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Trade credit financing, social trust, and financial distress: Evidence from Chinese listed companies

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ABSTRACT

This research investigates the relationship between trade credit financing and firms' financial distress using a sample of Chinese listed companies from 2000 to 2020. Our results reveal a significant U-shaped relationship between firms' trade credit financing and the likelihood of financial distress and that social trust moderates this curvilinear relationship. Our evidence suggests that firm liquidity and financial constraints are two underlying channels through which trade credit financing produces this U-shaped impact on firm bankruptcy risk. Our results are robust to alternative measures of key variables and tests for endogeneity (reverse causality and omitted variables).

1. Introduction

Past theoretical and empirical research has highlighted the key role of trade credit—the credit suppliers extend to their customers—as a financing resource (Cunat, 2007; Nilsen, 2002; Rui and Lai, 2015; Wang and Kong, 2019), while others have explored its determinants (Carbo-Valverde et al., 2016; Elliehausen and Wolken, 1993; Moro et al., 2021; Petersen and Rajan, 1997; Summers and Wilson, 2002). Recent studies focus on the consequences of trade credit financing and investigate its role in corporate operations by considering how it influences firm growth (Ferrando and Mulier, 2013) and performance (Martínez-Sola et al., 2014). Extant literature also explores trade credit's role in risk contagion along a supply chain (Jacobson and von Schedvin, 2015; Jorion and Zhang, 2009). Some studies suggest that credit-constrained firms may pass risk on to their supply chain, amplifying the risk of contagion (Costello, 2020; Gabaix, 2011). Surprisingly, the role trade credit financing plays in corporate bankruptcy risk has received far less attention (Boissay and Gropp, 2013; Burkart and Ellingsen, 2004; McGuinness et al., 2018; Petersen and Rajan, 1997). However, these studies have not reached a consensus in their findings; consequently, trade credit's relationship with bankruptcy remains in dispute.

Our analysis provides new insights by exploring how social trust impacts firms' decisions to provide trade credit (and thus, the customer's ability to utilise trade credit). We argue that trade credit helps firms cover their financial needs when they are credit constrained by banks. More importantly, we argue that the trade credit substitution role is more relevant in contexts where high social trust exists among the players.

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Using the data of Chinese A-share listed companies from 2000 to 2020, we find that the likelihood of financial distress is reduced for firms that use a moderate level of trade payables. When firms are highly reliant on payables, their bankruptcy risk grows. More interestingly, our results show a U-shaped relationship between trade credit financing and financial distress. This relationship is more pronounced among firms in provinces with lower social trust, suggesting that social trust is a factor that allows firms to use more trade credit without facing major increases in bankruptcy risk levels. As we cannot rule out the possibility of reverse causality between the probability of default and trade credit use, we retest our original model using lagged variables. The lagged variables also rule out possible spurious causality linked to omitted variables. The results of this re-estimation are consistent with the baseline findings. Moreover, tests indicate that firm liquidity and financial constraints are two underlying channels through which trade credit financing has a U-shaped impact on firm bankruptcy risk.

Our major contribution is in reconciling past conflicting results. Existing studies have examined the impact of trade credit on corporate financial distress (Bastos and Pindado, 2013; Garcia-Appendini and Montoriol-Garriga, 2020; Lamieri and Sangalli, 2019; McGuinness et al., 2018), but no consensus has been reached. Specifically, McGuinness et al. (2018) use a sample of European SMEs and find that the use of trade credit improves their survival during financial crisis, while the work of Lamieri and Sangalli (2019) based on a sample of Italian manufacturing firms suggests that more trade credit financing increases firms' distress likelihoods. From the perspective of a nonlinear relationship, this paper considers both the positive and negative effects of trade credit financing on bankruptcy risk. Our finding that trade credit can either benefit or damage firms depending on its level and the level of social trust in the firm's area allows us to explain past conflicting evidence. The implication of our results is the importance of careful trade credit management for firms, which should also consider the social fabric embedded in their area (i.e., the level of social trust).

The rest of this paper proceeds as follows. Section 2 summarises the literature review and proposes the study hypotheses. Section 3 describes the sample, data sources, variables, and model specification. Section 4 presents our main empirical results including a moderating effect, robustness checks, and channel analysis. Section 5 concludes the paper.

2. Literature review and hypotheses development

2.1. Trade credit financing and financial distress

Trade credit is widely researched because of its important role in many firms. Prior literature documents that two opposite effects may be present in the relationship between trade credit financing and firm risk.

On one hand, trade credit can act as a liquidity buffer. As use of trade credit financing increases, the supplier-customer relationship becomes closer. Given strong interdependence between customer and supplier, when customers face liquidity issues, suppliers may be willing to provide liquidity insurance by extending trade credit, thereby reducing firm bankruptcy risk. Thus, suppliers can dampen shocks by providing liquidity and support their customers by extending trade credit financing (Cunat, 2007). This suggests that trade credit may enhance firms' ability to deal with risk by reducing their likelihood of financial distress. Thus, McGuinness et al. (2018) find that trade credit has a positive impact on European SMEs' survival. This evidence is justified by the financing advantage theory of trade credit, which suggests that suppliers have informational and monitoring advantages *vis a vis* other fund providers (e.g., banks). Thus, suppliers may be willing to extend trade credit funds to their customers to ease their financing constraints because they are in a better position to assess customer creditworthiness than other funds providers like banks (Burkart and Ellingsen, 2004; Petersen and Rajan, 1997; Singh et al., 2024). This argument is also supported by Boissay and Gropp (2013), who find that firms in supply chains provide liquidity insurance for each other and alleviate credit constraints. As informal finance, trade credit can effectively supplement formal finance for firms with reduced access, especially small and medium-sized firms and those that are less transparent (Casey and O'Toole, 2014; Chen et al., 2017). Moreover, trade credit may act as a signal facilitating firms to access more bank credit since it signals trade creditors' confidence in the firms and indirectly reassures banks about borrowers' quality (Agostino and Trivieri, 2014; Biais and Gollier, 1997; Burkart and Ellingsen, 2004; Cook, 1999). Greater access to trade credit and facilitated access to bank finance - by facilitating access to financial resources - may help firms to survive during liquidity shocks and reduce their bankruptcy risk.

On the other hand, trade credit can lead to a contagion effect, increasing the likelihood of financial distress by amplifying financial shocks along a supply chain. This interconnectedness in trade credit relationships means that financial instability in one firm can quickly propagate to others, exacerbating overall economic vulnerabilities. Several studies highlight the systemic risks associated with trade credit networks, emphasising their role in magnifying financial distress across industries and economies (Costello, 2020; Gabaix, 2011; Jacobson and von Schedvin, 2015).

