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The Lender's Lender: Trade Credit and the Monitoring Role of Banks

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Abstract

A firm's role as lender to its customers (via trade credit) is influenced by the firm's own lenders. With a novel data set of trade credit between U.S. public companies, I find that firms limit customer credit concentrations, extending less generous trade credit to customers as the firms' sales dependence on them increases. Evidence points to lenders influencing firms to limit credit concentrations: First, cross-sectional variation shows stronger results with greater lender monitoring intensity. Second, analysis of granular loan contract details reveals that concentration limits in borrowing base formulas are a clear, previously unexplored way banks influence trade credit policies.

I. Introduction

The novel characteristic defining the most important source of short-term financing worldwide—trade credit—is that the financiers are operating firms rather than specialized financial institutions.[1] These trade credit lenders are themselves often borrowers of traditional bank lenders, who may exert influence over their borrowers' lending patterns. Particularly, since we know lenders concern themselves over financial vulnerabilities created by supply chain dependence (e.g., Campello and Gao (2017), Frankel, Kim, Ma, and Martin (2020)), we might expect banks to monitor and impact their borrowers' credit concentrations.

In this paper, I examine how a firm's lender affects the firm's extension of trade credit and resulting credit concentrations. Evidence on whether and how lenders influence their borrowers' trade credit policy is limited. Extant work has shown liquidity can pass along the supply chain from banks to borrowers' customers via trade credit: When borrowing firms have better credit access than their financially constrained customers, trade credit can be an important route to financing for these

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[1]See Rajan and Zingales (1995) and Barrot (2016).

small customers (Schwartz (1974), Emery (1987), Jain (2001), and Meltzer (1960)), and in times of crisis, well-funded firms can provide liquidity to constrained firms downstream (Love, Preve, and Sarria-Allende (2007), Fabbri and Menichini (2010), Garcia-Appendini and Montoriol-Garriga (2013), Costello (2020), and Amberg, Jacobson, von Schedvin, and Townsend (2021)). In this context, a supplying firm may have a lending advantage over a bank due to better information (e.g., Biais and Gollier (1997), Petersen and Rajan (1997)), greater ability to enforce payment (Cunat (2007)), or better ability to utilize repossessed collateral (Frank and Maksimovic (2005)).

However, even very large customers with seemingly easy access to capital use significant amounts of trade credit, potentially due to vertical bargaining power. Recent media[2] and literature (Murfin and Njoroge (2015), Fabbri and Klapper (2016)) find evidence that large customers' bargaining power allows them to extract large amounts of trade credit from small, dependent suppliers. These findings suggest powerful customers may extract particularly generous trade credit terms from dependent suppliers.

From the perspective of the firm's lenders, however, significant credit concentrations make the firm financially vulnerable, tying up its short-term liquidity and increasing vulnerability to adverse supply chain spillovers (Jacobson and von Schedvin (2015), Hertzel, Li, Officer, and Rodgers (2008), Boissay and Gropp (2013), and Kolay, Lemmon, and Tashjian (2016)). Because of the increased supply chain spillover risk large credit concentrations could create, firms' lenders may exert influence to constrain liberal extensions of credit. Prior studies show lenders consider customer sales concentration when setting loan terms (e.g., Campello and Gao (2017), Hasan, Minnick, and Raman (2020)), but whether a lender takes a more proactive role in their borrowers' interactions with significant customers by influencing trade credit policy remains an open question, particularly given the bargaining power these customers may exert in these relationships.

Examining trade credit concentrations requires data on a firm's sales and credit balances with individual customers—a nontrivial empirical hurdle, since standard sources of firm financial data include only aggregate balances of trade credit due to (all) suppliers (i.e., payables) and due from (all) customers (i.e., receivables). A standard approach, given data with known supply chain partners but only aggregate payables and receivables, is to ascribe *firm-level* trade credit patterns to the customer-supplier pair (e.g., Garcia-Appendini and Montoriol-Garriga (2013), Fabbri and Klapper (2016)). However, understanding credit concentrations and management of concentration risk within a firm's receivable portfolio (across customers) requires more granular data on trade credit between firm-customer pairs.

Using a novel hand-collected data set of trade credit balances between a firm and its individual customers, I examine pair-level trade credit outcomes to understand first whether firms avoid credit concentrations with significant customers and second, the role of the firm's lenders in credit concentration risk management. Because even in the absence of concentration risk concerns or customer

[2]See, e.g., "Big Companies Pay Later, Squeezing Their Suppliers," S. Strom, *New York Times* (Apr. 6, 2015); "Some Companies Are Taking Longer to Pay Suppliers Despite Recovery," K. Broughton, *Wall Street Journal* (June 7, 2021).

bargaining power, trade credit balances will typically increase mechanically with customer sales, I define TRADE CREDIT as the customer-specific trade credit scaled by customer-specific sales and examine whether this ratio varies with the firm's SALES DEPENDENCE on the customer, measuring sales to the customer relative to the supplier's total sales. If firms avoid credit concentrations, we should see a negative relationship between TRADE CREDIT and SALES DEPENDENCE; if customer bargaining power forces firms to provide disproportionately high trade credit to important customers, we should see a positive relationship; and if firms' credit extension is independent of sales dependence, no relationship will exist.

I focus first on examining the relationship between SALES DEPENDENCE and TRADE CREDIT. While understanding how sales concentration affects trade credit is a first-order question, empirical work has been hindered by the shortage of data on customer-specific trade credit and customer-specific sales dependence.[3] I am able to identify this relationship precisely with two empirical features: First, a novel data set of trade credit between U.S. publicly traded firms, matched at the firm-customer level, allows me to base inferences about trade credit allocation on actual customer-specific receivables rather than on firm-level aggregations. Second, I use customer × year fixed effects to hold constant customer-specific demand factors, comparing trade credit extended by different firms to the same customer at the same time; firm-year fixed effects to control for firm-specific supply factors, comparing trade credit extended by the same firm to different customers at the same time; or, in my strictest specification, both customer × year and firm-year fixed effects to control for both.

I find TRADE CREDIT decreases with SALES DEPENDENCE, indicating that firms extend trade credit less generously to customers they depend on most. This result is not driven by firms with concentrated customer bases extending less trade credit overall—total firm-level receivables balances are not significantly lower for firms with high SALES DEPENDENCE on major customers; these firms do not avoid large *aggregate* receivable balances, but they do avoid *concentrated* receivable portfolios.

Having established an inverse relationship between trade credit generosity and sales dependence, I examine the economic channel driving the effect. Evidence points to bank monitoring leading firms to limit customer credit concentrations: First, in a suggestive result, the negative effect of SALES DEPENDENCE on TRADE CREDIT only holds among firms with a significant banking relationship. Consistent with a monitoring effect, cross-sectional variation in expected monitoring intensity across bank default exposure and customer payment risk further supports the lending channel.

To illustrate a precise channel of lender influence, I examine granular information for a subsample of firms from a sample of loan contracts with receivable

[3] A few recent studies use proprietary data sets with pair-level trade credit data in select samples, e.g., Klapper et al. (2012) study contract terms between 56 large buyers and their suppliers, Giannetti, Serrano-Velarde, and Tarantino (2021) examine an accounts database of Italian limited liability companies, Jacobson and von Schedvin (2015) focus on the unique setting of trade credit defaults, and Costello (2019) uses an extensive database of interfirm credit sales, but without detailed customer information.

concentration limits built into their credit lines. Many loans backed by receivables include explicit concentration limits, sometimes with built-in exceptions for particular customers. Within the sample of firms with such loan terms, credit concentration avoidance is much stronger toward customers with strict concentration limits versus customers with explicit concentration limit *exceptions* built into the contracts. Exploring these contractual restrictions further, I find that banks are more likely to grant exemptions from the firm's receivable concentration limit to customers with whom the banks also have a lending relationship. While these concentration restrictions do not fully constrain firms from granting extra trade credit to some customers, they have a significant restrictive effect on trade credit provision. Suggestive evidence points to these limits dampening sales growth with major customers.

Overall, results indicate a strong negative relationship between a firm's dependence on a customer and the trade credit extended to that customer, with evidence suggesting lenders cause the effect via concern over credit concentrations. My findings relate most closely to two strands of the literature. First, by showing the role of banks in steering their borrowers' trade credit decisions on customer receivable concentrations, I contribute to papers studying the interaction between supply chain relationships and lending relationships. Particularly, my results on lender influence build on work documenting banks' monitoring of receivables (Frankel et al. (2020), Mester, Nakamura, and Renault (2007)). While Mester et al. (2007) show that banks glean information from receivables and Frankel et al. (2020) show that banks influence receivables reporting quality, evidence of direct *influence over* (rather than *reaction to*) trade credit policy is novel. Regarding bank concern over customer concentration, Campello and Gao (2017) and Hasan et al. (2020) show that lenders set stricter loan terms for borrowers with concentrated customer (sales) bases, though Cen, Dasgupta, Elkamhi, and Pungaliya (2016) also show a positive certification effect of long-term customer relationships. These papers show lenders are concerned about sales concentration but do not address lender influence over borrowers' trade credit policy.

Other papers study "supply chain lending," when a firm and its customer share a common bank: Amiram, Li, and Owens (2020) find evidence that supply chain lending affords the bank information synergies leading to more favorable loan spreads and relaxed monitoring, while Gong and Luo (2018) document extensive evidence that banks can more easily gather private information when lending to firms with supply chain connections, resulting in less conservative financial reporting from these borrowers and less stringent loan terms. Contributing to these findings, I find that banks are more likely to grant concentration limit exceptions for their borrower's customers that are also in the lender's portfolio.

