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Trade credit and financial crises in Kazakhstan[☆]Zarina Adilkhanova^a, Aruzhan Nurlankul^b, Aizat Token^c, Berk Yavuzoglu^{c,*}^a *NAC Analytica, Nazarbayev University, Nur-Sultan, Kazakhstan*^b *Department of Economics and Finance, EIEF and LUISS, Rome, Italy*^c *Department of Economics, Nazarbayev University, Nur-Sultan, Kazakhstan*

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ABSTRACT

This paper studies the trade credit and delinquency behavior in Kazakhstan paying attention to the effects of two recent crises using a unique dataset of large firms and SMEs from the year 2009 to 2016. Our estimates suggest that the relationship between trade and bank credit is mainly substitutional except that it was complementary for large firms following the year 2014–5 crisis. This new piece of evidence on the non-uniform relationship between trade and bank credit during crisis might provide more insight into the mixed findings in the literature. We also discern that trade credit demand is more prevalent among capital-intensive firms. Kazakhstani firms pass along a sizeable portion of their delinquent receivable to their trade credit suppliers. The transmission of trade credit delinquency, additionally, is amplified during the year 2014–5 economic crisis but the year 2009 global financial crisis.

1. Introduction

Trade credit plays a major role in firms' operations in Kazakhstan and is used more extensively than bank loans, as it is the case in countries with an underdeveloped financial system (Beck et al., 2008; Fisman & Love, 2003; Ge & Qiu, 2007). About 90% of large enterprises and 70% of small and medium enterprises (SMEs) in Kazakhstan use trade credit, whereas bank loans are accessed by only around one-third of large firms and one-tenth of SMEs. According to the National Bank of Kazakhstan the overwhelming majority of the firms with access to bank loans utilize the secured amount to finance their operational expenses, implying that the observed immense role of trade credit, especially for SMEs, might be partly attributed to the limited loan availability. This stems from the shortcomings in the banking sector including a large proportion of non-performing loans, about one-quarter in the year 2015, causing banks to be selective in their decisions to extend loans and above 5% real interest rates for businesses.¹ This paper analyzes the trade credit demand and supply behavior of both large enterprises and SMEs in Kazakhstan in between years 2009 and 2016 paying attention to the effects of the year 2009 global financial crisis and the year 2014–5 economic crisis that mainly arose from the sharp decline in energy prices. Having data on trade credit delinquency for large Kazakhstani firms, we further analyze the delinquency behavior and measure its degree of transmission.

The literature provides several motives behind the decisions of non-financial firms to extend trade credit to their customers, including market frictions due to the existence of taxes (Brick & Fung, 1984), transaction costs arising from cash management (Emery, 1984; Ferris, 1981), imperfect market competition allowing price discrimination that makes trade credit profitable (Brennan

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¹ There are government programs providing low-interest rate loans to SMEs, operated by the Damu Fund, but these are limited in volume.

et al., 1988), suppliers having information advantages over banks (Biais & Gollier, 1997; Petersen & Rajan, 1997), inter-firm relationships reducing moral hazard problems (Burkart & Ellingsen, 2004), and suppliers having better ability to enforce debt payments than banks due to the shared rents from a long-standing relationship (Cuñat, 2007). Trade credit is not only quantitatively large but also constitutes an economically important adjustment mechanism for companies. It is known to interact with bank credit whether as a substitute or a complement. The substitution hypothesis states that trade credit demand should be negatively associated with the amount of secured bank loans (e.g., Cuñat, 2007; García-Teruel & Martínez-Solano, 2010; Hill et al., 2017); on the other hand, according to the complementarity hypothesis, creditworthy firms are likely to attract both more trade credit and bank loans (e.g., Agostino & Trivieri, 2014; Andrieu et al., 2018; Giannetti et al., 2011).

Given the ample role of trade credit relative to bank loans in Kazakhstan, an anomaly observed in the financial system, the analysis of the relationship between these two types of external financing can provide insights about the constraints faced by firms in their financing decisions. Uncovering the role of trade credit in determining the financial position and resilience of different types of firms is essential to tailor policy recommendations to support businesses. Additionally the investigation of the trade credit behavior in periods of financial downturn might be particularly important in an attempt to infer the consequences of the ongoing COVID-19 pandemic and evaluate the variety of policy measures taken by the government to mitigate its negative effects on the financial positions of firms.

We conduct our analysis using the confidential data obtained from the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan. The data have two parts: administrative panel data consisting of large enterprises and repeated cross-sectional data of around 30% of SMEs in between years 2009 and 2016. In analyzing the trade credit and delinquency behavior in Kazakhstan, we utilize the determinants measuring firms' ability to obtain external and internal financing, inventory management, creditworthiness as well as geographical and sectoral variation.

Our estimates suggest that trade credit demand and bank loans are mainly substitutes for both large firms and SMEs except that they were complements for large firms following the year 2014–5 economic crisis. The mainly substitutional relationship between trade and bank credit can be perceived as a by-product of the anomaly observed in the financial system, with firms, having limited access to bank loans, extensively relying on trade credit. In contrast the complementary relationship observed for large firms following the year 2014–5 economic crisis indicates the difficulty the relatively less creditworthy firms experienced to secure external financing. Controlling for the heterogeneity in the size of assets along with the cost of labor in a year, we also discern that trade credit demand is more prevalent among capital-intensive rather than labor-intensive firms. Besides, we observe a positive association between trade credit demand and liquidity, which was exacerbated for large firms following the year 2014–5 economic crisis, implying a dearth of trade credit for illiquid firms, possibly arising from the default risk. We further find evidence for the existence of trade credit delinquency chains: On average, around 6% of delinquent receivable are passed along to trade credit suppliers through delayed payments. The transmission of corporate payment failure is estimated to be amplified, by 60%, during the year 2014–5 economic crisis but the year 2009 global financial crisis. These findings show that the ability of a large Kazakhstani firm to pay its trade credit on time is dependent on the ability of its borrowers to pay their credit on time and highlight the strain the year 2014–5 economic crisis brought about on the finances of firms.

The evidence regarding the relationship between trade credit and external financing during crisis is mixed in the literature. Hyun (2017) finds that financially constrained Korean SMEs secured more trade credit during the 1997–8 Asian financial crisis. The findings of Carbó-Valverde et al. (2016) for Spanish SMEs, Lawrenz and Oberndorfer (2018) for unlisted German SMEs, and Yang (2011) for the U.S. manufacturing firms regardless of their size during the Great Recession are also in favor of the substitution hypothesis. Differently, Love and Zaidi (2010) discover that financially constrained SMEs from four East Asian countries during the Asian financial crisis, and Psillaki and Eleftheriou (2015) that French SMEs in the manufacturing industry and Tsuruta (2015) that Japanese SMEs during the global financial crisis received less trade credit provided that they had difficulty accessing bank loans, in favor of the complementarity hypothesis. Our new piece of evidence from Kazakhstan on the non-uniform relationship between trade and bank credit during crisis might provide further insight into the mixed findings in the literature. Another contribution of our study is to utilize the labor cost in a year, in addition to the size of assets (e.g., Andrieu et al., 2018; Bougheas et al., 2009; Canto-Cuevas et al., 2016; García-Teruel & Martínez-Solano, 2010; Petersen & Rajan, 1997), as a measure of firm size to control for the creditworthiness of firms which makes it possible to uncover the implications of labor/capital intensity for trade credit behavior. While the dearth of trade credit observed for illiquid firms is consistent with Tsuruta (2013) in the context of Japan during the Asian financial crisis, the finding that trade credit delinquency chains propagated the effects of the year 2014–5 economic crisis corroborate with Altinoglu (2021), Costello (2020), and Reischer (2019).