When credit-constrained firms experience liquidity shocks—whether due to declining revenues, restricted access to external financing, or macroeconomic downturns—they may struggle to meet their trade credit obligations (Belghitar et al., 2022). In turn, this heightens the risk that their suppliers, who rely on timely payments, will also face liquidity shortages. Consequently, a single liquidity shock can trigger a chain reaction of delayed payments, defaults, and potential insolvencies across multiple firms in a supply chain. This dynamic illustrates how trade credit interconnections can amplify firm-specific shocks, transforming localised financial distress into broader economic disruptions.

Empirical evidence supports this view. Lamieri and Sangalli (2019) find that trade credit is a key determinant of a firm's likelihood of financial distress, suggesting that overreliance on trade credit increases the potential for financial instability. Similarly, Bastos and Pindado (2013) show that firms with higher of days-of-sales outstanding—indicating a longer credit repayment cycle—tend to exhibit higher probability of insolvency. This suggests that firms that are financially strained are more likely to rely on trade credit, thereby perpetuating fragility within the supply chain.

Furthermore, the macroeconomic relevance of trade credit contagion cannot be overlooked. During economic downturns, liquidity

tightening across multiple firms caused by payment delays can contribute to a broader credit crunch, reducing business investment and slowing economic growth (Samatas et al., 2019). This underscores the dual role of trade credit: while it can serve as a vital liquidity source, it also introduces systemic risk that can exacerbate financial distress when firms are already vulnerable.

We argue that both positions have solid support and that they act jointly. While the liquidity buffer effect is monotonically decreasing with diminishing margins, firms' risk of contagion simultaneously rises monotonically. Taken together, the two opposing forces may lead to a U-shaped relationship between trade credit financing and bankruptcy risk. Fig. 1 plots the combined effect.

When firms use a low level of trade payables from upstream suppliers, a moderate increase in the use of trade payables (e.g., as a consequence of a financial shock) helps alleviate their financial constraints and improve their liquidity reserves, reducing the likelihood of distress. However, increasing use of trade debt and excessive dependence on trade payables may increase a firm's debt burden and solvency pressure, which may translate into bankruptcy risk if a financial shock occurs (Petersen and Rajan, 1997). As a short-term financing channel in the presence of a two-part contract that implies customers pay for its use (Cunat, 2007), trade credit typically involves higher financing costs *vis a vis* bank credit. Thus, excess dependence on payables generates higher financing costs, amplifies solvency issues, and adversely affects firm performance. The negative effect may be both economically and financially unbearable since firms may ultimately suffer a liquidity shortage, which increases firm bankruptcy risk. Overall, firms should carefully evaluate the benefits of trade credit, such as additional flexibility and positive signaling effects, against the disadvantage linked to a potential increase in liquidity issues. Thus, we suggest that the relationship between trade credit financing and firm bankruptcy risk may exist but is not monotonic. While low levels of trade credit use may reduce the risk of bankruptcy, higher levels of trade credit increase it. Hence, we propose the following hypothesis:

H1. *: The relationship between trade credit financing and the likelihood of bankruptcy is non-monotonic (U-shaped).*

2.2. The moderating role of social trust

Business relationships, particularly those between customers and suppliers, do not exist in a vacuum. They are the result of the contexts and current and past relationships among the actors involved. This implies that social trust, an informal institution, plays an important role in shaping these relationships. Trust is critical for funds providers, and such relationships are influenced by past and current trust dynamics (Harhoff and Körting, 1998; Howorth and Moro, 2006; Maxwell et al., 2011; Moro and Fink, 2013; Palazuelos et al., 2018; Tang et al., 2017; Wijaya et al., 2023). Trust may be split into personal and (impersonal) societal trust (Brockman et al., 2022). Societal trust refers to a set of beliefs about the behavior of a group of individuals, is rooted in deep-seated beliefs about others, and involves a person's cultural and religious backgrounds (Dudley and Zhang, 2016). Growing evidence reveals how social trust impacts specific economic outcomes both at the macro (Guiso et al., 2004, 2008; Zak and Knack, 2001) and micro levels (Bottazzi et al., 2016; Guiso et al., 2008; Pevzner et al., 2015). The literature documents the importance of trust in supply chain management and interfirm relationships (Hemmert et al., 2016).

Past research suggests that, from the supply side point of view, social trust has a positive effect. High levels of social trust reward compliant behavior and punish dishonesty; thus, social trust supports trade credit agreements in the absence of formal institutions and encourages firms to promote more active trade credit policies (Amoako et al., 2021; Hasan and Habib, 2019). Wu et al. (2014) find that firms in regions with higher levels of social trust obtain more trade credit financing from suppliers. Levine et al. (2018) show that social trust facilitates firms' access trade credit. This greater access alleviates the negative impact a decline in bank financing availability during banking crises has on firm profitability; thus, it indirectly helps reduce firm bankruptcy risk. Moreover, in regions with high social trust, managers are more likely to publicly disclose more detailed information about the firm and its performance (Jha et al., 2019; Nanda and Wysocki, 2013). Greater disclosure alleviates information asymmetry between firms and stakeholders and reduces

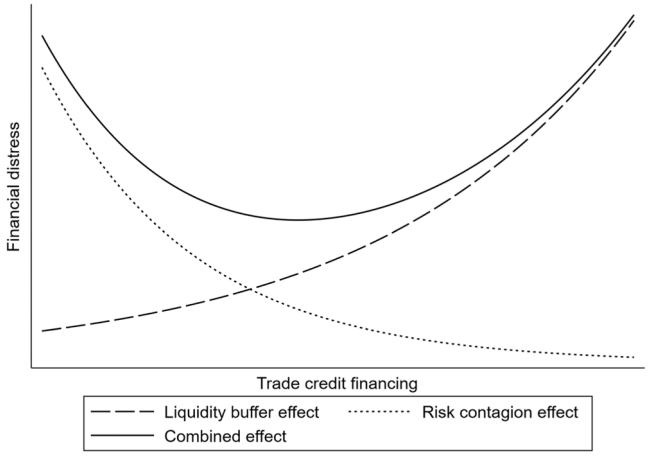

Fig. 1. Combined effect of trade credit financing and financial distress. This figure shows the liquidity buffer effect and risk contagion effect shape the U-shaped relationship between trade credit financing and financial distress to a U-shaped.

uncertainty in transactions (Coleman, 1994), which in turn can facilitate discrimination between low- and high-risk firms. Greater disclosure allows a firm to extend trade credit to those that deserve it. Finally, social trust promotes mutual trust and cooperation among employees, firms, and business partners (Cao et al., 2016), simplifying business relationships (e.g., lower transaction costs) and reinforcing the social fabric. Based on these arguments, firms operating in regions with high social trust are in a better position to select their business partners and establish long-term, constructive, cooperative, and non-antagonistic relationships. Such long-term relationships may facilitate financial collaboration among firms and reduce the negative effect of trade credit use. On one hand, firms may be in a better position when they have to make decisions about whether to extend credit. On the other hand, firms can have greater confidence in support from their suppliers in case of need. This may mitigate any transmission of shock throughout the supply chain, particularly if one of the supply chain members is strong enough to at least partially absorb the shock. Thus, we expect the non-monotonic U-shaped impact of trade credit on firm bankruptcy risk to be less pronounced for firms in regions with high social trust. Therefore, we propose our second hypothesis.