Second, I contribute to papers considering how dependence on a customer affects trade credit extension. Wilner (2000) and Cunat (2007) model a firm extending more trade credit to customers it depends on heavily in order to preserve the relationship. Recent empirical papers, relying on firm-level trade credit measures, suggest customers with bargaining power extract more favorable trade credit terms from suppliers heavily dependent on them (Murfin and Njoroge (2015), Dass, Kale, and Nanda (2015), and Fabbri and Klapper (2016)). I contribute to this

line of papers by showing a credit concentration avoidance effect that would be undetectable without using pair-level trade credit data and which exists beyond any bargaining power effect of sales dependence.[4] Particularly, I find firms manage their portfolios of receivables in such a way as to avoid excessive concentrations and appease their own lenders' concerns over customer credit exposure.

II. Data and Variables of Interest

A. Data

Studies often use firm-level receivables and payables to analyze trade credit, but understanding pair-level determinants and patterns in the provision of trade credit between a firm and its customer requires pair-level trade credit data. To this end, I compile a data set of pair-level trade credit from firm 10-K disclosures arising from two SEC reporting regulations. The Statement of Financial Accounting Standards (SFAS) No.14 and No.131 require public firms to disclose customers comprising 10% or more of their sales. Supply chain disclosures under this regulation form the basis of the Compustat Segment database frequently employed in the literature to analyze supply chain issues (e.g., Fee, Hadlock, and Thomas (2006), Banerjee, Dasgupta, and Kim (2008), Campello and Gao (2017), and Cen et al. (2016)). The second regulation is FASB 105, which requires disclosure of concentrations of credit risk.[5] Accounts receivable balances of major customers frequently qualify as credit concentrations, so many firms disclose these balances. As the reporting format is non-uniform across firms, I manually collect these disclosures from firms' annual 10-Ks. This procedure results in a firm-customer-year panel with 8,173 observations. My data collection procedure is detailed more thoroughly in the Supplementary Material. Table IA-1 compares characteristics of the reporting firms in my final sample with non-reporting (i.e., unused) firms. This comparison shows that reporting firms are somewhat smaller and more dependent on their customers, but have similar aggregate trade credit levels. I address potential selection concerns in Section III.A.

B. Variables of Interest

The main dependent variable of interest is TRADE CREDIT, defined as the ratio of the firm's trade receivable balance with a customer to the firm's annual sales to that customer. A higher value of TRADE CREDIT indicates a larger credit balance relative to the customer's economic importance to the firm. The

[4]Importantly, I do not claim to show that small firms do not suffer from the trade credit demands of high bargaining power customers. Instead, my results indicate that these large customers receive *proportionally* less than minor customers (though this may still be a very large dollar amount), and potentially point to lenders' influence curbing the bargaining power these large customers can exert.

[5]FASB 105 concerned concentrations of credit risk for all instruments as well as the disclosure of off-balance-sheet financial risks. Subsequent pronouncements and amendments shifted the paragraphs regarding concentrations of credit risk to FASB 107 then 161, but the disclosure guidance was unchanged.

TABLE 1

Summary Statistics

Table 1 reports summary statistics of key variables in the study, spanning 1993 to 2016. The observation level is a firm-customer-year, and the sample includes all pairs of supply chain partners in the Compustat Segment database with available information regarding firm-customer trade credit. TRADE CREDIT is the amount of trade credit extended by a firm to an individual customer, scaled by annual sales between the two firms. SALES DEPENDENCE is the logarithm of the proportion of total firm sales going to the customer (in whole percentage points). Other variable definitions are available in the Appendix. Leverage is constrained to be between 0 and 1. All continuous variables are winsorized at the 1st and 99th percentiles.

Variable	Observations	Mean	SD	25pctl	Median	75pctl
Pair Characteristics						
TRADE CREDIT	8,173	0.184	0.178	0.084	0.139	0.221
SALES DEPENDENCE	8,173	2.952	0.743	2.485	2.890	3.401
Firm Characteristics						
SIZE	8,173	5.250	1.950	3.920	5.140	6.537
LEVERAGE	8,173	0.172	0.215	0.000	0.092	0.272
PROFITABILITY	8,173	0.018	0.260	−0.025	0.087	0.149
HHI	8,173	0.139	0.139	0.055	0.094	0.158
AGE	8,173	2.537	0.732	1.946	2.565	3.045
Customer Characteristics						
SIZE	8,173	10.012	1.811	8.999	10.230	11.332
LEVERAGE	8,173	0.223	0.157	0.108	0.201	0.295
PROFITABILITY	8,173	0.128	0.077	0.081	0.126	0.168
HHI	8,173	0.195	0.179	0.068	0.134	0.268
AGE	8,173	3.286	0.732	2.833	3.466	3.912

primary relationship of interest is that between TRADE CREDIT and SALES DEPENDENCE, which captures how important the customer's sales are to the firm. I define SALES DEPENDENCE as the logarithm of the proportion (in percentage points) of annual firm sales attributed to the customer.[6] Scaling these variables allows me to examine the effect of SALES DEPENDENCE on TRADE CREDIT while controlling for the mechanical increase in receivables outstanding as transaction size increases.

Control variables (for both firm and customer) capture firm-level drivers of trade credit supply and demand: SIZE and LEVERAGE proxy for creditworthiness and access to capital, PROFITABILITY reflects ability and incentives to extend (and take) credit; AGE reflects firm quality and reputation; and HHI captures the effects of industry competitiveness (Petersen and Rajan (1997), Smith (1987), Brennan, Maksimovics, and Zechner (1988), and Barrot (2016)). Variable definitions are available in the Appendix.

Table 1 reports summary statistics for variables of interest and controls. The average (median) level of SALES DEPENDENCE is 2.952 (2.890), indicating that on average, a sample customer accounts for 19.1% (18.0%) of a firm's sales. TRADE CREDIT averages 18.4% (13.9% at the median) of annual pair-level sales. Turning to firm-level characteristics, suppliers tend to be smaller and younger than their customers, who are typically large, established corporations, as documented in prior studies using the Compustat Segment database. Thus, the sample provides a good setting for studying trade credit patterns in the presence of significant customer bargaining power and customers with purchases large enough to create the potential for large credit concentrations.

[6]Taking the natural logarithm significantly reduces skewness in the variable, so I adopt this transformation throughout my analysis; however, results are consistent when using the simple ratio of customer sales to total sales.

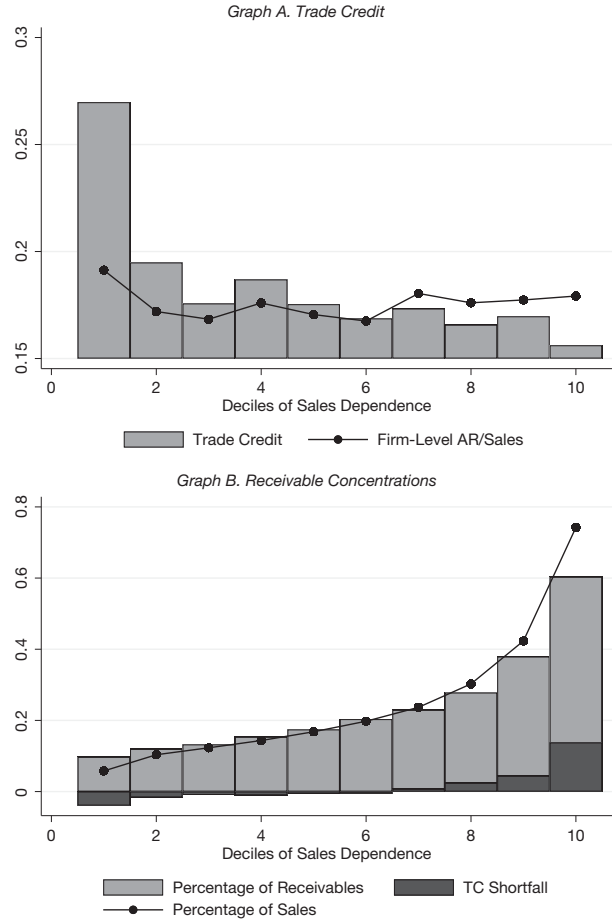
C. Univariate Analysis

Before turning to a regression framework, I first examine the univariate relationship between TRADE CREDIT and SALES DEPENDENCE. Graph A of Figure 1 reports averages of TRADE CREDIT across deciles of SALES DEPENDENCE. Also displayed (solid line) is the average firm-level ratio of receivables-to-sales (AR/SALES) as a benchmark for the TRADE CREDIT the observation customer would receive if the firm's receivables were distributed to all customers proportionately to sales concentration. The figure demonstrates decreasing TRADE CREDIT generosity as SALES DEPENDENCE increases. In the first 5 deciles,

FIGURE 1

Univariate Patterns in TRADE CREDIT and SALES DEPENDENCE

Graph A of Figure 1 plots averages of TRADE CREDIT across deciles of SALES DEPENDENCE. The line shows the average firm-level ratio of receivables-to-sales (AR/SALES) as a benchmark. In Graph B, gray bars show the average proportion of receivables comprised by individual customers across deciles of SALES DEPENDENCE, while the solid line plots the average proportion of sales across deciles as a benchmark and the darker bars show TC SHORTFALL, the difference between these two.



customers receive proportionately more trade credit than the firm's average customer, but this reverses after decile 6. This inflection point occurs around a SALES DEPENDENCE of 3.061, corresponding to 21% of the firm's sales. From this simple univariate exercise, it appears customers comprising a substantial proportion of the firm's sales receive less generous trade credit relative to minor customers.