2. Recent crises and dynamics of trade credit and its delinquency

The data used in this study span the two recent financial crises Kazakhstan experienced. The former one is the Great Recession that began in the United States officially in December 2007, with the burst of the housing bubble, and ended in June 2009. It met the IMF criteria of being a global recession only in the year 2009. Since the available Kazakhstani data cover the period starting from the year 2009, we choose to refer to the part of the crisis under study as the year 2009 global financial crisis. The next financial downturn for the Kazakhstani economy was the year 2014–5 economic crisis in Kazakhstan which started with the devaluation of the currency, Kazakh Tenge (KZT), by 19% against the U.S. dollar on February 11, 2014, from 155.6 KZT/USD to 185 KZT/USD according to the National Bank of Kazakhstan, as a consequence of the negative balance of payments and increased speculation due to devaluation expectations. This was followed by the decline in energy prices from more than \$100 per barrel to less than \$36 at the end of the year 2014 causing a significant decrease in government revenue since the economy of Kazakhstan is heavily

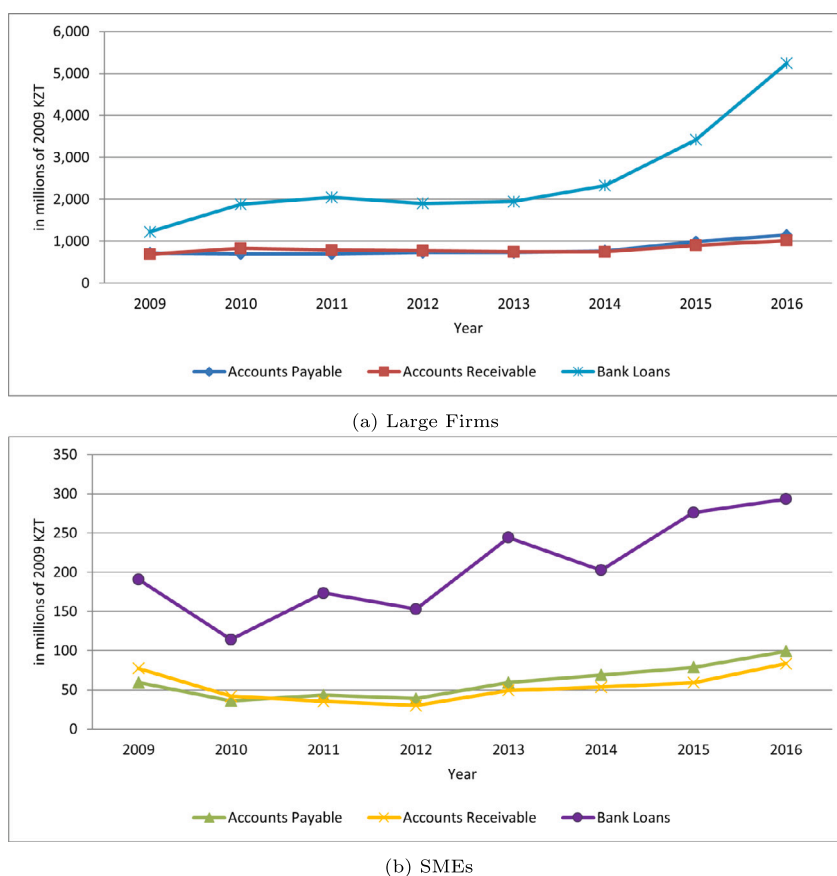


Fig. 1. Average sizes of trade credit and bank loans for firms with access.

dependent on the export of fuel and energy products, constituting about 70% of all exports according to the Statistics Committee of Kazakhstan. Additionally, the imposition of sanctions against Russia, the country's main trading partner, amplified the uncertainty in the economy. The government, in response, switched to a managed-floating exchange regime in the year 2015. KZT lost another 46% vis-à-vis the USD by the end of the year, having an exchange rate of 342.5 KZT/USD on Dec 31, 2015. This crisis indeed lasted in the first quarter of the year 2016.

We next focus on the trends in the usage of external financing sources in Kazakhstan, paying attention to the effects of the two recent crises. All the statistics in this section are obtained using the entire sample of firms broken down by their size: large firms and SMEs. We measure trade credit demand and supply via short-term accounts payable and receivable, utilizing the end of the year values here and elsewhere.

At the extensive margin the percentages of large firms and SMEs with access to trade credit (90% vs. 70%) and bank loans (35% vs. 10%) remained virtually the same in the period under consideration, except for slight temporary decreases following the year 2009 global financial crisis. Figs. 1(a) and 1(b) provide the dynamics for the average sizes of trade credit and bank loans for large firms and SMEs with access, respectively. The year 2009 global crisis had diverging effects on the financing behavior of large firms and SMEs at the intensive margin. The average size of trade credit stayed nearly unchanged for large firms with access but slightly decreased for SMEs between years 2009 and 2014. Regarding bank loans, large firms (SMEs) with access secured larger (smaller) amounts on average after the year 2009 global crisis. The year 2014–5 economic crisis, on the other hand, was followed by increases at the intensive margins of both financing sources for either firm size.

Fig. 2 depicts the dynamics for the average ratios of trade credit to sales for large firms and SMEs with access. While SMEs with access, compared to large enterprises, consistently resorted to and extended proportionally more trade credit on average, the normalized trade credit dynamics by firm size are very similar except for a repercussion observed for SMEs in the year 2016. The most notable feature of this figure is that both of the recent crises were associated with higher amounts of trade credit proportional to sales. Interpreting Fig. 2 together with Figs. 1(a) and 1(b), it is possible to conclude that sales of large firms (SMEs) were affected more by the year 2014–5 (2009) crisis.

The percentage of large firms that are delinquent on their accounts payable decreased continuously from 8% in the year 2009 to 4% in the year 2016. Yet the average ratio of delinquent amount proportional to sales for these firms, after a 10 percentage points decrease following the year 2009 global financial crisis, remained almost intact at around 37%.

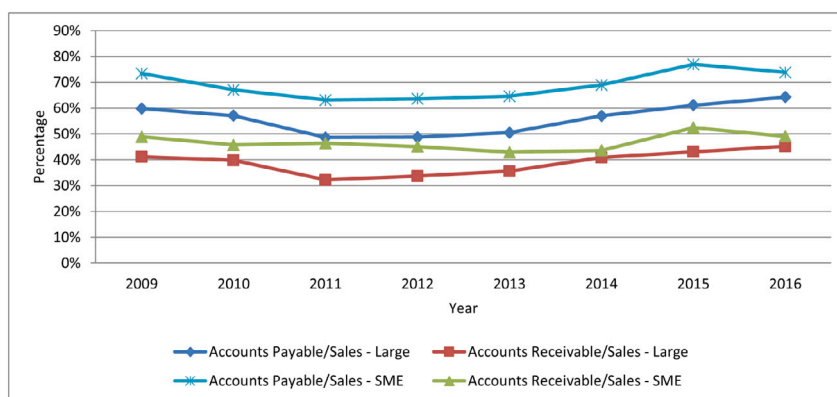


Fig. 2. Average ratios of trade credit to sales for firms with access.

3. Data

The data utilized in this paper are obtained from the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan,² part of the national statistical monitoring. It is confidential and composed of the information reported, in written forms, annually by (i) the population of big firms with more than 50 employees (1-PF data) and (ii) a random sample of around 30% of SMEs (2-MP data) except for educational and medical organizations, banks, and public associations for the period of 2009–14. Since then, the agency started collecting the data online and revised its cutoff for the definition of SMEs to more than 100 employees. A firm that is observed in the year 2014 but not in 2015 in the 1-PF data then either had less than 100 workers or went out of business. In the former case, there is a chance for this firm to be present in the 2-MP data in the years 2015 and/or 2016. The data contain information on balance sheet components and some firm-level characteristics including firm size, industry, and location. The large firm data additionally include information on delinquent receivable from suppliers and delinquent payable to customers, the latter being the unique feature of the Kazakhstani data.

The administrative panel data of large firms have a total of 43,417 firm-year observations out of 10,208 firms. We drop 1,889 firm-year observations including mainly inactive but still registered firms having annual revenue of less than 10 million year 2009 KZT, corresponding to around 65,000 USD, as well as a limited number of observations with inconsistencies over the time in the variables of interest in this study. We also drop 1,236 firm-year observations with missing values for any variable of interest except for delinquency to obtain our working large firm sample, consisting of 9,151 firms with a total of 40,292 observations. For the repeated cross-sectional data of SMEs, we drop 7.8% of firm-year observations that are inactive but still registered with a revenue of less than 150,000 KZT, corresponding to around 80% of the minimum wage. Since the SME data are not a panel, we cannot check inconsistencies in variables of interest over time, as we did for large firms. We additionally censorize the top 1% of the ratios we constructed from balance sheet variables, corresponding to a total of 3% of observations. The working SME sample consists of 136,923 observations, from 63,857 firms.

As determinants of trade credit and its delinquency, we control for the ability to obtain external and internal financing, inventory management, creditworthiness as well as geographical and sectoral variation. We measure trade credit demand using short-term (up to one-year) accounts payable (AP) and trade credit supply via short-term accounts receivable (AR). Delinquent payable are measured using overdue liabilities to suppliers and contractors (*AP overdue*), and delinquent receivable utilizing overdue collectibles from buyers and consumers (*AR overdue*).