H2. *: The non-monotonic (U -shaped) relationship between trade credit financing and the likelihood of bankruptcy is lower for firms in regions with higher social trust.*

Fig. 2 depicts the study's conceptual model.

3. Methodology and data

3.1. Sample and data

We rely on A-share listed companies in the Shanghai and Shenzhen stock markets of China during the period of 2000–2020 as our research sample since data before 2000 is not available. We exclude firms in the financial sector (since they do not use trade credit), observations with negative assets, and missing values for key variables. Our final sample consists of 37,276 firm-year observations from 3233 firms. The financial and firm characteristics data are sourced from the China Stock Market and Accounting Research database (CSMAR). Regional social trust information for 2003–2018 is obtained from the Chinese General Social Survey (CGSS), which is the first comprehensive, continuous, and cross-sectional survey project in China. Macroeconomic data are retrieved from the National Bureau of Statistics.

3.2. Variables

Drawing on extant studies (McGuinness et al., 2018; Tykvová and Borell, 2012), we measure firm bankruptcy risk using Altman (2002) revised Z score. Since a higher Z score indicates lower bankruptcy risk, we transform it into a positive index for bankruptcy risk by multiplying it by −1. Specifically, the Z score is calculated using Eq. (1):

$$Zscore = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.42X_4 + 0.998X_5 \quad (1)$$

where X_1 is the ratio of working capital to total assets, X_2 is retained earnings scaled by total assets, and X_3 is the ratio of earnings before interest and taxes to total assets. X_4 is the book value of equity to total liabilities, and X_5 is the ratio of sales to total assets. The Z score is an overall score.

Trade credit financing is deferred payment for goods transactions among firms. It may be in the form of deferred payment (payables) to upstream suppliers or prepayments from downstream customers. Following prior studies (Fisman and Love, 2003; Kestens et al., 2012; Kong et al., 2020), we measure trade credit financing as the ratio of total payables (accounts payable, notes payable, and prepayments) to total liabilities.

In China, the level of social trust varies across provinces due to cultural diversity. Following relevant studies (Chen et al., 2021; Qin et al., 2022; Wu et al., 2014), we construct a social trust indicator based on the CGSS.[1] The main item related to social trust in these surveys is "Generally, do you agree that most people in this society can be trusted?" with responses using a five-point Likert-type scale. Higher values denote a higher degree of identification with social trustworthiness. The province-level average score of these respondents' choices is used to measure social trust (*Trust*).

Following relevant studies (Bhattacharjee and Han, 2014; Jacobson and von Schedvin, 2015; Lian, 2017; McGuinness et al., 2018; Zhang, 2015), we control for variables that may affect firm bankruptcy risk, including firm size and age, cash holdings, market competition (measured with the Lerner index) (Elzinga and Mills, 2011), leverage, the book-to-market ratio, and trade credit supply in terms of trade receivables. Following McGuinness et al. (2018), we also introduce the quadratic form of firm age into the regression. Specifically, firms of different ages are likely to be in different life cycle stages. We control for the effect of business cycles, considering that firm bankruptcy risk is highly related to macroeconomic development (Bhattacharjee and Han, 2014). Drawing on relevant

[1] The CGSS is conducted by the Survey Research Center at the Hong Kong University of Science and Technology and the Department of Sociology at Renmin University of China. It aims to systematically monitor the evolving interplay between social structures and quality of life across urban and rural China. The CGSS gathers quantitative data on various factors, including social structure, community, family, and individual behaviors. The CGSS started in 2003, and data were gathered for a total of nine years, including 2005, 2010–2013, 2015, 2017 and 2018. Since our sample period ranges from 2000 to 2020, the time span of the CGSS does not fully cover it. Therefore, we use province-level average values from 2003 to 2018 to measure regional social trust.

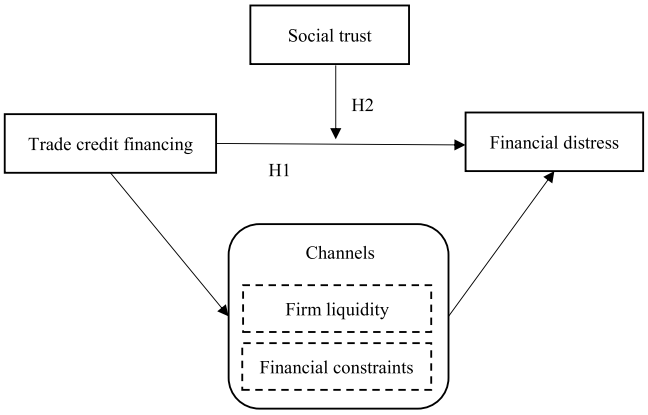

Fig. 2. Conceptual model. This figure depicts the study's conceptual model.

studies (Bhattacharjee et al., 2009; Lin and Zhang, 2020), we conduct Hodrick-Prescott filtering on the annual GDP growth rate and extract the periodic element as the business cycle indicator. All variables are described in Table 1.

3.3. Model specification

To investigate the relationship between trade credit financing and firm bankruptcy risk, we estimate the quadratic regression model shown in Eq. (2):

$$Risk_{i,t} = \beta_0 + \beta_1 TC_{i,t-1} + \beta_2 TC_{i,t-1}^2 + \beta_3 X_{i,t-1} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (2)$$

where i and t specify the firm and year, respectively. As previously noted, $Risk_{i,t}$ is a Z score calculated following Altman (2002) and multiplied by −1. $TC_{i,t-1}$ is a trade credit financing indicator, measured as the ratio of total trade payables to total liabilities. $X_{i,t-1}$ is the vector of control variables. $\sum Industry$ and $\sum Year$ are dummies for industry and year to control for industry and year fixed effects. To eliminate the interference of outliers, all continuous variables are winsorized at the 1 % and 99 % levels. β_1 captures the linear effect and β_2 captures the non-linear (quadratic) effect of trade credit financing on the dependent variable (bankruptcy risk). A significantly negative β_2 indicates an inverted U-shaped relationship, and a significantly positive β_2 indicates a U-shaped relationship (Haans et al., 2016). However, Lind and Mehlum (2010) propose that U-shaped relationships cannot be judged solely based on the significance of the quadratic term. They draw on the general framework developed by Sasabuschi (1980) to test the existence of U-shaped and inverted U-shaped relationships between two variables. Therefore, we use the *utest* command in the text to further verify the U-shaped relationship. One-year lagged trade credit and control variables are incorporated to deal with potential reverse causality.