Another way to visualize the pattern is to compare the proportion of a firm's receivables accounted for by an individual customer to its sales percentage. Graph B of Figure 1 plots, in gray bars, the average percentage of receivables accounted for by individual customers across deciles of SALES DEPENDENCE. As the benchmark for comparison in this graph, the solid line tracks the proportion of receivables each decile would account for, on average, if customers' receivable concentration matched their sales concentration. The darker bars capture a measure of TC SHORTFALL, the gap between the hypothetical benchmark of receivables distributed proportionally with sales and actual observed receivable concentrations. As in Graph A, through the first 5 deciles, customers receive relatively generous trade credit relative to sales, with individual customers comprising a higher proportion of receivables than sales (corresponding to negative TC SHORTFALL). After the sixth decile, however, the pattern reverses: While larger customers mechanically account for a larger proportion of receivables, the TRADE CREDIT they receive does not keep up with the increasing proportion of sales that they account for, generating a positive TC SHORTFALL.

To formalize this analysis, I turn to a multivariate framework in the following section.

D. Empirical Specification

To more thoroughly examine the baseline relationship between TRADE CREDIT and SALES DEPENDENCE, I begin with the following regression specification:

$$\text{TRADE CREDIT}_{i,j,t} = \alpha_i + \mu_j + \tau_t + \beta\ \text{SALES DEPENDENCE}_{i,j,t} + \text{Controls}_{i,j,t} + \epsilon_{i,j,t}, \quad (1)$$

where *i, j*, and *t* index the firm, a unique customer, and the year, respectively. To control for pair-level, firm-year, and customer-year unobserved characteristics, I sequentially tighten the fixed effects, replacing the individual firms' fixed effects (α and μ) with a fixed effect for the firm-customer pair, then alternatively replace the firm (customer) and time fixed effect with interacted firm-year (customer × year) fixed effects. The use of interacted firm and year fixed effects follows the Khwaja and Mian (2008) within-firm estimator. My strictest specification incorporates both firm-year and customer × year fixed effects, absorbing all firm-year and customer-year characteristics and isolating the effect of variation in SALES DEPENDENCE on TRADE CREDIT.[7]

[7]Note that this last specification, while useful in controlling for time-varying firm-level and customer-level supply and demand, significantly restricts the sample size, so I use it only for the baseline test and not in subsequent cross-sectional analysis (where the sample size reduction from the stringent fixed effects is too restrictive).

The use of firm-year fixed effects controls for any time-varying supply factors at the firm level, such as the firm's financial ability to extend trade credit or any aggregate trade credit policies unrelated to SALES DEPENDENCE. The customer × year fixed effect controls for the customers' aggregate demand for trade credit, allowing me to remove effects of time-varying demand factors unrelated to SALES DEPENDENCE. The strictest specification combining these two within-firm estimators for both firm and its customer, respectively, isolates variation in TRADE CREDIT for both partners to that arising from differences across supply chain partners in the same year. These rigorous within-firm estimations rule out time-varying firm-level patterns that could introduce omitted variable bias contaminating interpretation of the relationship between TRADE CREDIT and SALES DEPENDENCE. While a couple alternative explanations around other time-varying characteristics at the firm-customer-pair-level beyond SALES DEPENDENCE could be concocted (discussed in Section III.D), later robustness tests and mechanism tests support the TRADE CREDIT-SALES DEPENDENCE relationship reported in the following sections.

III. Baseline Effect of SALES DEPENDENCE on TRADE CREDIT

A. Baseline Results

Table 2 reports the baseline findings. Across all specifications, the coefficient on SALES DEPENDENCE shows a strong inverse relationship with TRADE CREDIT, regardless of fixed effects structure: Columns 1 and 2 employ firm, customer, and year then pair and year fixed effects, respectively; column 3 absorbs time-varying supply variation with a firm-year fixed effect; column 4 absorbs time-varying demand variation with a customer × year fixed effect; and the strictest specification in column 5 includes both the firm-year and customer × year fixed effects. Across all specifications, the TRADE CREDIT-SALES DEPENDENCE relationship is negative and significant, both statistically and economically. In terms of magnitude, going from the 25th to the 75th percentile of SALES DEPENDENCE corresponds to a 0.027–0.069 reduction in trade credit, depending on the specification.[8] This translates to an economically meaningful reduction in TRADE CREDIT, representing a shift of 0.28 standard deviations from the mean, using the column 1 coefficient.[9]

Table 2 results show that customers upon whom the firm depends for a greater proportion of its sales receive, relative to purchase size, a lesser amount of trade credit. This pattern is best viewed as an equilibrium outcome: While it is difficult to construe a reverse causality story—it is unlikely that a customer would purchase more from a supplier *because* doing so would result in less generous

[8]Economic magnitudes are typically weaker in specifications using firm × year fixed effects, mostly due to the nature of the sample: somewhat mechanically, suppliers reporting balances of multiple major customers tend to rely less, on average, on each individual customer, so a firm × year fixed effect effectively trims observations with the highest dependence from the sample.

[9]Using summary statistics from Table 1: (3.401-2.485) × (-0.029) ÷ 0.178 = 0.149.

TABLE 2

Baseline Results: Effect of Sales Dependence on Trade Credit

Table 2 shows determinants of pair-level TRADE CREDIT, defined as the trade credit extended by a firm to an individual customer, scaled by annual sales between the two firms. The sample includes all firms with identifiable data on trade credit to major customers in 1993–2016. SALES DEPENDENCE reflects the proportion of firm sales going to the customer, in logged percentage points. Variable definitions are available in the Appendix. *t*-statistics are shown in parentheses, calculated from standard errors double clustered by firm and customer. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: TRADE CREDIT				
	1	2	3	4	5
SALES DEPENDENCE	−0.055***	−0.074***	−0.029***	−0.050***	−0.029***
	(−6.69)	(−7.36)	(−3.16)	(−4.79)	(−3.33)
SIZE	0.022***	0.021***		0.021***	
	(3.62)	(3.08)		(2.73)	
LEVERAGE	0.000	0.001		−0.040	
	(0.02)	(0.05)		(−1.42)	
PROFITABILITY	−0.028	−0.019		−0.008	
	(−1.42)	(−0.98)		(−0.31)	
HHI	0.078	0.037		0.104***	
	(1.11)	(0.50)		(2.82)	
AGE	−0.037**	−0.056***		−0.025	
	(−2.08)	(−2.71)		(−1.49)	
Customer Size	0.009	0.008	0.009		
	(1.30)	(0.89)	(0.68)		
Customer Leverage	0.040	0.033	−0.028		
	(1.01)	(0.71)	(−0.56)		
Customer Profitability	0.032	0.028	0.050		
	(0.52)	(0.40)	(0.47)		
Customer HHI	−0.010	0.021	−0.139		
	(−0.15)	(0.28)	(−1.57)		
Customer Age	−0.049**	−0.069**	−0.026		
	(−2.28)	(−2.54)	(−0.82)		
Firm FE	Yes			Yes	
Customer FE	Yes		Yes		
Pair FE		Yes			
Year FE	Yes	Yes			
Firm × Year FE			Yes		Yes
Customer x Year FE				Yes	Yes
R^2	0.477	0.521	0.543	0.542	0.650
Observations	7,814	7,430	3,719	4,920	1,334

credit—trade credit and sales outcomes are likely jointly determined. Importantly, however, the observed negative coefficient on SALES DEPENDENCE shows a true inverse relationship between TRADE CREDIT and SALES DEPENDENCE; alternative explanations based on supply and demand factors that could otherwise hinder interpretation of the result are largely ruled out by the fixed effects structure: First, in the simplest specification, column 1 includes firm and customer fixed effects, absorbing any time-invariant patterns across either firm. Column 2 uses pair fixed effects to help control for unobservable supply-chain matching patterns. This specification shows a pattern occurring over time within the firm-customer pair: As a customer comprises a greater (lower) proportion of a firm's total sales, it receives less (more) trade credit per dollar of sales. Firms that are more dependent on one or a few customers may simply be more constrained and thus extend less trade credit; however, the use of a firm-year fixed effect in column 3 controls for time-varying financial constraint patterns for the firm. Customers accounting for a large proportion of a firm's sales may simply have deep pockets and not demand more trade credit, but customer × year fixed effects

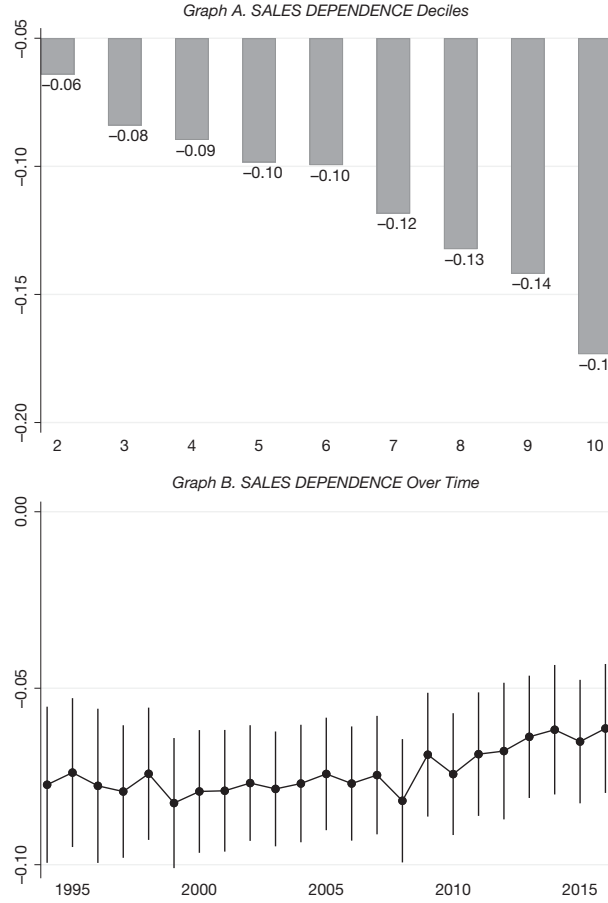
in column 4 show customers simultaneously receiving more trade credit from less dependent suppliers and less from more dependent suppliers. Column 5 holds both time-varying supply and time-varying demand factors constant, leaving only variation across pairs in the same year to explain TRADE CREDIT differences.