We control for firms' ability to obtain external financing via bank loans, short-term liabilities except for trade and bank credit (*ST Liabilities*), and long-term liabilities except for bank credit (*LT Liabilities*). Short- and long-term liabilities help us capture other financing sources such as tax liabilities and informal finance — the data provide only the sums. Access to bank loans is measured using two variables: a binary variable indicating whether a firm has an outstanding bank loan (*AF1*) along with its size (*AF2*).

Trade credit is known to interact with bank loans, whether as a substitute or as a complement. According to the substitution hypothesis, trade credit demand should exhibit a negative relationship with external financing: Firms unable to acquire bank loans should rely on trade credit. The findings of Cuñat (2007), García-Teruel and Martínez-Solano (2010), and Hill et al. (2017) are in line with this view. Alternatively, the complementarity hypothesis suggests that creditworthy firms attract more bank loans and trade credit simultaneously. Agostino and Trivieri (2014), Andrieu et al. (2018), and Giannetti et al. (2011) corroborate this hypothesis. Figs. 3(a) and 3(b) depict the relationship between the sizes of bank loans and trade credit normalized by sales for large firms and SMEs in Kazakhstan. The raw data suggests some complementarity, albeit with a sizeable variation. We indeed later show that

² This committee was recently renamed as the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.

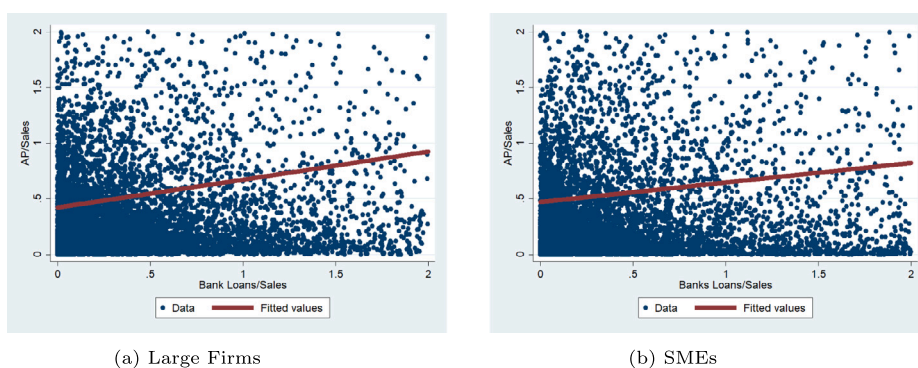


Fig. 3. Accounts payable vs. bank loans.

Table 1

Variable definitions.

Variable	Definition
AP	Short-term payable/Sales
AR	Short-term receivables/Sales
AP Overdue	Overdue payable to suppliers/Sales — only for large firms
AR Overdue	Overdue receivable from customers/Sales — only for large firms
AF1	Access to bank loans (dummy)
AF2	(Short-term bank loans + Long-term bank loans)/Sales
ST Liabilities	(Short-term liabilities – Short-term bank loans and payable)/Sales
LT Liabilities	(Long-term liabilities – Long-term bank loans)/Sales
Profitability	Gross profit/Sales
Liquidity	(Cash + Bank deposits + Other current assets)/Sales
Inventory	Inventory/Sales
SizeLA	log (Long-Term assets – Fixed assets)
SizeLC	log (Labor cost)
SizeCOL	log (Fixed assets)
Urban	Located in an urban area (dummy) — only for SMEs

controlling for observables, trade credit and bank loans are mainly substitutes in Kazakhstan, except for being complementary for large firms following the year 2014–5 economic crisis.

We measure firms' ability to generate internal funds using *Profitability* and *Liquidity*. More profitable firms, finding it easier to generate capital for reinvestment, might have less need to raise trade credit for their operations. A similar negative association with trade credit demand might be expected for *Liquidity* unless, arising from the default risk, illiquid firms find it difficult to attract credit from their suppliers. Being able to generate internal funds, we expect both profitable and liquid firms to extend more trade credit. We additionally analyze the importance of *Inventory* in trade credit behavior. We expect it to be positively associated with trade credit supply provided that large sizes of the inventory do not stem from the difficulty in selling products. We normalize all the introduced variables by sales revenue.³

To evaluate the effect of the creditworthiness of firms on trade credit behavior, we utilize the size of assets and the cost of labor in a year. This dual measure of creditworthiness helps us to discern the trade credit behavior of capital-intensive from labor-intensive firms. Since the implications of different types of assets on trade credit behavior might diverge, we separate fixed assets from the rest of the assets. The three firm size measures we utilize, long-term assets of the firm except for fixed assets (*SizeLA*), labor cost in a year (*SizeLC*), and collaterals measured by fixed assets (*SizeCOL*) are provided in logarithms after being normalized to the value of KZT in the year 2009 using consumer price index (CPI). The SME data also have information on whether a firm is located in an urban area (*Urban*). A recap of the variables of interest in our study along with their definitions can be found in [Table 1](#).

We additionally investigate if the relationship between trade and bank credit depends on the three firm size measures we utilize within each coarse firm size classification, large enterprises and SMEs, introduced by the data collection agency. This helps us to have a better understanding of the differential effect of firm size on trade credit behavior. To that end, we utilize three interaction terms between the size of bank loans and firm size measures. Since the relationship between trade and bank credit might also depend on the other sources of external financing, we consider two interaction terms between bank loans and liabilities. We further use three interaction terms between the level of inventory and firm size measures, and another two interaction terms between inventory

³ We choose to scale our control variables by sales rather than assets since one contribution of our paper is to uncover the implications of labor/capital intensity on trade credit behavior. It would not be possible to discern these implications if we used assets to scale control variables.

Table 2
Data structure.

	Large firms		SMEs	
	Freq.	Percent	Freq.	Percent
a: Industry composition				
Agriculture	4,419	10.97	8,325	6.08
Mining	1,423	3.53	2,657	1.94
Oil and Gas	329	0.82	90	0.07
Manufacturing	7,235	17.96	13,169	9.62
Utilities	2,445	6.07	4,609	3.37
Construction	5,898	14.64	14,235	10.40
Automobile	342	0.85	1,832	1.34
Retail and Wholesale Trade	5,263	13.06	21,942	16.03
Transportation and Warehouse	2,888	7.17	9,036	6.60
Accommodation and Food Services	1,097	2.72	4,773	3.49
Information and Communication	1,042	2.59	6,328	4.62
Finance and Insurance	198	0.49	6,896	5.04
Real Estate	1,072	2.66	12,315	8.99
Professional, Sci. & Tech. Services	2,811	6.98	13,006	9.50
Administration and Support Services	2,574	6.39	10,148	7.41
Art, Entertainment and Recreation	1,063	2.64	3,527	2.58
Other Services	193	0.48	4,035	2.95
# of Obs.	40,292	100.00	136,923	100.00
b: Location composition				
	Freq.	Percent	Freq.	Percent
Akmola oblast	2,150	5.34	7,059	5.16
Aktobe oblast	1,872	4.65	6,766	4.94
Almaty oblast	2,300	5.71	8,449	6.17
Atyrau oblast	1,694	4.20	5,041	3.68
West Kazakhstan oblast	1,273	3.16	5,017	3.66
Zhambyl oblast	970	2.41	4,831	3.53
Karagandy oblast	3,024	7.51	12,430	9.08
Kostanay oblast	2,679	6.65	7,963	5.82
Kyzylorda oblast	1,300	3.23	3,703	2.70
Mangystau oblast	1,657	4.11	5,314	3.88
Turkestan oblast ^a	2,349	5.83	9,287	6.78
Pavlodar oblast	1,694	4.20	7,025	5.13
North Kazakhstan oblast	1,972	4.89	6,048	4.42
East Kazakhstan oblast	2,984	7.41	11,832	8.64
Nur-Sultan city ^b	3,570	8.86	11,720	8.56
Almaty city	8,804	21.85	24,438	17.85
# of Obs.	40,292	100.00	136,923	100.00
c: Year composition				
	Freq.	Percent	Freq.	Percent
2009	4,917	12.20	15,742	11.50
2010	5,112	12.69	21,291	15.55
2011	5,405	13.41	12,690	9.27
2012	5,625	13.96	12,057	8.81
2013	5,778	14.34	17,839	13.03
2014	5,930	14.72	18,779	13.72
2015	3,776	9.37	16,145	11.79
2016	3,749	9.30	22,380	16.34
# of Obs.	40,292	100.00	136,923	100.00

^aSouth Kazakhstan oblast was renamed to Turkestan oblast in 2018 when the city of Shymkent was given the status of a city of republican significance and removed from the oblast.