To investigate the effect of social trust on the relationship between trade credit financing and firm bankruptcy risk (H2), we add the interaction terms of $Trust_j$ and $TC_{i,t-1}$ and $TC_{i,t-1}^2$ to Model (2), as shown in Eq. (3):

$$Risk_{i,t} = \varphi_0 + \varphi_1 TC_{i,t-1} + \varphi_2 TC_{i,t-1}^2 + \varphi_3 Trust_j + \varphi_4 Trust_j \times TC_{i,t-1} + \varphi_5 Trust_j \times TC_{i,t-1}^2 + \varphi_6 X_{i,t-1} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (3)$$

where $Trust_j$ represents the average annual social trust in province j based on data from CGSS. We mean-center the interaction terms ($Trust_j \times TC_{i,t-1}$ and $Trust_j \times TC_{i,t-1}^2$) to minimise multicollinearity (Aiken et al., 1991). According to Haans et al. (2016), if φ_5 is significantly negative, we can infer that social trust alleviates the non-monotonic effect of trade credit financing on firm bankruptcy risk.

3.4. Summary statistics and correlations

Table 2 reports the summary statistics of all variables. The mean and median values of bankruptcy risk (*Risk*) are −2.071 and −1.729, respectively, which implies relatively low bankruptcy risk among our sample firms. However, the mean value is slightly lower than the median, indicating a mildly left-skewed distribution. The mean and median values of trade credit financing (*TC*) are 0.385 and 0.351, indicating the important role of trade credit financing for Chinese listed companies that need short-term financing.

Table 3 presents the Pearson correlation matrix, which shows low correlations among the variables, suggesting that multicollinearity is not a concern. The correlations give us our first indication about possible multicollinearity issues. In particular, the correlation between trade credit financing and bankruptcy risk is −0.308 (significant at the 1 % level). This indicates a negative association between the use of trade credit financing and bankruptcy risk. Additionally, firm size and age, financial leverage, the book-to-market ratio, trade receivables, and business cycle are positively associated with bankruptcy risk, showing that firms larger in size, more mature, with higher leverage, higher book-to-market ratios, more trade receivables, or in an economic boom have higher

Table 1
Variable descriptions.

Variables	Description
Risk	Z score calculated based on Altman and Sabato (2007) multiplied by −1.
TC	Total payables/ total liabilities
Size	Natural logarithm of total assets
Age	Natural logarithm of firm age
Cash	Cash and cash equivalent/total assets
Lerner	(Sales - sales cost – expenses)/total sales
Leverage	Total liabilities/total assets
BM	Book value of assets/market value
PTC	Total receivables/total assets
Cycle	Business cycle component extracted via HP filtering

Table 2
Summary statistics.

Variables	N	Mean	SD	Min	Median	Max
Risk	37,276	−2.071	1.480	−8.898	−1.729	0.270
TC	37,276	0.385	0.228	0.020	0.351	0.915
Size	37,276	21.955	1.277	19.712	21.763	26.018
Age	37,276	2.607	0.518	0.693	2.708	3.434
Cash	37,276	0.168	0.132	0.011	0.130	0.652
Lerner	37,276	0.121	0.133	−0.354	0.105	0.543
Leverage	37,276	0.433	0.200	0.053	0.432	0.870
BM	37,276	0.647	0.238	0.134	0.655	1.137
PTC	37,276	0.170	0.119	0.003	0.151	0.534
Cycle	37,276	0.078	0.021	0.043	0.079	0.106

This table reports the descriptive statistics of variables. All variables are defined in Table 1.

bankruptcy risk. Cash holdings and the Lerner index are negatively related to bankruptcy risk, indicating that bankruptcy risk is lower for firms with higher cash holdings or higher market positions. The variance inflation factor (VIF) is used to check for multicollinearity; the results show that VIF= 1.48, indicating that multicollinearity is not a concern in our analysis (Shrestha, 2020).

4. Empirical results

4.1. Baseline results

To investigate the relationship between trade credit financing and bankruptcy risk, we first regress bankruptcy risk on trade credit financing. Our results are reported in Table 4. The results without fixed effects are reported in Column (1). Year fixed effects are controlled in Column (2), and industry and year fixed effects are controlled in Column (3). In the results, the coefficient of trade credit financing is negative (significant at the 1 % level), and the coefficient of its quadratic term is positive (also significant at the 1 % level). These results imply that a non-monotonic U-shaped relationship exists between the amount of trade credit financing and firms' likelihood of facing financial distress. The results are confirmed in Columns (3), where we re-estimate the original model including both year and industry fixed effects. Utest is used to validate the presence of the U-shaped relationship and is applied using the *utest* command in STATA 17 (Lind and Mehlum, 2010). The null hypothesis is that a monotone or inverse U-shaped relationship exists between the variables, and the p-value is reported.

The results suggest that trade credit financing decreases bankruptcy risk for firms with relatively low levels of trade credit, in line with the findings of McGuinness et al. (2018). Trade payables can offset a shortage of other short-term funds like bank credit (Bastos and Pindado, 2013), help relieve financial constraints, diversify the sources of finance, and improve firm growth. Additionally, the signaling effect of trade credit financing facilitates firms' access to external financing with better conditions. However, as trade credit financing increases beyond a certain threshold, it begins to have a detrimental impact on corporate bankruptcy risk. This may be marginally linked to higher costs, but only in the case of a two-part contract such as that proposed by Cunat (2007). More likely, excessive use of payables may exacerbate a firm's financial burden when it leads to debt repayment pressure, which is a signal that the firm is unable to access alternative sources of finance. When firms become too reliant on trade credit and miss the opportunity to diversify funds sources or become delinquent on their payments, they risk having the provision of raw material/services cut off (Boissay and Gropp, 2013; Cunat, 2007). Moreover, trade credit is a very short-term form of financing (typically 60–90 days). Excess reliance on it implies firms will face higher financial risk if, for some reason, suppliers decide to tighten their payment conditions. In other words, excessive use of trade credit makes firms overly reliant on suppliers, which may allow suppliers to exploit their strong position by overcharging for their materials/services, or expose the firm to any financial/economic shocks that affect the suppliers. The results demonstrate that using trade credit can negatively impact a firm's financial health, which echoes the findings of Lamieri and Sangalli (2019). Therefore, H1 is supported.

Table 3
Correlation matrix.