Figure 2 demonstrates that the effect of SALES DEPENDENCE on TRADE CREDIT is both monotonic (Graph A) and consistent over time (Graph B). Specifically, Graph A replicates the specification in column 2 of Table, but replaces SALES DEPENDENCE with indicators for increasing deciles of the variable. Compared to a baseline group of customers in the first decile of SALES DEPENDENCE, TRADE CREDIT falls monotonically with increasing SALES DEPENDENCE. Graph B repeats the column 2 specification, but replaces SALES DEPENDENCE

FIGURE 2

Sales Dependence Patterns: Monotonicity and Consistency over Time

Figure 2 Graph A plots coefficients on regressions replacing SALES DEPENDENCE with indicators for deciles of increasing sales dependence. The regression producing the coefficients matches the specification in column 2 of Table 2, except the substitution of SALES DEPENDENCE with decile indicators. Graph B plots coefficients for SALES DEPENDENCE interacted with year indicators. The regression producing the coefficients matches the specification in column 2 of Table 2, except the year fixed effects are dropped and SALES DEPENDENCE is instead interacted with year indicators.



and year-fixed effects with interactions between SALES DEPENDENCE and an indicator for each year. Every year, the SALES DEPENDENCE coefficient falls in the -0.05 to -0.10 range and is statistically less than zero. Baseline results are also robust to regressing changes in TRADE CREDIT on changes in SALES DEPENDENCE, or controlling for the observation customer's sales growth, as shown in Table IA-2 of the Supplementary Material.

Turning to control variables reported in Table 2, coefficients are usually statistically insignificant, with a few exceptions: Larger firms extend more trade credit, consistent with better access to financial markets. Older firms extend less credit, likely consistent with age as a proxy for reputation: Using trade credit to guarantee product quality is likely less important for established firms (e.g., Lee and Stowe (1993)). Older customers also take less trade credit, potentially consistent with older customers having better access to external financing; however, the effect weakens substantially once firm-year fixed effects are included.

B. Disclosure and Selection

As is common with studies relying on firm disclosures, selection issues are a potential concern. While firms in my data comfortingly have similar ratios of receivables to sales (AR/SALES) as the firms not disclosing receivable balances, they do differ along other dimensions tabulated in Table IA-1 of the Supplementary Material. Particularly, firms with greater SALES DEPENDENCE on their major customers are more likely to disclose trade credit details in their 10-Ks. This pattern is unavoidable given that more significant customers are more likely to hold significant trade credit balances. To some extent, the tilt toward major customers makes the sample well-suited to examining competing roles of customer bargaining power and credit concentration, in a similar spirit to Murfin and Njoroge (2015), who intentionally construct their panel with high-bargaining power customers paired with constrained suppliers. However, to alleviate concerns that sample selection may drive results, I perform tests to address selection concerns regarding i) the choice of a firm to report receivable balances of any customers and ii) potential discretionary disclosure of customers' balances within a given year. For brevity, I summarize these results below, delegating more thorough explanations and tabulations to the Supplementary Material.

To address the first selection concern, the choice of whether to provide any disclosure, I exploit variation in disclosure propensities across auditors, computing the ex ante proportion of (other) firms with the observation firm's auditor that disclose individual trade credit balances. This measure, AUDPROPENSITY, strongly predicts whether the firm reports a customer credit balance. I use AUDPROPENSITY as the first-stage instrument in a Heckman selection model and show in Table IA-3 that results are robust to this 2-stage framework. To exploit variation in AUDPROPENSITY further, I show that the relationship between TRADE CREDIT and SALES DEPENDENCE is virtually identical for firms with a high (above-median) AUDPROPENSITY and a matched sample of firms with a low (below-median) AUDPROPENSITY. I also repeat the matching process for a smaller sample of firms that switch from not reporting to reporting, including only the first 3 years after they switch to reporting. In this

TABLE 3

Trade Credit Across the Firm's Customer Portfolio

Table 3 shows determinants of trade credit-to-sales for aggregations of customers. In column 1, the dependent variable is firm-level receivables scaled by firm-level sales. In column 2, the dependent variable is aggregated receivables of all reported major customer balances scaled by sales to these customers. In column 3, the dependent variable is aggregated receivables of all non-individually-reported customer balances, computed as firm-level receivables minus all reported major customer balances, scaled by the sales to these customers, computed as firm-level sales minus aggregate sales to major customers with reported receivable balances. DEPENDENCE, AGG. MAJORS is constructed parallel to SALES DEPENDENCE, but aggregated across all major customers with reported trade; specifically, it is the logged ratio of the proportion of firm sales (in percentage points) made to major customers with reported receivable balances. The observation level is the firm year. The sample includes all firms with identifiable data on trade credit to major customers in 1993–2016. Controls include observation firm's characteristics. Variable definitions are available in the Appendix. *t*-statistics are shown in parentheses, calculated from standard errors clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Receivables/Sales Ratio for:		
	All Customers	Major Customers	Minor Customers
	1	2	3
DEPENDENCE, AGG. MAJORS	0.002	–0.063***	0.028***
	(0.59)	(–7.06)	(3.56)
Firm Characteristics	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.545	0.501	0.422
Observations	5,655	5,655	5,652

narrower window, too, the negative coefficients on SALES DEPENDENCE are strong and indistinguishable between the two groups. While I cannot claim that the firms with a higher AUDPROPENSITY began reporting *because* of their auditor, it is reassuring that the result for newly reporting firms is the same in both groups.

To address the concern that firms could selectively report some customers' credit balances and not others within a given year, Table IA-5 in the Supplementary Material replicates the baseline results of Table 2 for firm-years in which the firm discloses the trade credit balances of every major customer disclosed under the mandatory sales threshold reporting under SFAS No.14 and No.131.[10] Results hold here as well, indicating that any (potential) discretionary reporting of customers' trade credit balances does not drive the results.

C. Trade Credit Across the Firm's Customer Portfolio

The main results in Table 2 include pair-wise trade credit to major customers for which the firm reports trade credit balances, but do not represent a firm's entire "portfolio" of credit outstanding with all customers. To see how sales concentration affects firm trade credit policy across its broader portfolio of receivables, I examine effects of SALES DEPENDENCE on trade credit policy across alternative groups of customers in Table 3, collapsing the sample to the firm-year level and using various aggregations of TRADE CREDIT as dependent variables. For this table, I compute the firm's aggregate dependence on (all) major customers, constructed parallel to SALES DEPENDENCE, as the logged proportion of total sales (in percentage points) attributed to all major customers in the sample (*DEPENDENCE, AGG.*

[10]Note that full disclosure of all customers is the norm, representing 83% of the sample.

MAJORS). In columns 1–3, the dependent variable reflects the receivable-to-sales ratio across all of the firm's customers (column 1), across all of the firm's major customers (column 2), and across all of the firm's minor customers (column 3). More specifically, column 1 uses the firm's overall receivables-to-sales ratio; column 2 uses the ratio of aggregate receivables outstanding with major customers to aggregate sales to these customers; and column 3 uses the ratio of minor customers' receivables (aggregate receivables minus receivables owed from major customers) to minor customers' sales (aggregate sales minus sales to major customers).

Results from this exercise indicate, first, that overall sales concentration with major customers does not correlate with lower overall receivables, as the column 1 coefficient on *DEPENDENCE, AGG. MAJORS* is positive but insignificantly different from zero. Second, as expected given baseline results with individual major customers in Table 2, *DEPENDENCE, AGG. MAJORS* predicts lower trade credit to major customers in aggregate (column 2). Third, following from and reconciling these two results, column 3 shows that firms with higher *DEPENDENCE, AGG. MAJORS*, extend more trade credit to their minor customers in aggregate. To summarize, Table 3 shows customer sales concentration leads to a more generous trade credit extension to minor customers simultaneously to tighter trade credit to major customers. These simultaneous patterns cause a net effect on the firm's balance sheet that is generally indistinguishable from zero, consistent with a concentration avoidance effect rather than a broader austerity in trade credit provision.

D. Robustness: Addressing Potential Confounding Explanations

Baseline findings show that firms extend less TRADE CREDIT to major customers as their sales importance increases, while simultaneously offering *more* trade credit to less important customers. This pattern is at odds with a bargaining power explanation. It is, however, consistent with firms avoiding credit concentrations with their major customers. Section IV examines this explanation more thoroughly, studying credit concentration avoidance through the perspective of bank stakeholders monitoring a firm's trade credit policy. Before shifting to the lender monitoring mechanism, here I briefly discuss some robustness tests tabulated in the Supplementary Material that help rule out alternative explanations that could conceivably lead to the negative TRADE CREDIT-SALES DEPENDENCE relationship.

First, while I do not observe customer-specific prices for underlying transactions, several tests tabulated in Table IA-6 suggest that a tradeoff between trade credit and pricing does not explain the results. Specifically, Panel A shows no evidence of a systematic pattern between TRADE CREDIT and firm gross margins, which we would expect if customers pay more quickly in exchange for lower prices. Further, cross-sectional analysis shows consistent results in subsamples where the firms' ability to price discriminate is unlikely, based on high industry competition and lack of product specialization (Panels B-D). Additionally, the use of trade credit as either a guarantee of quality or means of attracting new customers likely cannot explain the results, as results hold in Table IA-7 when I limit the sample to long-term customer relationships (defined as relationship length above the median of 4 years).