^bAstana city was renamed to Nur-Sultan city in 2019.

and other sources of external financing to inspect whether the effect of inventory on trade credit behavior depends on firm size or liabilities. Eventually, we only include the highly significant interaction terms in our regressions.

The industry-location-year composition of firms is provided in Table 2. The industrial variation in our data is provided via 5-digit classification, similar to O*NET. We use the first 2 digits and identify 17 sectors. Among them, manufacturing, construction, and retail and wholesale trade are the major sectors regardless of firm size. The other major sectors are agriculture for large firms, professional, scientific and technical services, and real estate for SMEs. The geographical data are composed of all 14 regions (called *oblasts*) and 2 cities of republican significance having a population of above 1 million, Almaty and Nur-Sultan (capital). Almaty city has the largest concentration of firms followed by Nur-Sultan city, Karagandy region, and East Kazakhstan region. The numbers of observations for the years 2015 and 2016 in the large firm dataset are lower due to the change in the data collection regulations discussed earlier.

Table 3
Summary statistics.

Variable	# of Obs.	Mean	Std. Dev.	Min	Max
a: Summary statistics for large firms					
AP	40,292	0.503	1.742	0	48.859
AR	40,292	0.351	1.395	0	47.133
AP Overdue	39,573	0.032	0.506	0	43.793
AR Overdue	38,424	0.019	0.321	0	22.966
AF1	40,292	0.327	0.469	0	1
AF2	40,292	0.321	1.748	0	62.288
ST Liabilities	40,292	0.255	1.347	0	68.845
LT Liabilities	40,292	0.301	2.149	0	100.669
Profitability	40,292	0.246	0.499	-20.746	1
Liquidity	40,292	0.236	1.062	0	44.221
Inventory	40,292	0.280	0.780	0	31.866
SizeLA	40,292	6.753	4.862	0	21.118
SizeLC	40,292	11.565	1.376	0	18.408
SizeCOL	40,292	11.189	3.140	0	20.495
b: Summary statistics for SMEs					
AP	136,923	0.488	1.910	0	40.72
AR	136,923	0.318	1.246	0	27.22
AF1	136,923	0.080	0.517	0	7.903
AF2	136,923	0.087	0.281	0	1
ST Liabilities	136,923	0.279	1.231	0	27.74
LT Liabilities	136,923	0.238	1.303	0	21.55
Profitability	136,923	0.488	0.425	-1.779	1
Liquidity	136,923	0.408	1.700	0	48.03
Inventory	136,923	0.218	0.678	0	11.67
SizeLA	136,923	2.269	3.493	0	19.40
SizeLC	136,923	8.252	1.703	0	14.70
SizeCOL	136,923	5.880	4.145	0	19.75
Urban	136,923	0.841	0.366	0	1

Summary statistics for large firms and SMEs are provided in Table 3. While accounts payable constitute around 50% of sales for an average firm regardless of its size, accounts receivable account for 35% of sales for large firms and 32% for SMEs. This discrepancy in the average rates of accounts payable and receivable arises from the fact that relatively smaller firms secure trade credit from relatively larger firms on average. It also extends to the delinquency behavior of large firms: delinquent payable and receivable are around 3% and 2% of sales. Proportional to their sales, SMEs are more profitable and liquid on average, but have a limited access to bank loans. The average size of labor cost is significantly larger than the average size of long-term assets which is more pronounced for SMEs. Large firms and SMEs do not seem to differ in terms of their average levels of trade credit, other external financing sources, and inventory management.

Table 4 presents the pairwise correlations among the determinants of trade credit analyzed in this paper for large firms and SMEs. The pairwise correlations among the three firm size measures we utilize are sizeable. We keep them to account for the different trade credit behavior of firms based on capital/labor structure. The two other sizeable correlations are between short-term liabilities with liquidity and inventory for large firms. The former might be caused by a necessity to hold on to cash to repay short-term liabilities, whereas the latter might be due to the presence of firms having difficulty with selling their products.

4. Trade credit and delinquency determinants in Kazakhstan

Accounting for the panel structure of the data, we analyze the determinants of trade credit for large firms employing fixed effects models, which allow to control for the unobservable heterogeneity across firms that is fixed over the years. Since the fixed effects Tobit model fails to produce a sufficient statistic for estimation, we resort to a linear model. Considering that more than 91% of large Kazakhstani firms rely on trade credit, the benefit of this choice outweighs the cost of renouncing the Tobit model, not accounting for the present left censoring.

Our regression model for large firms is presented below in Model 1. The dependent variable is either Accounts Payable or Accounts Receivable. We set $\beta_{12} = \beta_{17-18} = \beta_{20} = 0$ in both trade credit demand and supply regressions, and additionally set $\beta_{11} = \beta_{13-15} = 0$ when the dependent variable is Accounts Payable and $\beta_{19} = 0$ when the dependent variable is Accounts Receivable since the relevant interaction terms are not estimated to be highly significant (p-value more than 0.05). α_i denotes the firm fixed effect, β_n is the vector of parameters for the year dummies, β_m is the vector of parameters for the location dummies, and β_k is the vector of parameters for the sector dummies. We control for location and sector dummies to account for the behavior of firms that were relocated or switched sectors.

Table 4
Pairwise correlation tables.

a: Pairwise correlation table for large firms														
	AP	AR	AP Overdue	AR Overdue	AF1	AF2	ST Liabilities	LT Liabilities	Profitability	Liquidity	Inventory	Size LA	SizeLC	SizeCOL
AP	1.000													
AR	0.608	1.000												
AP Overdue	0.245	0.173	1.000											
AR Overdue	0.203	0.248	0.622	1.000										
AF1	0.041	0.066	0.022	0.033	1.000									
AF2	0.257	0.398	0.128	0.167	0.261	1.000								
ST Liabilities	0.174	0.254	0.203	0.245	0.014	0.163	1.000							
LT Liabilities	0.191	0.203	0.031	0.022	-0.003	0.122	0.096	1.000						
Profitability	-0.143	-0.095	-0.059	-0.043	-0.050	-0.062	-0.119	-0.042	1.000					
Liquidity	0.243	0.219	0.041	0.052	0.015	0.229	0.357	0.263	-0.064	1.000				
Inventory	0.386	0.249	0.198	0.159	0.073	0.230	0.346	0.158	-0.128	0.172	1.000			
SizeLA	0.049	0.052	0.006	0.014	0.197	0.119	0.077	0.124	-0.002	0.112	0.055	1.000		
SizeLC	-0.122	-0.076	-0.050	-0.041	0.065	-0.051	-0.036	-0.009	0.033	0.001	-0.135	0.442	1.000	
SizeCOL	0.060	0.048	0.008	0.009	0.262	0.109	0.054	0.096	-0.091	0.063	0.070	0.523	0.463	1.000
b: Pairwise correlation table for SMEs														
	AP	AR	AF1	AF2	ST Liabilities	LT Liabilities	Profitability	Liquidity	Inventory	Size LA	SizeLC	SizeCOL	Urban	
AP	1.000													
AR	0.417	1.000												
AF1	0.048	0.094	1.000											
AF2	0.011	0.022	0.505	1.000										
ST Liabilities	0.150	0.270	0.037	-0.000	1.000									
LT Liabilities	0.058	0.126	0.039	0.005	0.060	1.000								
Profitability	-0.042	0.016	-0.003	-0.087	-0.005	-0.003	1.000							
Liquidity	0.215	0.175	0.067	-0.003	0.271	0.116	0.069	1.000						
Inventory	0.279	0.131	0.084	0.058	0.197	0.125	-0.123	0.092	1.000					
SizeLA	0.076	0.063	0.172	0.198	0.096	0.187	-0.047	0.072	0.055	1.000				
SizeLC	-0.071	-0.065	0.032	0.160	-0.051	-0.025	-0.072	-0.077	-0.057	0.315	1.000			
SizeCOL	0.099	0.035	0.139	0.263	0.078	0.112	-0.116	0.001	0.097	0.385	0.489	1.000		
Urban	-0.017	-0.002	-0.043	-0.03	-0.009	-0.075	0.203	0.016	-0.069	-0.046	0.023	-0.105	1.000	

Model I: The Determinants of Accounts Payable and Receivable for Large Firms

$$\begin{aligned}
 Trade\ credit_{it} = & \alpha_i + \beta_1 AF1_{it} + \beta_2 AF2_{it} + \beta_3 ST\ Liabilities_{it} + \beta_4 LT\ Liabilities_{it} \\
 & + \beta_5 Profitability_{it} + \beta_6 Liquidity_{it} + \beta_7 Inventory_{it} + \beta_8 SizeLA_{it} \\
 & + \beta_9 SizeLC_{it} + \beta_{10} SizeCOL_{it} + \beta_{11} AF2 * ST\ Liabilities_{it} \\
 & + \beta_{12} AF2 * LT\ Liabilities_{it} + \beta_{13} AF2 * SizeLA_{it} + \beta_{14} AF2 * SizeLC_{it} \\
 & + \beta_{15} AF2 * SizeCOL_{it} + \beta_{16} Inventory * ST\ Liabilities_{it} \\
 & + \beta_{17} Inventory * LT\ Liabilities_{it} + \beta_{18} Inventory * SizeLA_{it} \\
 & + \beta_{19} Inventory * SizeLC_{it} + \beta_{20} Inventory * SizeCOL_{it} + \beta_n Year_n \\
 & + \beta_m Location_m + \beta_k Sector_k + \epsilon_{it}.
 \end{aligned}$$

We estimate the determinants of trade credit for small firms within a Tobit framework since we have only a repeated cross-sectional data, see Model 2 below. We set $\beta_{11-14} = \beta_{18} = \beta_{20} = 0$ for both trade credit demand and supply regressions, and additionally set $\beta_{15} = 0$ when the dependent variable is Accounts Payable since these estimates turn out not to be highly significant.

