *t*-1 acquires one in year *t*, and zero otherwise. $\widehat{Get\ LOC}$ is the predicted value of *Get LOC* from the 1st stage estimation. All estimations contain supplier-customer pair level fixed effects. *t*-statistics in the logit estimations are calculated from bootstrapped standard errors based on fifty replications. In the 2SLS estimations, the *t*-statistics are based on robust standard errors and clustered at the state level. All continuous variables are winsorized at the 1% and the 99% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation			Logit			2SLS, 1st Stage	2SLS, 2nd Stage
Dependent Variable			*Retained*			*Get LOC*	*Retained*
R-Index	-0.07**	-0.07**	-0.06**	-0.06*	-0.05*		
	(-2.44)	(-2.22)	(-2.06)	(-1.76)	(-1.74)		
Lagged R-Index						-0.01*	
						(-1.70)	
$\widehat{Get\ LOC}$							4.75*
							(1.74)
Percent Sales		1.16***			1.16***	-0.04**	0.55***
		(6.54)			(5.76)	(-2.23)	(5.11)
Customer Tobin's Q			0.06**		0.07**	-0.01	0.05**
			(2.07)		(2.05)	(-1.15)	(2.29)
Customer Z-Score				0.05	0.03	0.01***	-0.03
				(1.05)	(0.61)	(2.76)	(-1.21)
Angrist–Pischke F-statistic						2.88*	
Andersen–Rubin F-statistic							7.930***
Endogeneity test statistic							3.318*
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Supplier–customer pair fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,854	15,815	14,552	14,543	14,504	1,202	1,202

Table VI
Additional Measures of Liquidity and Trade Credit

This table provides the results based on OLS regressions using Compustat firms with identifiable customer data from 1980 to 2008. Financial firms are excluded. The variable *AR/Sales* is calculated as accounts receivable divided by sales and is the dependent variable in all specifications; *Z-Score* is Altman's (1968) Z-score for the supplier firm and is calculated as 3.3*EBIT/total assets + sales/total assets + 1.4*retained earnings/total assets + 1.2*working capital/total assets; *Customer Z-Score* is the weighted sum of a firm's key customers' Altman Z-scores, weighted by the percentage of the firm's sales to that customer; *HP Index* is the Hadlock–Pierce (2010) financial constraint index for the supplier firm; *Customer HP Index* is the weighted sum of a firm's key customers' *HP Index*, where weights are the percentage of the firm's sales to that customer; *AP/COGS* is accounts payable divided by the cost of goods sold; *Cash/Total Assets* is cash divided by total book assets; *Firm ROA* is net income over total assets; *Log[Total Assets]* is the natural logarithm of total assets; *Sales Intensity* is net sales divided by total assets; *Tobin's Q* is the market value of assets divided by the book value of assets; *Book Leverage* is the book value of debt divided by the total book value of assets; *Market Share* is a firm's sales divided by total sales in the firm's primary three-digit SIC industry; *Customer Market Share* is the weighted market shares of a firm's key customers; *Differentiated Goods* is a dummy variable equal to one if a firm produces a differentiated good and zero otherwise; and *Service Goods* is a dummy variable equal to one if a firm's output is a service and zero otherwise. The base case is a homogeneous good. All three industry definitions are from Rauch (1999). Customer weights are not required to sum to one. The *t*-statistics are calculated from robust standard errors clustered by firm and are reported in parentheses. All continuous variables are winsorized at 1% and 99%.

	Dependent Variable: *AR/Sales*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Z-Score	0.0028***	0.0032***		0.0028***				
	(5.667)	(7.006)		(5.622)				
Customer Z-Score	-0.0053***		-0.0049***	-0.0046*				
	(-2.831)		(-2.595)	(-1.881)				
HP Index					-0.0084*	-0.0076		-0.0065
					(-1.792)	(-1.599)		(-1.309)
Customer HP Index					0.0052***		0.0050***	0.0060***
					(3.323)		(3.288)	(2.994)
AP/COGS	0.0730***	0.0726***	0.0725***	0.0625***	0.0739***	0.0739***	0.0730***	0.0617***
	(12.233)	(12.586)	(12.150)	(8.180)	(12.197)	(12.204)	(12.152)	(7.797)
Cash/Total Assets	-0.0739***	-0.0741***	-0.0729***	-0.0763***	-0.0714***	-0.0715***	-0.0710***	-0.0747***
	(-10.353)	(-10.491)	(-10.185)	(-10.302)	(-10.193)	(-9.857)	(-10.192)	(-10.144)
Firm ROA	0.0067*	0.0058*	0.0191***	0.0078**	0.0209***	0.0204***	0.0208***	0.0208***
	(1.944)	(1.791)	(6.630)	(2.140)	(7.267)	(7.109)	(7.287)	(6.678)
Log[Total Assets]	-0.0029*	-0.0049***	-0.0000	-0.0039**	-0.0025	-0.0025	0.0003	-0.0030
	(-1.938)	(-3.926)	(-0.025)	(-2.478)	(-1.237)	(-1.231)	(0.213)	(-1.380)
Sales Intensity	-0.0410***	-0.0426***	-0.0395***	-0.0414***	-0.0408***	-0.0408***	-0.0404***	-0.0409***
	(-22.230)	(-24.423)	(-21.762)	(-21.114)	(-22.926)	(-22.908)	(-22.894)	(-21.433)

(continued)

Table VI (continued)

Tobin's Q	0.0006	0.0006	0.0002	0.0007	-0.0001	-0.0001	-0.0002	0.0003
	(1.243)	(1.229)	(0.389)	(1.379)	(-0.213)	(-0.290)	(-0.325)	(0.669)
Book Leverage	0.0001	-0.0002	-0.0065	0.0008	-0.0089**	-0.0086**	-0.0090**	-0.0058
	(0.019)	(-0.037)	(-1.562)	(0.189)	(-2.140)	(-2.052)	(-2.195)	(-1.302)
Market Share				-0.0163*				-0.0123
				(-1.894)				(-1.614)
Customer Market Share				-0.0050				0.0129
				(-0.289)				(0.716)
Differentiated Goods				0.0128*				0.0123*
				(1.769)				(1.686)
Service Goods				0.0212***				0.0202**
				(2.631)				(2.490)
Constant	0.2312***	0.2256***	0.2272***	0.2246***	0.2286***	0.2271***	0.2345***	0.2165***
	(29.950)	(28.997)	(29.712)	(22.985)	(26.441)	(26.256)	(30.479)	(20.567)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	33,012	35,598	33,012	28,990	32,698	32,698	33,801	27,312
Adjusted R-squared	0.134	0.133	0.131	0.126	0.135	0.134	0.132	0.123