In this subsample, customers are familiar with the firm's output from repeated interactions (so their reputation is established) and also are not new buyers receiving teaser rates.

Overall, pricing variation, quality guarantees, and teaser rates seem unlikely explanations for the inverse TRADE CREDIT-SALES DEPENDENCE relationship. Instead, the next section points to a bank monitoring mechanism leading firms to avoid credit concentrations and restrict trade credit to their major customers.

IV. The Bank Monitoring Motive

Baseline results document a robust negative relationship between SALES DEPENDENCE and TRADE CREDIT. Clearly, firms do not uniformly extend the same amount of trade credit per sales dollar to all customers, nor do they extend proportionally *more* to their more important customers. Rather, these findings in combination with evidence of *increased* trade credit to the firm's non-major customers point not only to firms limiting credit concentrations with their customers but also seemingly diversifying their trade credit portfolio with respect to other customers. Because customer concentration makes a firm vulnerable to the policies and (mis)fortunes of their trade partners, reducing credit concentrations is consistent with the firm reducing supply chain risk. While diversified shareholders may not care about this type of risk if it corresponds to higher returns,[11] bank stakeholders have a demonstrated aversion to supply chain risk (e.g., Campello and Gao (2017), Mester et al. (2007), and Frankel et al. (2020)) and could influence their borrowers' trade credit policy accordingly.

I find evidence consistent with a bank monitoring channel, both in cross-sectional variation across bank monitoring intensity and in more granular contract-level stipulations about receivable concentrations.

A. Cross-Sectional Motivation

To motivate the monitoring channel, I perform several cross-sectional tests exploiting variation in lender monitoring. For brevity, I summarize these findings here but delegate more thorough explanations and tabulations to the Supplementary Material. First, I link sample firms to Dealscan using the Roberts' Dealscan-Compustat linking database (Chava and Roberts (2008)), focusing on firms linking to Dealscan at least once by the observation year. In an initial, coarse test, I show that firms with a major lender presence (i.e., an outstanding Dealscan loan) exhibit a strong negative TRADE CREDIT-SALES DEPENDENCE relationship, as in the baseline tests, but firms without a major lender presence show no such effect (Panel A of Table IA-8). I next exploit variation in monitoring intensity within the set of firms with a major lender. In the spirit of Murfin (2012), I use banks' exposure to portfolio defaults as quasi-exogenous variation in the bank's propensity to monitor firm balance sheet risk. For firms whose lender has experienced HIGH DEFAULTS in the past year, the negative coefficient on SALES DEPENDENCE is significantly stronger (Panel B of Table IA-8).

[11]For example, Patatoukas (2012) and Irvine, Park, and Yıldızhan (2016) show that a dedicated customer base can enhance profitability.

In addition to bank-level variation, we would also expect more lender scrutiny of customers posing a higher repayment risk. In Table IA-9 of the Supplementary Material, I report subsample analyses across customers' receivable risk. I find stronger results for trade credit extended to customers with a shorter distance to default or customers that tend to pay their (other) suppliers slowly. With this motivating evidence suggesting a lender monitoring channel, I turn to a precise mechanism through which this monitoring limits credit concentrations.

B. A Precise Mechanism: Evidence from Loan Contracts

As discussed in the previous section, cross-sectional patterns suggest greater credit concentration avoidance among banked firms when their lenders have greater monitoring incentives. In this section, I document a direct bank monitoring mechanism inducing credit concentration avoidance by manually collecting contract-level details on accounts receivable conditions in loan agreements. Details of the data collection and empirical findings results are below, but in short, I find that many loan contracts hinge credit line access on receivable concentration limits, and that the presence of these limits results in tighter trade credit policy toward many of the firm's customers.

Specifically, I manually examine loan agreements for contracts with accounts receivable provisions by searching for the keywords "receivable" or "accounts" and reading the surrounding paragraphs.[12] I read through these contracts and label a loan agreement as an A/R CONTRACT if it specifies stipulations on receivables, including restricting receivable purchasing, mandating periodic receivable aging reports, reserving rights to inspect accounts receivable, explicitly naming receivables as collateral, and/or including receivables as part of a borrowing base formula for credit line limits.[13]

Among observations with available loan agreements (4,021 observations), 1,114 were classified as subject to A/R CONTRACTS, as reported in Panel A of Table 4. Among these A/R CONTRACTS, I search the loan contract text to identify any explicit conditions placed on receivables. In 743 of the 1,114 observations, the A/R CONTRACT places conditions on which receivables qualify as "eligible" or "qualifying" receivables (A/R CONDITIONS). Most typically, these conditions restrict which receivables can be included in the BORROWING BASE for the firm's credit limit, accounting for 700 of the 743 contracts with A/R CONDITIONS, or otherwise for determining receivables' eligibility to be collateralized. Common qualifiers on customer receivables include solvency of the customer, customer location restrictions, payment denomination in U.S. dollars, and exclusion of overdue amounts. Additionally, most relevant to this study, many contracts exclude customer receivables surpassing certain limits, either in the form of a dollar credit limit or a concentration limit on the proportion of total receivables an individual customer can comprise. 562 observations involve such an A/R LIMIT.

[12]I thank Malcolm Wardlaw for graciously providing access to a loan contract repository and a Python text search tool, which substantially reduced data collection time (Ganglmair and Wardlaw (2017)).

[13]I do not classify agreements in which receivables are simply mentioned in a list of substantially all firm assets as A/R CONTRACTS, nor agreements which mention receivables only as an input to a common financial covenant formula.

TABLE 4

Receivables Restrictions in Loan Contracts: Descriptive Statistics

Table 4 reports contract characteristics from the sample of years in which the firm had an outstanding searchable loan contract. Indicators in Panel A are defined as follows: A/R CONTRACT indicates whether a firm had a contract with receivable provisions; in particular, this indicator equals 1 if the contract specifies restrictions on receivable repurchasing, requires periodic aging reports on receivables, reserves rights to inspect accounts receivable, explicitly names receivables as collateral, and/or included receivables as part of a borrowing base formula for credit line size. A/R CONDITIONS is defined within the sample of A/R CONTRACTS as an indicator for the contract placing restrictions on which receivables qualify the loan requirements. BORROWING BASE is defined within the sample of A/R CONTRACTS to indicate a loan whose credit line is based on a defined borrowing base formula. A/R LIMIT is defined within observations with A/R CONDITIONS to indicate an eligibility condition on receivables based on a dollar credit limit or a percentage concentration limit. CUSTOMER EXCEPTION is defined within observations with an A/R LIMIT to indicate the customer being granted an explicit exception from the generic concentration limit. Panel B provides summary statistics for measures of credit tightness based on specified concentration limits. Variables are as defined in the Appendix.

Panel A. Characteristics from Loan Contracts

	Yes	No	Total
A/R CONTRACT	1,114	2,907	4,021
A/R CONDITIONS	743	371	1,114
BORROWING BASE	700	414	1,114
A/R LIMIT	562	181	743
CUSTOMER EXCEPTION	305	257	560

Panel B. Concentration Limit Summary Statistics

Variable	Observations	Mean	SD	25pctl	Median	75pctl
GENERIC LIMIT	537	18.859	8.176	10.000	20.000	25.000
CUSTOMER-SPECIFIC LIMIT	491	25.789	10.348	20.000	25.000	30.000
SALES%-LIMIT	491	–5.960	12.706	–13.700	7.450	0.000

While dollar credit limits are generally not stated in the contracts, concentration percentage limits tend to be given explicitly. In these cases, I can examine contract tightness numerically based on the strictness of these concentration limits. More specifically, the contract for a revolving loan whose credit line amount depends on a borrowing base formula may define what I label a GENERIC LIMIT, specifying that the receivable balance of an individual customer must not comprise more than a certain proportion of outstanding receivables in order to be included in the borrowing base computation. As a concrete illustration, if the agreement defines the GENERIC LIMIT to be 20% of outstanding receivables, any dollar amounts of outstanding receivables to an individual customer in excess of 20% of the total will be excluded from the borrowing base computation.

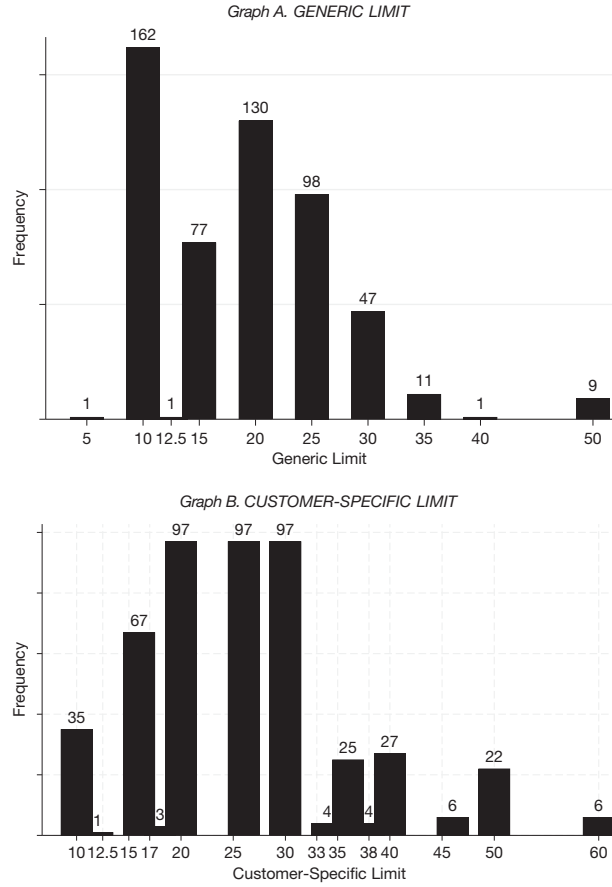
In many cases, contracts state a GENERIC LIMIT but allow exceptions for specific customers or customers with a high credit rating. Continuing the example above, the loan agreement may specify a GENERIC LIMIT of 20% but allow an exception for a particular customer to comprise 30% of receivables. For each of the firm's reported customers, I record whether an exception exists and, if so, what the excepted concentration limit is. Using this information, I record CUSTOMER EXCEPTION as an indicator for whether the observation customer has an exception from the GENERIC LIMIT in the firm's loan contract. I define the CUSTOMER-SPECIFIC LIMIT to equal the customer-specific concentration limit if one is given or to equal the GENERIC LIMIT if the customer does not have a stated exception.[14] Importantly, these conditions on eligibility are not loan covenants the borrowers are contractually bound to: These restrictions do place