	1 Risk	2 TC	3 Size	4 Age	5 Cash	6 Lerner	7 Leverage	8 BM	9 PTC	10 Cycle
1 Risk	1									
2 TC	−0.308***	1								
3 Size	0.272***	−0.128***	1							
4 Age	0.070***	−0.002	0.281***	1						
5 Cash	−0.482***	0.274***	−0.242***	−0.176***	1					
6 Lerner	−0.235***	−0.071***	0.119***	−0.004	0.158***	1				
7 Leverage	0.731***	−0.215***	0.434***	0.106***	−0.423***	−0.244***	1			
8 BM	0.271***	−0.109***	0.440***	−0.049***	−0.194***	−0.076***	0.360***	1		
9 PTC	0.012**	0.294***	−0.179***	−0.099***	−0.084***	−0.176***	0.067***	−0.072***	1	
10 Cycle	0.031***	−0.059***	−0.273***	−0.560***	0.095***	−0.112***	0.090***	0.089***	0.015***	1

This table reports the correlations among variables. All variables are defined in Table 1. ***, **, and * indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

Table 4
Trade credit financing and financial distress: OLS regressions.

	(1)	(2)	(3)	(4)
Variables	Risk	Risk	Risk	Risk
L.TC	−1.858***	−1.747***	−1.343***	−1.669***
	(0.101)	(0.101)	(0.109)	(0.159)
L.TC^2	1.323***	1.267***	0.966***	1.259***
	(0.109)	(0.109)	(0.114)	(0.179)
L.Trust				−0.096***
				(0.036)
L.TC × Trust				0.590***
				(0.196)
L. TC^2 × Trust				−0.530**
				(0.220)
L.Size	−0.091***	−0.089***	−0.095***	−0.095***
	(0.005)	(0.006)	(0.006)	(0.006)
L.Age	−0.340***	−0.102	−0.101	−0.105
	(0.069)	(0.075)	(0.075)	(0.075)
L.Age^2	0.036**	−0.000	0.005	0.006
	(0.015)	(0.016)	(0.016)	(0.016)
L.Cash	−1.965***	−1.901***	−1.863***	−1.857***
	(0.072)	(0.071)	(0.071)	(0.071)
L.Lerner	−0.482***	−0.434***	−0.744***	−0.749***
	(0.062)	(0.063)	(0.069)	(0.069)
L.Leverage	4.013***	3.995***	4.089***	4.091***
	(0.047)	(0.047)	(0.050)	(0.050)
L.BM	0.304***	0.387***	0.376***	0.372***
	(0.030)	(0.037)	(0.038)	(0.038)
L.PTC	−0.177***	−0.202***	−0.229***	−0.229***
	(0.055)	(0.055)	(0.057)	(0.057)
L.Cycle	−5.591***	1.923*	3.704***	3.689***
	(0.381)	(0.997)	(1.007)	(1.007)
Constant	0.036	−0.865***	−0.809***	−0.684***
	(0.141)	(0.182)	(0.186)	(0.189)
Observations	33,010	33,010	33,010	33,010
R-squared	0.473	0.476	0.494	0.494
Year FE	No	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes
Utest (p-value)	0.000	0.000	0.000	0.000
Extreme point	0.702	0.689	0.695	0.663

This table reports the regression results examining the impact of trade credit on firm bankruptcy risk. All variables are defined in Table 1. Values in parentheses are robust standard errors. ***, **, and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively.

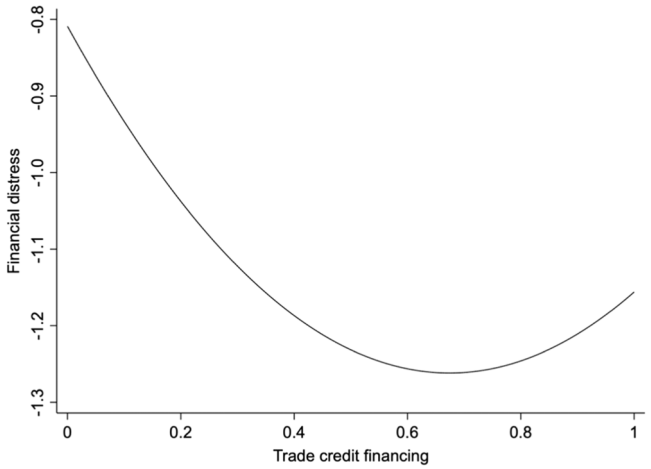

Fig. 3. The U-shaped relationship between trade credit financing and financial distress. This figure plots the relationship between trade credit financing and financial distress based on the results in Column (3) of Table 4. The black line plots the relationship between trade credit financing and financial distress.

Based on the results in Column (3), which includes both year and industry fixed effects, we estimate a turning point of 0.695, which is within our trade credit financing range (0.020–0.915), as shown in Fig. 3. We also estimate standard errors and plot the conditional marginal effects of trade credit financing and their significance levels (Fig. 4) to investigate changes in the marginal effect. Fig. 4 shows that the marginal effect of trade credit financing is characterised by a shift from negative to positive. Specifically, when *TC* is less than 0.7 (close to the turning point of 0.695), an increase in *TC* has a negative marginal effect on *Risk*. When *TC* exceeds 0.7, the marginal effect of *TC* on *Risk* becomes positive. This implies that as trade credit financing increases and surpasses the threshold (0.695), firms may face greater financial pressure, thereby exacerbating their financial distress. Taken together, this indicates that the U-shaped relationship is robust.

4.2. Moderating effect

We next investigate whether the optimal level of trade credit depends on the level of social trust. To pursue this analysis, we introduce two interaction term: $TC \times Trust$ and $TC^2 \times Trust$. The results are presented in Column (4) of Table 4. The coefficients of *TC* and TC^2 are −1.669 and 1.259, respectively, and significant at 1 % level, indicating that the non-monotonic U-shaped relationship between trade credit and bankruptcy risk holds. The coefficient of $TC^2 \times Trust$ is −0.530 and significant at 1 % level, indicating that the U-shaped relationship flattens as social trust increases. Thus, the moderating role of social trust on the non-monotonic U-shaped relationship between trade credit financing and bankruptcy risk is alleviated. Based on Haans et al. (2016) arguments, the turning point increases and the curve moves to the right as social trust increases ($-1.669 \times (-0.530) - 1.259 \times 0.590 = 0.142 > 0$). Therefore, H2 is supported.

Fig. 5 plots the impact of trade credit financing on firm bankruptcy risk under low and high (below and above the median, respectively) levels of social trust. The non-monotonic U-shaped curve becomes flatter in regions with higher social trust. This suggests that the relationship between trade credit financing and financial distress is more (less) pronounced among firms in provinces with lower (higher) social trust. We suggest that firms in regions with high social trust are more likely to obtain trade credit financing from suppliers (Levine et al., 2018) and that the alleviating effect of trade payables on financing constraints is more pronounced, which helps reduce their bankruptcy risk.