Model II: The Determinants of Accounts Payable and Receivable for SMEs

$$\begin{aligned}
 Trade\ credit_{it} = & \beta_0 + \beta_1 AF1 + \beta_2 AF2 + \beta_3 ST\ Liabilities + \beta_4 LT\ Liabilities \\
 & + \beta_5 Profitability + \beta_6 Liquidity + \beta_7 Inventory + \beta_8 SizeLA + \beta_9 SizeLC \\
 & + \beta_{10} SizeCOL + \beta_{11} AF2 * ST\ Liabilities + \beta_{12} AF2 * LT\ Liabilities \\
 & + \beta_{13} AF2 * SizeLA + \beta_{14} AF2 * SizeLC + \beta_{15} AF2 * SizeCOL \\
 & + \beta_{16} Inventory * ST\ Liabilities + \beta_{17} Inventory * LT\ Liabilities \\
 & + \beta_{18} Inventory * SizeLA + \beta_{19} Inventory * SizeLC \\
 & + \beta_{20} Inventory * SizeCOL + \beta_{21} urban + \beta_n Year_n + \beta_m Location_m \\
 & + \beta_k Sector_k + \epsilon.
 \end{aligned}$$

Table 5 provides the regression results of Models I and II. We only provide the non-trivial average marginal effects (AMEs) for the fixed effects regression of large firms, since the estimates of linearly modeled regressors are identical to their AMEs, and the unconditional AMEs for the Tobit regression of SMEs. For the trade credit supply regression for large firms, while the estimate of AF1 is negative but imprecise, AF2 is positively and precisely estimated. These estimates suggest that trade credit demand and bank loans are mainly substitutes for large firms and the degree of substitutability decreases with the size of bank loans. This substitutional relationship switches to being complementary for 11.3% of the observations having access to bank loans amounting to more than 40.0% of their sales. Since bank loan estimates in the supply regression for large firms differ significantly when we account for

Table 5
Regression results of Models I and II.

VARIABLE	LARGE FIRMS				SMEs			
	AP		AR		AP		AR	
	FE Est.	AME ^a	FE Est.	AME ^a	Tobit Est.	Uncond'l AME	Tobit Est.	Uncond'l AME
AF1	-0.036 (0.031)		-0.068** (0.028)		-0.164*** (0.022)	-0.079*** (0.011)	-0.016 (0.016)	-0.007 (0.007)
AF2	0.090*** (0.024)		0.553** (0.229)	0.488*** (0.058)	0.044** (0.021)	0.021** (0.010)	0.511*** (0.072)	0.132*** (0.016)
ST Liabilities	-0.048 (0.034)	-0.052 (0.033)	0.183*** (0.039)	0.178*** (0.039)	0.084*** (0.018)	0.034*** (0.008)	0.265*** (0.017)	0.122*** (0.007)
LT Liabilities	0.069*** (0.028)		0.091*** (0.027)		-0.002 (0.012)	-0.008 (0.005)	0.099*** (0.012)	0.044*** (0.005)
Profitability	-0.173*** (0.065)		-0.088 (0.059)		-0.220*** (0.029)	-0.105*** (0.014)	0.005 (0.017)	0.002 (0.008)
Liquidity	0.298*** (0.070)		0.030 (0.046)		0.230** (0.018)	0.110*** (0.008)	0.059*** (0.009)	0.028*** (0.004)
Inventory	2.279*** (0.621)	0.683*** (0.091)	0.193*** (0.054)	0.191*** (0.054)	1.327*** (0.129)	0.395*** (0.018)	0.214*** (0.019)	0.093*** (0.008)
SizeLA	0.002 (0.004)		-0.005 (0.003)	-0.010*** (0.003)	0.038*** (0.003)	0.018*** (0.002)	0.009*** (0.002)	0.004*** (0.001)
SizeLC	-0.191*** (0.040)	-0.230*** (0.035)	-0.125*** (0.026)	-0.110*** (0.026)	-0.077*** (0.008)	-0.046*** (0.004)	0.012** (0.005)	0.005*** (0.002)
SizeCOL	0.013** (0.007)		0.005 (0.006)	-0.009 (0.007)	0.115*** (0.003)	0.055*** (0.002)	0.043*** (0.002)	0.018*** (0.001)
Urban					0.225*** (0.033)	0.108*** (0.016)	0.189*** (0.023)	0.088*** (0.011)
AF2*ST Liabilities			-0.010*** (0.001)					
AF2*SizeLA			-0.014** (0.006)					
AF2*SizeLC			0.045** (0.023)					
AF2*SizeCOL			-0.044*** (0.013)				-0.036*** (0.007)	
Inventory*	-0.012*** (0.003)		-0.007*** (0.003)		-0.041*** (0.007)		-0.019*** (0.005)	
ST Liabilities					-0.046*** (0.009)		-0.019*** (0.006)	
Inventory*								
LT Liabilities								
Inventory*SizeLC	-0.138** (0.055)				-0.057*** (0.016)		-0.017** (0.008)	
year2010	0.029 (0.021)		0.001 (0.017)		0.012 (0.022)	0.006 (0.010)	0.046*** (0.017)	0.022*** (0.007)
year2011	0.045* (0.023)		-0.012 (0.020)		-0.053** (0.026)	-0.025** (0.012)	0.040** (0.018)	0.019** (0.009)
year2012	0.071*** (0.025)		0.028 (0.022)		-0.044 (0.028)	-0.021 (0.013)	0.030 (0.019)	0.014 (0.009)
year2013	0.086*** (0.027)		0.050** (0.023)		-0.015 (0.025)	-0.007 (0.012)	0.046*** (0.017)	0.021*** (0.008)
year2014	0.168*** (0.031)		0.116*** (0.027)		-0.015 (0.025)	-0.006 (0.012)	0.033* (0.017)	0.015* (0.008)
year2015	0.198*** (0.031)		0.101*** (0.027)		0.026 (0.027)	0.012 (0.013)	0.121*** (0.018)	0.057*** (0.009)
year2016	0.219*** (0.036)		0.095*** (0.028)		-0.020 (0.025)	-0.010 (0.012)	0.085*** (0.017)	0.040*** (0.008)
Constant	1.182* (0.703)		1.351*** (0.319)		-0.383*** (0.078)		-0.822*** (0.051)	
Location	Controlled		Controlled		Controlled		Controlled	
Sector	Controlled		Controlled		Controlled		Controlled	
# of Obs.	40,292		40,292		136,923		136,923	

Robust clustered standard errors are in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Year 2009 is the reference category.

^aOnly non-trivial AMEs are provided.

their changing role in crisis periods in the next section, we choose not to emphasize them any further here. For SMEs, trade credit demand and bank loans are estimated to be substitutes, unless the size of bank loans amounts to more than 4 times the sales, and the degree of substitutability decreases with the size of bank loans like large firms. Large firms and SMEs have a diverging trade credit behavior though in response to the other sources of external financing: Only long-term (short-term) liabilities are estimated to be complements with trade credit for large firms (SMEs).

At the average values of firm size variables and short-term liabilities, large firms having access to bank loans more than 13.9% of their sales are estimated to use some portion of their loans to extend trade credit, with its size increasing with labor intensity but decreasing with the amount of short-term liabilities. The limited number of SMEs having access to bank loans are also estimated to extend more trade credit, relatively less in size for those having more collaterals. Similarly, we discover positive associations between other external financing sources and trade credit supply.