[14]The number of GENERIC LIMIT observations (537) is less than the number of A/R LIMIT observations due to cases where the limit is left unspecified or is retracted in the contract. Similarly, the

FIGURE 3

Distribution of GENERIC LIMITS and CUSTOMER-SPECIFIC LIMITS

In Figure 3, GENERIC LIMIT (Graph A) is the standard limit on a receivable balance concentration for eligibility in contracts with such concentration limits. CUSTOMER-SPECIFIC LIMIT (Graph B) is also the limit on receivable balance concentration, but the standard limit is replaced with a customer-specific limit for customers granted an exception in the contract.



conditions on loan access—typically by excluding non-eligible receivables from borrowing base calculations—but borrowers are not legally obligated to modify their trade credit policy around them. However, they are still a likely means through which bank monitoring influences supply chain transactions.

For contracts with concentration limits, Figure 3 reports the frequencies of GENERIC LIMIT and CUSTOMER-SPECIFIC LIMIT, with their distribution summarized in Panel B of Table 4. The mean GENERIC LIMIT is around 19%,

number of CUSTOMER-SPECIFIC LIMIT observations (491) is less than the GENERIC LIMIT number due to cases in which the customer is granted an exception without an explicitly named threshold.

with 10% being the most common threshold. CUSTOMER-SPECIFIC LIMIT is around 7 percentage points higher than the GENERIC LIMIT, on average.[15]

I use these concentration limits to construct two measures of lender-imposed trade credit strictness: First, I label observations where the supplier has an A/R LIMIT condition and the customer has no built-in exception as "*Strict*," while observations involving customers with a built-in exception are labeled "*Lax*" (i.e., CUSTOMER EXCEPTION is equal to 1). Second, I compute SALES%-LIMIT to represent the difference between the percentage of the firm's sales sold to the customer and that customer's receivable limit. Intuitively, SALES%-LIMIT posits that, absent a limit, a customer's credit concentration would be similar to its sales concentration and computes the difference between this benchmark and the contract limit. Observations with an above-median SALES%-LIMIT are labeled "*Strict*" and observations below the median are labeled "*Lax.*" Both strictness measures provide an indication of how binding the customer's concentration limit is, with distinct advantages and disadvantages: The simultaneous advantage and disadvantage of measuring strictness based on the absence of a CUSTOMER EXCEPTION is that it is based on contract details without using (endogenous) observed sales to the customer, making it a cleaner measure but also potentially less informative; a CUSTOMER EXCEPTION allowing a CUSTOMER-SPECIFIC LIMIT of 30% versus a GENERIC LIMIT of 20% may be a very lax limit if the customer comprises only 10% of the firm's sales, but may be a tight limit if the customer instead comprises 35% of sales. Conversely, SALES%-LIMIT is intuitively a better proxy for whether a credit limit is binding since it is measured relative to sales concentration, but is less empirically appealing because a customer's purchases likely (at least partly) depend on trade credit extension.

Table 5 reports regressions of TRADE CREDIT on SALES DEPENDENCE for subsamples based on whether concentration limits are *Strict* or *Lax.* In columns 1 and 2, the *Strict* subsample includes observations where firms have an A/R LIMIT imposed in their loan contract and the customer under observation does not have a CUSTOMER EXCEPTION, while *Lax* represents observations where firms have an A/R LIMIT, but the customer's receivables have an exception to the limit. Column 1 shows a strong negative SALES DEPENDENCE coefficient for customers subject to the generic restriction but no effect for customers with built-in exceptions. Differences in the coefficients are sizable and statistically significant. The intuitive implication is that when the firm faces a looser restriction on a given customer's receivable concentration limit for eligibility purposes, there is no evidence of credit concentration avoidance. Conversely, when the firm is more restricted regarding a customer's concentration limit, we observe TRADE CREDIT decreasing with SALES DEPENDENCE.

A similar pattern emerges using the computed measure of contract strictness, SALES%-LIMIT. In columns 3–4, the subsample splits are based on whether the SALES%-LIMIT is above the median (the median customer's sales percentage is

[15]As plotted in Figure 3, the majority of CUSTOMER-SPECIFIC LIMITS fall at 20%, 25%, or 30%, either due to GENERIC LIMITS named at these thresholds (and no CUSTOMER EXCEPTION), or a modified limit for the customer (CUSTOMER EXCEPTION) at one of these levels. Coincidentally, there are 97 observations at each of these three common thresholds, representing 72 individual suppliers in total.

TABLE 5

Variation on Concentration Limits in Loan Contracts

Table 5 compares the effects of SALES DEPENDENCE on TRADE CREDIT across sample cuts based on the the existence of receivable concentration limits in the firm's loan contracts. In Panel A, the sample is firm-years with identifiable data on trade credit to major customers in 1993–2016 and an identifiable loan contract specifying receivable concentration limits for pledged receivables. The sample is split into *Strict* and *Lax* concentration restrictions with varying cutoff criteria: In columns 1 and 2 of Panel A, *Strict* indicates a specified concentration limit or credit limit without an exception for the observation customer, while *Lax* indicates that the firm has a specified concentration or credit limit, but an exception granted for the customer. In columns 3 and 4, a *Strict* limit indicates an observation where the difference between the percentage of firm sales made to the customer and the concentration percentage limit is above the median, while a *Lax* limit is below this median. Panel B is identical, except the *Lax* subsamples are expanded to include firm-years with identifiable trade credit data and an identifiable loan contract with any accounts receivable condition, but not meeting the definition of the *Strict* subsample, as defined in Panel A. SALES DEPENDENCE reflects the proportion of firm sales going to the customer, in logged percentage points. Controls (as in Table 2) are included but suppressed for presentation. Variable definitions are available in the Appendix. *t*-statistics are shown in parentheses, calculated from standard errors double clustered by firm and customer. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Firms with Credit or Concentration Limits

	Dependent Variable: TRADE CREDIT					
Strictness measure:	No CUSTOMER EXCEPTION			Low SALES%-LIMIT		
	Strict	Lax	Difference	Strict	Lax	Difference
	1	2	1–2	3	4	3–4
SALES DEPENDENCE	–0.105**	–0.007	–0.098**	–0.146***	–0.006	–0.141***
	(–2.62)	(–0.24)	(–2.09)	(–3.15)	(–0.20)	(–2.63)
Firm Characteristics	Yes	Yes		Yes	Yes	
Customer Characteristics	Yes	Yes		Yes	Yes	
Firm FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Year FE	Yes	Yes		Yes	Yes	
R^2	0.349	0.602		0.274	0.664	
Observations	248	232		192	209	

Panel B. Firms with A/R CONTRACTS

	Dependent Variable: TRADE CREDIT					
Strictness measure:	No CUSTOMER EXCEPTION			Low SALES%-LIMIT		
	Strict	Lax	Difference	Strict	Lax	Difference
	1	2	1–2	3	4	3–4
SALES DEPENDENCE	–0.105**	–0.048***	–0.057	–0.146***	–0.047***	–0.100**
	(–2.62)	(–4.14)	(–1.50)	(–3.15)	(–3.86)	(–2.18)
Firm characteristics	Yes	Yes		Yes	Yes	
Customer characteristics	Yes	Yes		Yes	Yes	
Firm FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Year FE	Yes	Yes		Yes	Yes	
R^2	0.349	0.602		0.274	0.664	
Observations	248	732		192	711	

7.3 percentage points below its allowed concentration limit).[16] The coefficient on SALES DEPENDENCE is strong statistically and in economic magnitude in the *Strict* subsample and statistically greater than the coefficients in the *Lax* subsample. When bank-imposed limits on receivable concentrations are more severe, firms constrain credit extended to those customers; when bank-imposed limits are relaxed (by lighter GENERIC LIMITS or by a CUSTOMER EXCEPTION), the credit concentration avoidance effect disappears. Thus, it appears that firms restrict trade

[16]Concentration limits are typically based on the percentage of *eligible* receivables, an (unobservable) subset of the total receivables I observe. This implies that the percentage of sales observed for a customer is an underestimate of the percentage of *eligible* sales, likely explaining why the average SALES%-LIMIT is negative.

credit to their customers as a direct consequence of their lenders' eligibility restrictions on receivables-backed loans.

Concentration limits appear to be one direct mechanism through which bank monitoring induces changes in trade credit policy, since Panel A of Table 5 shows that linking firms' permissible draw amounts to concentration limits effectively restricts the liberality of the firms' trade credit policy. While these results provide usefully clear evidence of lender influence, this precise mechanism may not fully explain credit concentration avoidance by bank monitored firms: To see this, Panel B is identical to Panel A, except the *Lax* subsamples are expanded to include other suppliers with A/R CONTRACTS but no explicit (observed) concentration limits. While coefficients on the *Strict* subsamples are still much larger (negatives) in magnitude than those for the *Lax* subsamples, all of the *Lax* subsamples in Panel B also show evidence of credit concentration avoidance. In some cases, firms in the expanded sample labeled as *Lax* may have receivable eligibility requirements for loan contracts not available in my manual collection effort (e.g., loans not in the Dealscan database), or lenders may express concentration limit preferences implicitly or explicitly through other means. Regardless, borrowing base concentration limits represent a concrete, identifiable medium through which lenders restrict trade credit balances of their borrowers.