4.3. Channel test

Our results provide a clear indication of the non-monotonic U-shaped relationship between the intensity of using trade credit and bankruptcy risk. In this section, we propose two potential channels through which trade credit financing has a non-monotonic U-shaped impact on bankruptcy risk: firm liquidity and financial constraints. We follow Sui et al. (2016) to examine these two channels by first examining the impact of trade credit financing on the mediating variables, and then exploring the mediating role of firm liquidity and financial constraints on the non-monotonic U-shaped relationship between trade credit financing and firm bankruptcy risk.

4.3.1. Liquidity channel

Suppliers may act as liquidity providers, insuring against liquidity shocks that could endanger the survival of their customer relationships (Cunat, 2007). In contrast to banks, suppliers are more willing to extend credit by renegotiating the payment terms of the outstanding credit or granting additional credit in the future (Huyghebaert et al., 2007). Suppliers are often in a better position than

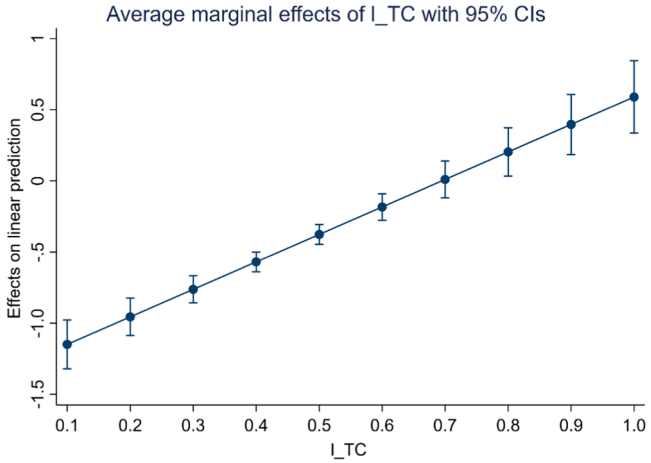

Fig. 4. The marginal effect of trade credit financing. This figure plots the conditional marginal effect of trade credit financing with significance levels to investigate how the marginal effect changes. The marginal effect of trade credit financing is characterized by a negative to positive shift, which indicates the U-shaped relationship is robust.

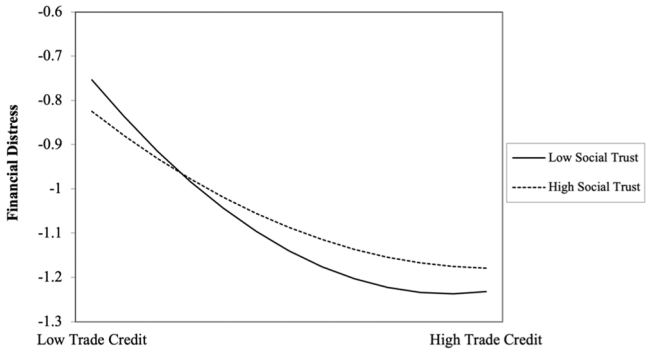

Fig. 5. Moderating effect of social trust. This figure plots how the relationship between trade credit financing and financial distress differs depending on the level of social trust based on the results in Column (4) of Table 4. The dashed line plots the effect of high social trust and the solid line plots the effect of low social trust.

banks to assess a customer's creditworthiness. Thus, they are an important source of reserve liquidity for firms, allowing firms to manage liquidity shortages by increasing the amount of credit drawn from suppliers in the case of liquidity shortfalls (Amberg et al., 2021). Therefore, we suggest firm liquidity as a channel through which trade credit financing affects bankruptcy risk.

To test the role played by this channel, we follow prior literature (Duchin et al., 2010; Gonçalves et al., 2018) and use the ratio of operating income before depreciation to total assets as a proxy for firm liquidity. We then regress firm liquidity on trade payables, the results are reported in Columns (1)–(2) of Table 5.

The results show that the coefficients of *TC* and TC^2 in Column (1) of Table 5 are positive and negative, respectively (both significant at the 1 % level), supporting previous evidence suggesting that a moderate amount of trade payables helps a firm maintain a sound level of liquidity. This lies in that as firms use more trade credit funds, their short-term funding shortages are satisfied and liquidity improves. However, when trade credit financing exceeds a certain threshold, excessive reliance on it can increase the firm's financial burden and reduce its liquidity. The results in Column (2) indicate that the non-monotonic U-shaped association between *TC* and bankruptcy risk still holds. The coefficient of firm liquidity is −2.930 (significant at the 1 % level), indicating that firm liquidity is negatively associated with firm bankruptcy risk. Taken together, this implies that trade credit affects the likelihood of financial distress via firm liquidity.

4.3.2. Financial constraints channel

Trade credit can be an efficient substitution for bank credit (e.g., Lin and Chou, 2015; Nilsen, 2002) because it facilitates firm access to external funds and thus relieves financial constraints (e.g., Wang and Kong, 2019). This is especially true in a bank-dependent economy, such as China, where most listed firms face financial constraints (Shi et al., 2020). Firms can decide to diversify the financial resources they use by expanding their use of trade credit. This can reduce the risk of being too dependent on bank credit, a situation that can increase firm bankruptcy risk. Banks can decide unilaterally to shut down the credit provided to a firm and are less flexible in extending repayment terms when a customer faces difficulty repaying a loan. Thus, we argue that a financial constraints channel exists through which trade credit financing affects bankruptcy risk. To capture the financial constraints of Chinese listed companies, we follow Gu et al. (2020) to measure it by calculating FC index.[2] We then regress financial constraints (*FC*) on trade payables and report the results in Columns (3)–(4) of Table 5.

The results in Column (3) in Table 5 suggest an association between trade credit financing and financial constraints: firms face fewer financial constraints when they receive more trade credit financing from suppliers but face more financial constraints after trade payables exceed an optimal value. The results in Column (4) show that the non-monotonic U-shaped association between *TC* and bankruptcy risk still holds. The coefficient of financial constraints (*FC*) is 0.218 (significant at the 1 % level), indicating that firms facing greater financial constraints have greater exposure to bankruptcy risk. As such, our results indicate that trade credit financing affects firms' distress likelihoods via financial constraints channel.

4.4. Robustness checks

We check our results by implementing a set of robustness tests. First, we replace the bankruptcy risk measure with the original Z score (*Risk_new*) proposed by Altman (1968), which is widely used in related studies (Chatterjee et al., 2023; Jacobson and von Schedvin, 2015; Lian, 2017).The regression results are reported in Column (1) of Table 6 and are qualitatively similar to the baseline results.

In addition to the Z-score, other indicators, such as the O-score (Ohlson, 1980) and ZM-score (Zmijewski, 1984), are sometimes used to measure corporate financial distress. Therefore, we use the O-score to measure a firm's financial distress, where a higher

[2] See more details in Appendix A.

Table 5
Channel tests.