Our estimates suggest that more profitable firms on average recur to trade credit less, as expected since they can use their profits for investment and in line with Bougheas et al. (2009) and García-Teruel and Martínez-Solano (2010). We yet find a positive association between liquidity and trade credit demand implying that the default risk might drive suppliers away from extending trade credit to illiquid firms. This finding has an important policy implication as it underlines the difficulty the illiquid firms, a group that includes mainly smaller and newly created firms, experience in raising external financing for their operations. Regarding trade credit supply, liquid SMEs are estimated to extend more along with the expectations, yet the finding that profitable large firms extend less on average is puzzling.

The positive AME estimate of Inventory for the demand regression suggests that inventory might be considered as collaterals, in line with Cuñat (2007). Inventory is also estimated as a positive determinant of trade credit supply contrary to Bougheas et al. (2009) who utilized firm-level data from the U.K. and Ireland. Since the financial system of Kazakhstan is not well developed and trade credit is the primary external financing source unlike the U.K. and Ireland, this estimate might signal the difficulty of firms selling their products, rather than having a choice to extend more trade credit to decrease their inventory as in Bougheas et al. (2009). This line of thinking might be backed-up by the relatively high positive correlation between short-term liabilities (except trade credit) and inventory, see Table 4.

Firm size is used to control for the creditworthiness of firms in trade credit literature and measured typically using assets (Andrieu et al., 2018; Bougheas et al., 2009; Canto-Cuevas et al., 2016; García-Teruel & Martínez-Solano, 2010; Petersen & Rajan, 1997). Going beyond, we utilize the cost of labor in a year as an additional measure to discern the trade credit behavior of labor-intensive firms. Since different types of assets might have diverging implications on trade credit behavior, we additionally separate collaterals from the rest of the assets in our analysis. For both large firms and SMEs, AME estimates of the variables measuring firm size by assets and labor cost in a year are opposite and significant, except for other long-term assets for large firms, in supply regressions. This reflects the differences in trade credit behavior of capital-intensive from labor-intensive firms, which is not surprising considering the nature of trade credit. The results tying firm size to trade credit supply are rather mixed: While large firms having higher labor cost and long-term assets but collaterals are estimated to extend less trade credit on average, we observe positive associations between trade credit and all of the size measures for SMEs.

SMEs located in urban areas are estimated to recur to and extend more trade credit on average, as in Niskanen and Niskanen (2006). Lastly, the majority of the industry, like in Giannetti et al. (2011) and Ng et al. (1999), and location dummy variables in Model II are estimated to be economically and statistically significant. Running another Tobit regression for large firms, omitting the panel structure, reveals the same pattern. These findings underline the sectoral and geographical variation in trade credit behavior in Kazakhstan.

A different strand of literature consists of works on trade credit networks pioneered by Kiyotaki and Moore (1997). In their work, they theoretically show how liquidity shocks are transmitted through delinquencies on trade credit. Boissay and Gropp (2013) and Jacobson and Von Schedvin (2015) are among the papers that estimate the degree of this transmission in the context of French and Swedish firms. Having data on trade credit delinquency for large Kazakhstani firms, we next analyze the determinants of delinquent payable along with the degree of transmission of corporate payment failure via Accounts Receivable Overdue, see Model III presented below. Since only 5.4% of large firm-year observations have delinquent payable the cost of renouncing the Tobit framework in favor of a linear fixed effects model is drastic. We, therefore, resort to the Tobit model omitting the panel structure of the data. Our model includes only two interaction terms, the ones between AF2 and ST Liabilities, and Inventory and SizeLC, since none of the other interaction terms considered are estimated to be highly significant.

Model III: The Determinants of Delinquent Payable for Large Firms

$$\begin{aligned} AP\ Overdue = & \beta_0 + \gamma AROverdue + \beta_1 AF1 + \beta_2 AF2 + \beta_3 STLiabilities \\ & + \beta_4 LTLiabilities + \beta_5 Profitability + \beta_6 Liquidity + \beta_7 Inventory \\ & + \beta_8 SizeLA + \beta_9 SizeLC + \beta_{10} SizeCOL + \beta_{11} AF2 * STLiabilities \\ & + \beta_{12} Inventory * SizeLC + \beta_n Year_n + \beta_m Location_m + \beta_k Sector_k + \epsilon. \end{aligned}$$

Table 6 illustrates the regression results of Model III where unconditional along with conditional AMEs are provided. Since only a small portion of large firms are delinquent on their payables, conditional and unconditional AMEs differ considerably from each other allowing to discern, additionally, the average behavior of large firms that are already delinquent on their trade credit. The estimates of AR Overdue suggest that a large firm's ability to repay its trade credit on time depends on the ability of its borrowers to repay their credit on time. Considering all the large firms, on average 6.2% of delinquent receivable are passed along to trade credit suppliers through delayed payments. The same statistic is estimated to be 17.1% for large firms that are already delinquent on their payable. Remark that Profitability is the only other economically and statistically significant determinant of delinquency in addition to many year, region, and sector dummies. More profitable large firms are estimated to be less delinquent on average as expected since they are more likely to pay off their debts on time.

Table 6
Regression results of Model III.

AP Overdue							
VARIABLE	Tobit Est.	Uncond'l AME	Cond'l AME	VARIABLE	Tobit Est.	Uncond'l AME	Cond'l AME
AR Overdue	1.295*** (0.235)	0.062*** (0.011)	0.171*** (0.031)	Inventories*	-0.119*** (0.047)		
AF1	-0.029 (0.068)	-0.001 (0.003)	-0.004 (0.009)	SizeLC			
AF2	0.020 (0.020)	0.001 (0.001)	0.003 (0.003)	year2010	-0.179*** (0.058)	-0.009*** (0.003)	-0.024*** (0.008)
ST Liabilities	0.042 (0.037)	0.002 (0.002)	0.005 (0.005)	year2011	-0.247*** (0.063)	-0.012*** (0.003)	-0.033*** (0.008)
LT Liabilities	0.005 (0.016)	0.000 (0.001)	-0.001 (0.002)	year2012	-0.339*** (0.070)	-0.016*** (0.003)	-0.045*** (0.009)
Profitability	-0.195*** (0.059)	-0.010*** (0.003)	-0.026*** (0.008)	year2013	-0.412*** (0.083)	-0.020*** (0.004)	-0.055*** (0.011)
Liquidity	-0.062 (0.052)	-0.003 (0.002)	-0.008 (0.007)	year2014	-0.513*** (0.087)	-0.025*** (0.004)	-0.068*** (0.011)
Inventory	1.427*** (0.543)	0.003 (0.002)	0.006 (0.006)	year2015	-0.550*** (0.096)	-0.026*** (0.004)	-0.073*** (0.012)
SizeLA	0.019** (0.008)	0.001** (0.000)	0.003** (0.001)	year2016	-0.624*** (0.110)	-0.030*** (0.005)	-0.083*** (0.014)
SizeLC	-0.035 (0.036)	-0.005*** (0.002)	-0.010** (0.004)	Constant	-3.343*** (0.653)		
SizeCOL	0.042*** (0.013)	0.002*** (0.001)	0.006*** (0.002)	Location	Controlled		
AF2*	-0.002***			Sector	Controlled		
ST Liabilities	(0.001)			# of Obs.	38,196		

Robust clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Year 2009 is the reference category.

The size of trade credit delinquency of large firms, in comparison to sales, is observed to decline steadily. Controlling for the other determinants, the estimated decrease is 3 percentage points with respect to sales in the year 2016 compared to the year 2009. Note that our regression models do not account for the extensive margin properly as they assume firm exit is random. Indeed, the annual exit rate of firms increased from around 9% to 13% while the annual bankruptcy rate increased from 0.4% to 0.6% following the year 2014–5 economic crisis (Nurlankul & Yavuzoglu, 2020). The robustness check we conduct in the next section, employing propensity score matching after splitting the sample into crisis and no-crisis periods, also provides evidence in favor of our findings being robust to the changes observed at the extensive margin. A structural analysis taking of the interplay among trade credit, its delinquency, and firm exit into account is taken up by Mateos-Planas et al. (2021).

5. Trade credit and its delinquency during crises

We next analyze the changes in the effects of financial indicators (bank loans, short-term and long-term liabilities, and liquidity) and three firm size measures (*SizeLA*, *SizeLC*, and *SizeCOL*) in the periods of crisis. To that end, we extend the fixed effects formulation for large firms and Tobit formulation for SMEs given in Models I and II including interaction terms of these variables with the year dummies for 2009, 2015, and 2016 (we choose to utilize a dummy for the year 2016 since the year 2014–5 economic crisis lasted only in the first quarter of the year 2016). These exercises, in other words, amounts to examining the trade credit behavior of financially constrained, illiquid, and capital/labor intensive firms in periods of financial downturns.