1. Factors Determining Contract Strictness

What conditions predict A/R LIMITS and CUSTOMER EXCEPTIONS? I examine factors affecting receivable monitoring intensity in Table 6, focusing on three sources of expected variation: Recent portfolio default experience of the lender as of the contract start date, investment grade status of the customer, and the lender's ability to monitor the firm's customers. I look at whether these factors predict whether a firm's loan has A/R LIMITS and whether, within the subsample of firms with such limits, a given customer has a CUSTOMER EXCEPTION.

Panel A focuses first on determinants of receivable limits in loan contracts, using A/R LIMITS as the dependent variable. In column 1, I include HIGH DEFAULTS, an indicator for whether the firm's lead bank has experienced a high (above 75th percentile) or low (below 75th percentile) level of recent exposure to borrower default at the contract start date, as in Section IV.A, along with firm-level controls. Column 1 shows that a firm whose lender has experienced more recent defaults is more likely to have receivable limits built into the loan contract. Column 2 reports that when a higher proportion of the firm's customers have investment-grade credit ratings (INVGRADE CUSTOMER), firms are less likely to have such limits in their contracts. Column 3 shows that the bank lending to one of the firm's customers (SHARED LENDER), does not affect the probability of an A/R LIMIT.

Panel B looks at the sample of observations subject to A/R LIMITS at determinants of CUSTOMER EXCEPTIONS from the GENERIC LIMIT. Here I revert to a firm-customer panel, considering the same predictor variables as in Panels A and B but measuring INVGRADE CUSTOMER and SHARED LENDER at the customer level. HIGH DEFAULTS does not predict a CUSTOMER EXCEPTION, but investment-grade customers and customers sharing a lender with the supplier firm are significantly more likely to be granted receivable limit exceptions.

TABLE 6

Factors of Contract Strictness

Table 6 examines factors affecting the receivables-specific strictness of loan contracts. In Panel A, the dependent variable is A/R LIMIT, an indicator for whether a loan contract includes an eligibility condition on receivables limiting receivable balances by dollar amount or concentration percentage. In Panel B, the dependent variable is CUSTOMER EXCEPTION, an indicator for the observation customer having a built-in exception to the GENERIC LIMIT in observations subject to an A/R LIMIT. The observation level is a firm-year in Panel A and a firm-customer year in Panel B. Variables are defined in the Appendix. *t*-statistics are shown in parentheses, calculated from standard errors clustered by firm in Panel A and double-clustered by firm and customer in Panel B. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Existence of an A/R LIMIT

	Dependent Variable: A/R LIMIT		
	1	2	3
HIGH DEFAULTS	0.132***		
	(3.45)		
INVGRADE CUSTOMER		–0.099**	
		(–2.46)	
SHARED LENDER			0.016
			(0.64)
SIZE	–0.082***	–0.077***	–0.073***
	(–3.56)	(–2.91)	(–3.15)
LEVERAGE	0.040	0.078	0.061
	(0.54)	(0.95)	(0.78)
PROFITABILITY	0.062	0.094	0.036
	(0.71)	(1.08)	(0.42)
HHI	0.471*	0.572**	0.490*
	(1.68)	(2.08)	(1.84)
AGE	–0.025	0.015	–0.011
	(–0.44)	(0.26)	(–0.19)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.562	0.557	0.544
Observations	2,683	2,458	2,706

Panel B. CUSTOMER EXCEPTION from a GENERIC LIMIT

	Dependent Variable: A/R LIMIT		
	1	2	3
HIGH DEFAULTS	–0.042		
	(–0.55)		
INVGRADE CUSTOMER		0.309**	
		(2.51)	
SHARED LENDER			0.223**
			(2.58)
SALES DEPENDENCE	–0.018	–0.036	–0.016
	(–0.41)	(–0.77)	(–0.36)
Firm Characteristics	Yes	Yes	Yes
Customer Characteristics	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.863	0.869	0.878
Observations	475	430	475

Of note, SALES DEPENDENCE does not predict CUSTOMER EXCEPTION, ruling out the possibility that lenders simply willingly write in exceptions for important customers that are likely to exceed the limits.

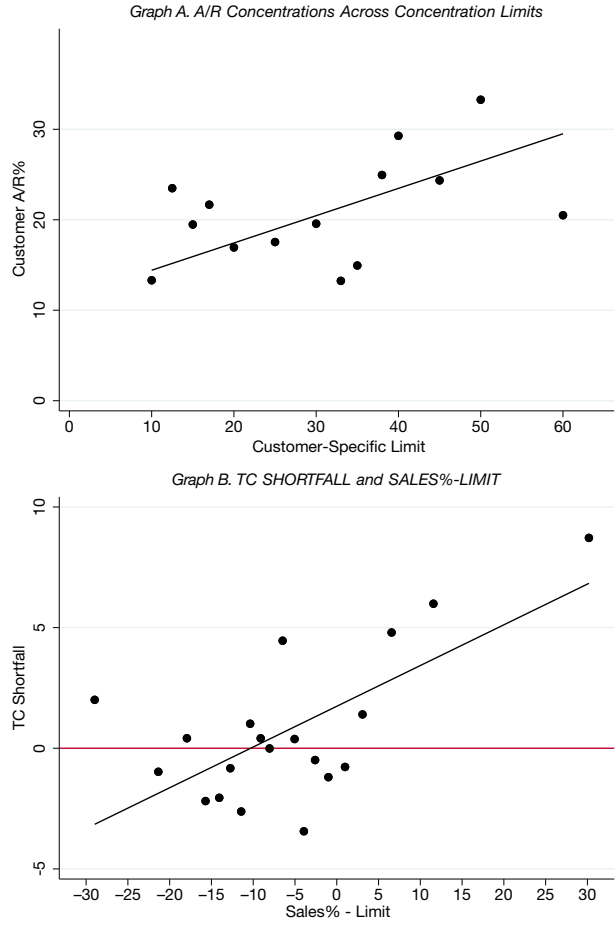
2. Effects of Contract Strictness on Customer Relationships

My final set of analyses is an exploration of how contract strictness affects customer relationships and firm outcomes. To the extent that customers want to purchase on credit, we might expect concentration limits to reduce customer

FIGURE 4

Receivable Limits and Realized Outcomes

Graph A of Figure 4 plots the average percentage of firm receivables comprised by an individual customer across bins of CUSTOMER-SPECIFIC LIMIT for firms with percentage-based A/R LIMITS. Graph B plots the average TC SHORTFALL, defined as the difference between the percent of sales and the percent of receivables an individual customer comprises, across twenty bins of SALES%-LIMIT, a measure of concentration strictness defined as the difference between the percent of sales the customer comprises and its CUSTOMER-SPECIFIC LIMIT.



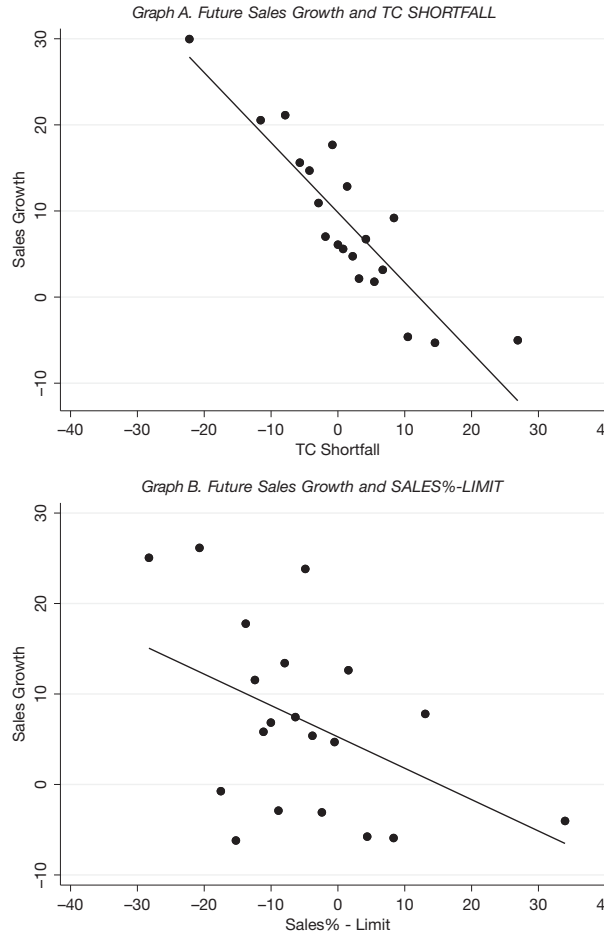
demand or even threaten the survival of the trade relationship. I find suggestive evidence consistent with this conjecture. In the absence of an observable measure of the gap between a customer's demand for trade credit and how much it receives, I focus on a proxy, TC SHORTFALL, measured as the difference between the proportion of a firm's sales a customer comprises and the proportion of its receivables it comprises.

Graphical evidence shows that concentration limits tend to correlate strongly with realized receivable concentrations. Graph A of Figure 4 plots the average proportion of firm receivables that a customer comprises as a function of the

FIGURE 5

Customer Sales Growth as a Function of Contract Strictness

Graph A of Figure 5 reports the average percentage growth in sales to an individual customer across bins of TC SHORTFALL, defined as the difference between the percent of sales and the percent of receivables an individual customer comprises. Graph B is identical, but averages are taken across bins of SALES%-LIMIT, a measure of concentration strictness defined as the difference between the percent of sales the customer comprises and its CUSTOMER-SPECIFIC LIMIT.