	Firm liquidity		Financial constraints	
Variables	Liquidity	Risk	FC	Risk
	(1)	(2)	(3)	(4)
L.TC	0.082***	−1.090***	−0.046***	−1.344***
	(0.006)	(0.109)	(0.014)	(0.109)
$L.TC^2$	−0.058***	0.780***	0.060***	0.969***
	(0.006)	(0.114)	(0.014)	(0.114)
L.Liquidity		−2.930***		
		(0.144)		
L.FC				0.218***
				(0.034)
Constant	−0.193***	−1.561***	4.644***	−1.571***
	(0.011)	(0.187)	(0.030)	(0.230)
Observations	33,010	33,010	33,010	33,010
R-squared	0.274	0.503	0.739	0.495
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Utest (p-value)	0.000	0.001	0.001	0.000
Extreme point	0.710	0.699	0.388	0.693

This table reports the regression results of the mediating role of firm liquidity and financial constraints. All variables are defined in Table 1. Values in parentheses are robust standard errors. ***, **, and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively.

Table 6
Robustness checks and GMM regressions.

	(1)	(2)	(3)	(4)	(5)
Variables	Risk_new	Oscore	Risk	Risk	Risk
L.TC	−1.505***	−0.828***		−1.369***	−1.865***
	(0.399)	(0.145)		(0.109)	(−2.813)
$L.TC^2$	1.979***	0.709***		0.991***	1.748***
	(0.411)	(0.146)		(0.115)	(2.971)
L.TC_new			−0.232***		
			(0.023)		
$L.TC\_new^2$			0.183***		
			(0.022)		
L.Risk					0.604***
					(7.552)
Constant	−6.914***	−0.538**	−1.140***	−0.858***	−6.593
	(0.658)	(0.260)	(0.185)	(0.190)	(−1.002)
Observations	33,010	29,955	33,010	33,010	33,010
R-squared	0.473	0.632	0.491	0.498	0.122
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Province FE	No	No	No	Yes	No
Utest (p-value)	0.000	0.000	0.000	0.000	0.003
Extreme point	0.380	0.584	0.634	0.691	0.533
AR(1) (p-value)					0.000
AR(2) (p-value)					0.203
Hansen (p-value)					0.209

This table reports the regression results of robustness checks and system GMM regression for the impact of trade credit financing on firm bankruptcy risk. All variables are defined in Table 1. OLS regression is employed in Columns (1)–(4). In Column (5), a two-step system GMM regression is employed. Wald is the Wald test for the joint significance of all independent variables under the null that all parameters are not statistically different from zero. AR(2) is the Arellano-Bond test for second-order serial correlation under the null hypothesis that no serial second-order correlation exists. Hansen is the test for over-identification under the null that instruments are over-identified. Values in parentheses are robust standard errors. ***, **, and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively.

O-score indicates higher bankruptcy risk. As shown in Column (2), the coefficients of *TC* and TC^2 are significant, supporting the U-shaped relationship.

Second, we use alternative trade credit financing measures. Considering that trade credit is essentially a two-way form of credit, including funds obtained from upstream suppliers in terms of payables, and funds extended to downstream customers in terms of receivables, using net trade credit as the measure can more accurately capture the actual use of trade credit funds by a firm. Specifically, we follow McGuinness et al. (2018) and use the ratio of accounts payable minus receivables to sales *(TC_new)* to proxy for trade credit financing. The regression results are reported in Column (3) of Table 6. Again, the results we obtain are qualitatively the

same as our baseline results.

Finally, we control for province fixed effects to mitigate the impact of potential regional characteristics on corporate bankruptcy risk. The regression results are reported in Column (4) of Table 6. The results remain robust.

In addition to these robustness tests, our model could suffer from omitted variables. For example, firm-level characteristics may affect the use of trade credit and influence bankruptcy risk. Moreover, our analysis may suffer from reverse causality. Firms with higher bankruptcy risk are likely to reduce their trade credit supply to increase their liquidity and use more trade credit financing from upstream suppliers if available. To alleviate these concerns, we conduct an additional robustness check. We estimate Model (1) using two-step system-GMM estimator regressions as proposed by Blundell and Bond (1998), a method widely used in literatures (Chen and Xie, 2022; Yang et al., 2021). We introduce lagged dependent and independent variables from t-1 to t-3 as instrumental variables. The results are reported in Column (5) of Table 6. The p-value of the Arellano-Bond AR (2) test is greater than 0.1, which fails to reject the null hypothesis that the disturbance term does not have second-order autocorrelation. The results of the Hansen test suggest that our instruments are valid.

Overall, the results are similar to those observed in Table 4 and provide a further indication that our analysis does not suffer from endogeneity.

5. Discussion and conclusion

We investigate the impact of trade credit financing on corporate bankruptcy risk using the data from a sample of Chinese listed companies and consider the moderating role of social trust on this relationship. China is an important context in which to test such effects, since trade credit financing is an important component of working capital financing for listed firms. Moreover, social capital is an essential non-institutional factor that plays a very important role in China. China's society is characterised by a highly collectivistic culture in which people tend to act in the interests of the group rather than their own; this culture has a strong influence on corporate funding.

We find that trade credit financing has a U-shaped impact on the bankruptcy risk of Chinese listed companies. Our results indicate that firm bankruptcy risk initially declines with an increase in the use of trade payables due to the improved liquidity buffer and alleviation of financial constraints. However, when firm trade payables increase beyond a certain level, bankruptcy risk will rise because a heavier debt burden becomes more salient. Our evidence indicates that moderate use of trade credit financing helps lower bankruptcy risk, while excessive use increases firm risk. More importantly, we find that social trust smooths the U-shaped relationship between trade credit financing and bankruptcy risk. Specifically, the bankruptcy risk of firms in regions with high social trust are less negatively affected by an increase in trade credit use. This highlights the vital role of social trust as an informal institution that helps firms access financial resources and implicitly reduces their bankruptcy risk. Past literature provides alternative justifications for social trust's positive role, arguing that firms in regions with high social trust commit fewer financing violations (Qiu et al., 2021). Moreover, they are more committed, so they enjoy lower corporate default (Ho et al., 2020) and crash risks (Li et al., 2017). Our evidence extends existing theory and empirical evidence by introducing the critical role-social trust plays in reducing firm bankruptcy risk in an emerging economy context (i.e., China), suggesting it smooths the U-shaped relationship.