In Models IV and V presented below, FI denotes the vector of financial indicators including bank loans, short- and long-term liabilities, and liquidity, $Size$ denotes the vector of variables representing firm size including *SizeLA*, *SizeLC*, and *SizeCOL*, $\beta_{FI,year}$ is the vector of parameters for the interaction terms between years of crisis and financial indicators, $\beta_{Size,year}$ is the vector of parameters for the interaction terms between years of crisis and variables measuring firm size, X_1 is the matrix of independent variables in Model I except for the interaction terms that turn out to be not highly significant, β_{X_1} is the vector of parameters for these variables, X_2 is the matrix of independent variables in Model II except for the interaction terms that turn out to be not highly significant, and β_{X_2} is the vector of parameters for the variables in X_2 .

Model IV: Trade Credit Behavior of Large Firms During the Crisis

$$\begin{aligned}
 Trade\ credit_{it} = & \alpha_i + \beta_{FI,2009} year2009 * FI_{it} + \beta_{Size,2009} year2009 * Size_{it} \\
 & + \beta_{FI,2015} year2015 * FI_{it} + \beta_{Size,2015} year2015 * Size_{it} \\
 & + \beta_{FI,2016} year2016 * FI_{it} + \beta_{Size,2016} year2016 * Size_{it} + \beta_{X_1} X_{1it} + \epsilon_{it}.
 \end{aligned}$$

Model V: Trade Credit Behavior of SMEs During the Crisis

$$\begin{aligned} \text{Trade credit} = & \beta_{FI,2009,year2009} * FI + \beta_{Size,2009,year2009} * Size \\ & + \beta_{FI,2015,year2015} * FI + \beta_{Size,2015,year2015} * Size \\ & + \beta_{FI,2016,year2016} * FI + \beta_{Size,2016,year2016} * Size + \beta_{X_2} X_2 + \epsilon. \end{aligned}$$

The regression results of Models IV and V are presented in Table 7. The estimated AMEs of the trade credit determinants in years of no crisis are very similar to those of previous regressions in Section 4 except for bank loans for large firms. We then confine our attention to interpreting how the effects of financial indicators and firm size measures altered with the year 2009 global financial and the year 2014–5 economic crises along with the effect of bank loans in no crisis periods.

Accounting for the changing role of bank loans during crises, we discover that, in periods of no crisis, the trade credit and bank loans are substitutes for large firms until the ratio of bank loans to sales exceeds 0.77, which is the case for only 7.3% of observations, along with SMEs regardless of the size of bank loans. These findings are in line with the findings of Cuñat (2007), García-Teruel and Martínez-Solano (2010), and Hill et al. (2017) rather than Agostino and Trivieri (2014), Andrieu et al. (2018), and Giannetti et al. (2011).

The substitutional relationship between trade and bank credit observed in the periods of no crisis extends to the year 2009 global financial crisis for both large firms and SMEs, corroborating Carbó-Valverde et al. (2016), Hyun (2017), Lawrenz and Oberndorfer (2018), and Yang (2011), with an increased degree of substitutability for SMEs. This relationship weakened for large firms in the year 2015 such that the relationship switches to being complementary when bank loans exceed 29.4% of sales, the case for 44.4% observations with access to bank loans, as well as for SMEs in the year 2016 when bank loans amount to more than 64.1% of sales. Trade and bank credit are indeed estimated to be fully complements for large firms in the year 2016: As the secured amount of bank credit increases, trade credit is observed to increase by 9.2% of that amount on average, in line with the findings of Love and Zaidi (2010), Psillaki and Eleftheriou (2015), and Tsuruta (2015). One might wonder if the complementary relationship found for large firms following the year 2014–5 crisis might be caused by the firm size classification criterion imposed by the data collection agency, which is low. This line of thinking is not warranted, unlike in Canto-Cuevas et al. (2016), since we indirectly control for this possibility via the interaction terms between firm sizes and bank loans. As these estimates turn out to be statistically insignificant, we ran our regressions after excluding these terms from our model. Indeed, the relevant interaction term estimates are also economically insignificant and inclusion of them in the demand regression does not change any of our findings qualitatively.

This new piece of evidence from Kazakhstan on the non-uniform relationship between trade credit and bank loans during crisis might provide further insight into the mixed findings in the literature. Hyun (2021) similarly finds evidence for a non-uniform relationship during the year 1997 Korean financial crisis, but based on business group affiliations. In his case, the substitutional relationship between trade credit and bank loans held only for *chaebol*-affiliated firms. Because of data limitations, we cannot explore the role of group affiliations behind our findings.

Regarding other sources of external financing, short-term liabilities are estimated not to affect trade credit demand for SMEs during the year 2009 global financial crisis, contrary to the rest of the time period under study. The positive correlations observed between trade credit supply and external financing sources conform with Hyun (2017) and Love and Zaidi (2010).

The observed positive association between trade credit demand and liquidity, even stronger for large firms following the year 2014–5 economic crisis, is consistent with Tsuruta (2013) in the context of Japan during the Asian financial crisis. This finding reveals that suppliers might limit their credit to illiquid firms during crisis due to the risk of credit contagion. While liquid SMEs extended more trade credit in Kazakhstan following the year 2014–5 economic crisis, in line with Hyun (2017) and McGuinness et al. (2018), interestingly they offered less trade credit during the year 2009 global financial crisis as did the large firms during the year 2014–5 economic crisis.

The finding that labor-intensive firms recur to less trade credit remains intact with its magnitude estimated to be lower for large firms and higher for SMEs during the year 2009 global financial crisis. The estimates for the year dummies imply that, even after controlling for the levels of trade credit determinants, large firms increased their supply of trade credit to SMEs during the year 2014–5 economic crisis.

We next analyze the trade credit delinquency behavior of large Kazakhstani firms during crisis, paying special attention to the transmission of corporate payment failure along with the effects of the same set of financial indicators and firm size, see Model VI below. X_3 denotes the matrix of independent variables in Model III except for the interaction terms as they are estimated not to be highly significant and β_{X_3} denotes the vector of parameters for those variables.

Model VI: Trade Credit Delinquency Behavior of Large Firms During the Crisis

$$\begin{aligned} AP\ Overdue = & \beta_{AROverdue,2009,year2009} * AROverdue + \beta_{FI,2009,year2009} * FI \\ & + \beta_{Size,2009,year2009} * Size + \beta_{AROverdue,2015,year2015} * AROverdue \\ & + \beta_{FI,2015,year2015} * FI + \beta_{Size,2015,year2015} * Size \\ & + \beta_{AROverdue,2016,year2016} * AROverdue + \beta_{FI,2016,year2016} * FI \\ & + \beta_{Size,2016,year2016} * Size + \beta_{X_3} X_3 + \epsilon. \end{aligned}$$

Table 7
Regression results of Models IV and V.

VARIABLE	LARGE FIRMS		SMEs	
	AP FE Est.	AR FE Est.	AP Tobit Est.	AR Tobit Est.
AF1	-0.057* (0.031)	-0.052* (0.028)	-0.148*** (0.028)	-0.016 (0.016)
year2009*AF1	0.023 (0.046)		-0.165*** (0.054)	
year2015*AF1	0.036 (0.053)		0.012 (0.060)	
year2016*AF1	0.105* (0.060)		0.011 (0.052)	
AF2	0.074*** (0.027)	0.851*** (0.154)	0.010 (0.025)	0.513*** (0.072)
year2009*AF2	0.005 (0.054)	0.148** (0.072)	-0.013 (0.049)	
year2015*AF2	0.105* (0.064)	0.071 (0.046)	0.050 (0.060)	
year2016*AF2	0.018 (0.060)	0.106* (0.055)	0.203*** (0.068)	
ST Liabilities	-0.052* (0.031)	0.177*** (0.039)	0.093*** (0.024)	0.267*** (0.017)
year2009*ST Liabilities			-0.100*** (0.038)	
year2015*ST Liabilities			-0.017 (0.041)	
year2016*ST Liabilities			0.047 (0.041)	
LT Liabilities	0.069** (0.027)	0.090*** (0.028)	-0.002 (0.012)	0.094*** (0.014)
year2009*LT Liabilities				0.099*** (0.028)
year2015*LT Liabilities				0.003 (0.026)
year2016*LT Liabilities				-0.042* (0.022)
Liquidity	0.216*** (0.054)	0.048 (0.056)	0.230*** (0.018)	0.060*** (0.013)
year2009*Liquidity	-0.072 (0.077)	-0.088 (0.056)		-0.086*** (0.022)
year2015*Liquidity	0.097 (0.091)	-0.100** (0.050)		-0.003 (0.021)
year2016*Liquidity	0.324** (0.150)	0.022 (0.096)		0.042* (0.023)
SizeLA	0.005 (0.004)	-0.003 (0.003)	0.040*** (0.004)	0.009*** (0.002)
year2009*SizeLA	-0.008 (0.005)	-0.008* (0.004)	0.009 (0.009)	
year2015*SizeLA	-0.011* (0.007)	-0.007* (0.004)	-0.015** (0.008)	
year2016*SizeLA	-0.004 (0.008)	-0.010** (0.005)	-0.009 (0.007)	
SizeLC	-0.191*** (0.040)	-0.109*** (0.027)	-0.061*** (0.010)	0.011** (0.005)
year2009*SizeLC	0.032* (0.016)		-0.082*** (0.022)	
year2015*SizeLC	-0.006 (0.027)		-0.015 (0.023)	
year2016*SizeLC	-0.025 (0.031)		-0.017 (0.019)	
SizeCOL	0.015** (0.007)	0.003 (0.006)	0.111*** (0.004)	0.043*** (0.002)
year2009*SizeCOL			0.027*** (0.008)	
year2015*SizeCOL			0.011 (0.008)	
year2016*SizeCOL			-0.005 (0.006)	