CUSTOMER-SPECIFIC LIMIT for firms with A/R LIMITS, revealing a strong positive correlation. In Panel B, this pattern translates, similarly, to a positive correlation between TC SHORTFALL, the rough proxy of unmet trade credit demand, and SALES%-LIMIT, the computed measure of contract strictness relative to sales used in Table 5. In a sense, for firms with concentration limits, SALES%-LIMIT acts as an instrument for TC SHORTFALL: The stricter the credit concentration limit relative to the sales importance of a customer, the greater the gap between its realized sales and receivable concentrations. Further exploration suggests greater TC SHORTFALLS translate to lower future sales growth. Figure 5

TABLE 7

Effects of Receivable Austerity on Customer Relationships

Table 7 examines the impact of receivable conditions in loan contracts on customer relationships. TC SHORTFALL is defined as the difference between a the proportion of sales a customer comprises and the proportion of receivables it accounts for. A/R LIMIT indicates the existence of a concentration restriction on receivable eligibility within A/R CONTRACTS. RELEND is an indicator for the year being the last year the firm reports a customer in its financial statements. SALES GROWTH is the growth in customer sales in the year following the observation year. SALES%-LIMIT is defined as the difference between the proportion of sales a customer comprises and its CUSTOMER-SPECIFIC LIMIT in contracts with an A/R LIMIT. Control variables are included but suppressed for presentation. Variables are defined in the Appendix. *t*-statistics are shown in parentheses, calculated from standard errors double clustered by firm and customer. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable				
	TC SHORTFALL	RELEND	SALES GROWTH	RELEND	SALES GROWTH
	1	2	3	4	5
A/R LIMIT	3.786*				
	(1.93)				
TC SHORTFALL		0.005***	–0.775***		
		(5.03)	(–5.01)		
SALES%-LIMIT				0.006**	–0.704
				(2.16)	(–1.56)
Controls	Yes	Yes	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
R^2	0.351	0.186	0.219	0.146	0.164
Observations	1,005	3,446	2,949	397	331

shows a strong negative effect of TC SHORTFALL and next year's SALES GROWTH with the customer (Graph A), along with a parallel negative effect of SALES%-LIMIT on next year's sales growth (Graph B). I formalize this analysis in a multivariate framework in Table 7: Column 1 shows the existence of an A/R LIMIT increases a customer's TC SHORTFALL. Both TC SHORTFALL and SALES%-LIMIT correlate with a higher probability of the end of a customer relationship (columns 2 and 4) and lower sales growth (columns 3 and 5).

As these receivable concentration limits are not truly binding for the firm in that extending a customer credit beyond the specified limit is not a breach of contract, firms may optimally choose to exceed these credit limits in some cases. For example, if a customer demands trade credit beyond the bank's allowable limit, a firm may exceed the limit if retaining the customer is sufficiently important. Additionally, if the firm does not need to draw down as much of its credit line, the cost of extending beyond the receivable limit may be minimal. I confirm this intuition in Table IA-10 of the Supplementary Material, where I find that firms are more likely to extend credit beyond the limit imposed by their lender to customers with high market share or when the firm has more cash on hand and is less likely to be constrained by their credit limit.

Finally, beyond observable effects on individual relationships with customers in my sample, receivable constraints could have broader effects on aggregate sales growth or customer concentration. I explore this possibility in Table 8, where I exploit the fact that a lender's HIGH DEFAULTS experience predicts the probability of A/R LIMITS in loan contracts. I use HIGH DEFAULTS as an instrument for the presence of an A/R LIMIT, then examine effects on next year's firm-level

TABLE 8

Firm-Level Effects of Receivable Austerity Using HIGH DEFAULTS as an Instrument

Table 8 examines the impact of receivable conditions in loan contracts on firm-level sales growth (column 2) and average dependence on major customers (column 3) in a 2-stage framework. Column 1 reports first-stage results using HIGH DEFAULTS to predict the presence of an A/R LIMIT in the firm's loan contract. Columns 2 and 3 use the instrumented *A/R LIMIT* to predict the firm's sales growth and average customer dependence, respectively, in the following year. A/R LIMIT indicates the existence of a concentration restriction on receivable eligibility in an A/R CONTRACT. The sample is a firm-year panel of years in which the firm had an outstanding loan with available contract details. Control variables are included but suppressed for presentation. Variables are defined in the Appendix. *t*-statistics are shown in parentheses, calculated from standard errors clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable		
	A/R LIMIT	SALES GROWTH	AVG. DEPENDENCE
	1	2	3
HIGH DEFAULTS	0.130***		
	(3.30)		
A/R LIMIT		–0.168	–0.145
		(–1.08)	(–1.58)
First Stage F Stat	10.86		
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.562		
Observations	2,500	2,500	2,500

sales growth and customer concentration in a 2-stage framework. Results suggest that firms with A/R LIMITS experience lower sales growth (column 2) and depend less heavily on their major customers, on average (column 3), in the following year. However, the effects are not statistically significant, and while HIGH DEFAULTS is a statistically strong predictor of A/R LIMITS in the first stage result (column 1), the first-stage F-statistic is relatively weak (10.86). Thus, results are *suggestive* of dampened sales growth and customer concentration but not conclusive. Overall, the patterns in this section suggest that receivable concentration limits affect trade patterns by discouraging customer-specific sales growth.

V. Conclusion

In this paper, I examine the relationship between a firm's sales dependence on a customer and its credit exposure to that customer. While we might expect sales dependence to afford a major customer bargaining leverage to obtain proportionally more trade credit, I find the opposite outcome dominates empirically: A customer's trade credit-sales ratio decreases with the supplier's sales dependence on the customer. Instead, firms extend more trade credit to *other* customers when they have heavy customer concentrations. Evidence suggests firms' aversion to credit concentrations is driven by their banking relationships, as the inverse relationship between sales dependence and trade credit only manifests in years the firm has a major lender and is stronger when the lender has more monitoring incentives. With novel contract-level evidence, I show a precise mechanism through which lenders reduce borrowers' trade credit exposures: Concentration limits in the definitions of what constitutes "eligible receivables" in receivables-backed loans. Within firm-years with lender-imposed concentration limits for determining eligibility, customers whose receivables are limited have trade credit-sales ratios that decrease significantly with sales

dependence, while the trade credit ratio of customers exempt from the concentration limit (via a customer exception to the generic concentration criterion) has no relationship to sales dependence. Lenders with greater monitoring motivations are more likely to impose these conditions and are more likely to except customers from the concentration requirement when the bank perceives them to be a lower credit risk: Limits are looser for customers that are investment grade or who also have a lending relationship with the supplying firm's bank.

Overall, this paper shows how lenders influence a firm's trade credit lending to its customers. While other papers have shown lenders reacting to their borrowers' trade credit policy (Mester et al. (2007), Frankel et al. (2020)), my results show a more proactive role of banks in altering the firm's trade credit extension. My paper also contributes to studies showing that large customers use their bargaining power to extract trade credit benefits (e.g., Klapper, Laeven, and Rajan (2012), Murfin and Njoroge (2015), and Billett, Freeman, and Gao (2022)), by showing that a firms' lender relationships can constrain the ability of powerful customers to extract disproportionately high trade credit. More broadly, these findings expand our knowledge of how lenders affect their borrowers' supply chain interactions (Cen et al. (2016), Campello and Gao (2017), Gong and Luo (2018), Hasan et al. (2020), and Amiram et al. (2020)).

Appendix. Variable Definitions

TRADE CREDIT: Pair-level receivables scaled by pair-level sales.

SALES DEPENDENCE: Logarithm of pair-level sales as a proportion of total supplier sales (in percentage points).

DEPENDENCE, AGG. MAJORS: Logarithm of total sales to customers with reported receivable balances scaled by total supplier sales (in percentage points).

SIZE: Logarithm of total assets.

LEVERAGE: Short-term debt + long-term debt, scaled by total assets.

PROFITABILITY: Operating income before depreciation scaled by total assets.

HHI: Herfindahl index of industry sales, computed across all Compustat firms in the same 3-digit SIC code and year.

AGE: Logarithm of number of years firm has appeared in Compustat.

AUDPROPENSITY: The ratio of the count of firm-year observations in the previous 5 years (up to and including $year_{t-1}$) in which other firms using the firm's $year_t$ auditor report trade credit in their 10Ks, scaled by the number of firm-years using this auditor over the same interval.

A/R CONTRACT: Indicator for a loan agreement specifying restrictions on receivables.

A/R CONDITIONS: Indicator for a loan agreement specifying conditions for receivable eligibility.

BORROWING BASE: Indicator for a loan agreement specifying eligibility conditions for which receivables can be borrowed against in the firm's credit line.

A/R LIMIT: Indicator for a loan agreement placing limits (dollar values or percentages) on receivable concentrations for eligibility.

CUSTOMER EXCEPTION: Indicator for whether the observation customer has a specified receivable concentration exception in the firm's loan contract.

GENERIC LIMIT: General upper bound specified on receivable concentrations for eligibility in a loan contract.

CUSTOMER-SPECIFIC LIMIT: Upper bound on receivable concentrations for eligibility, adjusted for any specified CUSTOMER EXCEPTION.

TC SHORTFALL: The difference between the percentage of firm sales and percentage of receivables a customer comprises.

SALES%-LIMIT: The difference between the percentage of firm sales a customer comprises and the CUSTOMER-SPECIFIC LIMIT on its receivables.

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0022109024000656.

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