(continued on next page)

Table 7 (continued).

VARIABLE	LARGE FIRMS		SMEs	
	AP	AR	AP	AR
	FE Est.	FE Est.	Tobit Est.	Tobit Est.
year2010	0.343* (0.175)	-0.016 (0.023)	-0.518*** (0.159)	0.039** (0.016)
year2011	0.359** (0.180)	-0.034 (0.025)	-0.583*** (0.160)	0.033* (0.019)
year2012	0.387** (0.182)	0.004 (0.025)	-0.574*** (0.161)	0.023 (0.019)
year2013	0.403*** (0.181)	0.027 (0.026)	-0.552*** (0.162)	0.038** (0.017)
year2014	0.488*** (0.183)	0.095*** (0.028)	-0.549*** (0.162)	0.026 (0.017)
year2015	0.606* (0.336)	0.145*** (0.042)	-0.418* (0.223)	0.115*** (0.018)
year2016	0.734* (0.379)	0.109** (0.049)	-0.388* (0.199)	0.070*** (0.017)
Constant	0.900 (0.721)	1.194*** (0.325)	-0.038 (0.153)	-0.811*** (0.051)
Other determinants	Controlled	Controlled	Controlled	Controlled
Location	Controlled	Controlled	Controlled	Controlled
Sector	Controlled	Controlled	Controlled	Controlled
# of Obs.	40,292	40,292	136,923	136,923

Robust clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Year 2009 is the reference category.

Table 8 provides the results of this regression. The estimated marginal effects for the transmission of the trade credit delinquency in years of no crisis are virtually the same compared to the findings in Section 3, with an unconditional AME of 0.060 and a conditional AME of 0.166. Most importantly, we find that the financial ability of large Kazakhstani firms to repay their debts on time was negatively influenced by the year 2014–5 economic crisis with marginal effects amplified by 60% when all the large firms and by 95% when only the large firms that are already delinquent on their payables are considered, in line with the findings of Altinoglu (2021), Costello (2020), and Reischer (2019) that delinquency of trade credit acts as a transmission channel of aggregate fluctuations since it imposes losses for firms in an arms' length relationship. Such an amplification was not observed during the year 2009 global financial crisis. The only other determinant with substantial and significant marginal effects is access to bank loans following the year 2014–5 economic crisis: Large firms with access to bank loans are estimated to be more delinquent on average by 0.9% of their sales in the year 2016, and the same statistic is estimated to be 3.1% for firms that are already delinquent.

As a robustness check, we conduct propensity score matching after splitting the dataset into no-crisis (years 2010–14) and crisis (years 2009, 2015–16) periods. To that end, we employ one-to-one nearest-neighbor matching without replacement imposing the common support condition. Differently from our results, trade credit and bank loans are estimated to be complements regardless of the size of bank loans also in the year 2015, instead of only for firms with access to bank loans amounting to more than 29.4% of their sales, and there is no statistical evidence for the puzzling negative association between profitability and trade credit supply. Both these departures indeed strengthen our results. The rest of the matched sample estimates corroborate all our findings qualitatively, providing a robustness check.

6. Conclusion

Trade credit plays an ample role in the operations of Kazakhstani firms: Around 90% of large enterprises and 70% of SMEs resort to trade credit, whereas bank loans, the other major source of external financing, are accessed by only around 30% of large firms and 10% of SMEs. The enormous role of trade credit in relation to bank loans, an anomaly observed in the financial system, might be partly attributed to the limited loan availability caused by the shortcomings in the banking sector. The shortcomings include high level of non-performing loans along with high real interest rates on loans for businesses.

Trade and bank credit in Kazakhstan are estimated to be mainly substitutes for both large firms and SMEs except that they were complements for large firms during the year 2014–5 economic crisis. This new piece of evidence on the non-uniform relationship between trade and bank credit during crisis might provide further insight into the mixed findings in the literature. Another contribution of our study is to utilize the cost of labor in a year as a firm size measure, in addition to the size of assets, which allows us to discern that trade credit demand is more prevalent among capital-intensive firms. Our estimates also attest to the limited availability of trade credit to illiquid firms which was exacerbated for large firms during the year 2014–5 economic crisis, likely due to default risk with credit contagion.

Transmission of corporate payment failure is sizeable in Kazakhstan: Large firms, on average, pass along 6.2% of delinquent receivable to trade credit suppliers through delayed payments. This statistic imparts how trade credit delinquency may form a chain of financial problems in the economy. We additionally discover that the transmission of trade credit delinquency was amplified by

Table 8
Regression results of Model VI.

AP Overdue			
VARIABLE	Tobit Est.	VARIABLE	Tobit Est.
AR Overdue	1.258*** (0.274)	SizeLA	0.020*** (0.008)
year2009*AR Overdue	0.139 (0.300)	SizeLC	-0.040 (0.036)
year2015*AR Overdue	1.393* (0.784)	year2009*SizeLC	-0.046 (0.040)
year2016*AR Overdue	-0.436 (0.554)	year2015*SizeLC	0.134*** (0.048)
AF1	-0.065 (0.074)	year2016*SizeLC	0.053 (0.053)
year2009*AF1	0.006 (0.100)	SizeCOL	0.042*** (0.013)
year2015*AF1	0.114 (0.131)	year2010	-0.663 (0.485)
year2016*AF1	0.317** (0.150)	year2011	-0.732 (0.487)
AF2	0.022 (0.021)	year2012	-0.822* (0.492)
ST Liabilities	0.083 (0.056)	year2013	-0.894* (0.494)
year2009*ST Liabilities	-0.015 (0.082)	year2014	-0.994** (0.497)
year2015*ST Liabilities	-0.199* (0.120)	year2015	-2.698*** (0.807)
year2016*ST Liabilities	-0.114* (0.066)	year2016	-1.834** (0.833)
LT Liabilities	0.014 (0.017)	Constant	-2.742*** (0.683)
year2009*LT Liabilities	-0.031 (0.034)	Other determinants	Controlled
year2015*LT Liabilities	-0.017 (0.033)	Location	Controlled
year2016*LT Liabilities	-0.092* (0.050)	Sector	Controlled
Liquidity	-0.159 (0.107)	# of Obs.	38,196
year2009*Liquidity	0.172 (0.111)		
year2015*Liquidity	-0.016 (0.215)		
year2016*Liquidity	0.217* (0.119)		

Robust clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Year 2009 is the reference category.

60% during the year 2014–5 economic crisis, which manifests the pressure the year 2014–5 economic crisis put on the finances of firms.

Our findings have important policy implications for the local economy. Most eminently, there is a need to reform the financial system to increase the availability of bank loans, especially to SMEs, to alleviate the financing problems firms experience. Second, rather than taking a one-size-fits-all approach, the policies aimed towards increasing access to finance should prioritize illiquid firms, consisting of mainly smaller and younger firms including entrepreneurial firms, as well as capital-intensive firms. Lastly, since the year 2014–5 economic crisis was more detrimental for financially constrained and/or illiquid large firms, policymakers should oversee the operations of such firms during crisis and introduce interventions in support of their finances if necessary.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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