We also investigate the potential channels through which the U-shaped relationship between trade credit financing and bankruptcy is created. Channel tests show that firm liquidity and financial constraints are the underlying channels that explain this curvilinear link. Specifically, when firms use low levels of trade payables, which increases trade credit funds, their financial constraints are alleviated and liquidity buffers are strengthened, consistent with financing advantage theory (Petersen and Rajan, 1997). However, when firms use an excessive amount of trade credit funds from suppliers, the implied financing costs (when two-part contracts are used) and debt burden start to negatively affect the firm's financial soundness. Particularly, increasing use of trade credit may signal that a firm is struggling financially (e.g., having issues with cash inflows), forcing it to renegotiate payments with suppliers to cover its increasing financial needs. Moreover, suppliers that are virtually forced into granting a firm extra time for repayment can decide to charge extra for the firm's future orders. Consequently, the firm may end up paying more for materials and services, which adversely affects both the firm's profitability and its future net cash flows. Overall, our evidence provides insights into the curvilinear relationship between trade credit financing and bankruptcy risk by reconciling mixed findings from prior research.

Our study makes multiple theoretical and empirical contributions. First, it contributes to the trade credit literature by empirically testing the non-linear relationship between trade credit financing and bankruptcy risk. Previous studies on trade credit financing have primarily focused on the consequences of trade credit and investigated the role of trade credit in firm operations, including firm growth (Ferrando and Mulier, 2013) and efficiency (Martínez-Sola et al., 2014). Nevertheless, little research has analysed the impact of trade credit use on firm bankruptcy risk, information that is vital for firm survival. Prior research largely focuses on the linear effect of trade credit financing on firm risk; however, the findings related to the liquidity insurance and risk contagion hypotheses have been inconsistent (Boissay and Gropp, 2013; Costello, 2020; Cunat, 2007; Jacobson and von Schedvin, 2015; McGuinness et al., 2018). Our study extends and reconciles past research by revealing a U-shaped relationship between trade credit financing and bankruptcy risk. Second, this study expands our understanding of the dynamics of trade credit by uncovering social trust's moderating effect on the relationship between trade credit financing and firm bankruptcy risk. While previous studies have examined social trust's impact on firm stock crash and default risk, limited analysis addresses its impact on firm bankruptcy risk. This research presents novel evidence that social trust is a significant contingent factor in the link between trade credit financing and bankruptcy risk since it smooths bankruptcy risk linked to greater use of trade credit. Our research echoes prior studies that suggest social trust may act as an important shield against firm risk. Third, this study adds to prior findings that provide theoretical explanations of the effect of trade credit financing on firm operations and risks, which have been primarily based on financing advantage theory (Petersen and Rajan, 1997)

and the liquidity insurance hypothesis (Cunat, 2007). However, these theoretical explanations have mainly been tested in studies investigating the linear relationship between trade credit financing and its consequences. Our study introduces two arguments to explain the curvilinear impact of trade credit financing on bankruptcy risk, providing valuable extensions to past literature.

The results of our research have important implications for firms, suppliers, and policymakers. For firms, the results indicate the vital importance of sustainable trade credit policies. The turbulence in the global economy increases environmental uncertainty for firm operations. Faced with increased competitive pressure and more severe credit rationing, firms may be tempted to increase the use of trade credit financing. However, they should be fully aware that moderate trade credit financing is helpful for improving liquidity and alleviating financing constraints, but overreliance may lead to increased bankruptcy risk. Therefore, enterprises must formulate sustainable trade credit policies and take full advantage of trade payables to promote sales and firm efficiency but must avoid overusing trade credit funds to reduce potential financial risks. Suppliers, as stakeholders in firms, may be motivated by risk-sharing to provide more trade credit funds to help firms increase liquidity, alleviate financing constraints, and reduce financial risks (Huyghebaert et al., 2007; Li et al., 2015). However, our results reveal a U-shaped relationship between trade credit financing and bankruptcy risk. This suggests that suppliers should pay attention to the risk of contagion in their supply chain caused by an excessive supply of trade credit. Specifically, when a debtor defaults on its trade credit or files bankruptcy, liquidity shocks will be transmitted to suppliers along the supply chain (Jorion and Zhang, 2009). In fact, bankruptcies of downstream firms may also narrow suppliers' sales channels and shrink demand for products, thus increasing suppliers' operational and financial risks (Jacobson and von Schedvin, 2015). Our evidence further suggests that policymakers must consider the role of informal institutions and cultivate an environment of social trust. Formal systems, like laws and regulations, are often unable to engage with informal systems. This implies that informal systems like social trust play a complementary role that is vital for establishing good public order and a successful business environment. Our results highlight social trust's significant role in smoothing the impact of trade credit financing on firm bankruptcy risk, supporting its role in promoting economic development. This evidence suggests that the public sector can potentially further enhance a culture of honesty and trust between individuals and organisations in society, which helps reduce transaction costs and alleviate the risk of firm bankruptcy.

Naturally, our study has limitations that provide opportunities for future research. First, only listed companies are analysed in this study due to data availability. However, most Chinese companies are not listed and are much smaller in size; moreover, they are more dependent on the use of trade credit financing and the role of social trust. Future research could expand this topic to unlisted companies. Second, our findings may be subject to the Chinese institutional environment, as its society is characterised by a highly collectivistic culture where people tend to act in the interests of the group rather than their own. The effects of the channels and moderators identified in this study may not be universal and may depend on the context in which they are applied. Our evidence suggests a need for further research that retests the U-shaped relationship in alternative institutional environments. Finally, our research examines the moderating effects of social trust on the relationship between trade credit financing and bankruptcy risk. However, other contingency factors could also influence this relationship. Thus, future research exploring other possible moderators is encouraged and may provide additional valuable insights.

CRediT authorship contribution statement

Jinyu Chen: Visualization, Supervision, Methodology. **Andrea Moro:** Resources, Investigation, Data curation. **Maura Sheehan:** Writing – review & editing, Validation. **Ying Tang:** Methodology, Funding acquisition, Conceptualization. **Biliang Wang:** Writing – original draft, Formal analysis.

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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Appendix A

FC index proposed by Gu et al. (2020) is calculated as follows:

First, the three variables of firm size, firm age, and cash dividend payout ratio are standardized annually. According to the mean values of the standardized variables, a dummy variable (*QUFC*) is generated. For firms with mean values below the 1/3 quantile which are classified as the high financing constraint group, *QUFC* is assigned a value of 1. For firms with mean values above the 1/3 quantile which are classified as the low financing constraint group, and *QUFC* is assigned a value of 0.

Second, we select firm size (*Size*), leverage (*Leverage*), the ratio of cash dividend (*CashDiv*), market-to-book value ratio (*MB*), net working capital (*NWC*), earnings before interest and taxes (*EBIT*), and total assets (*TA*) to perform a Logit regression on Model (A1) and fit the annual probability of financing constraints for firms.

Finally, FC index is calculated on the model fitting results, with its value ranging in the interval [0,1]. A larger FC value indicates

higher financing constraints.

$$FC = \quad P(QUFC = 1|Z_{it}) = \frac{e^{Z_{it}}}{1 + e^{Z_{it}}} \tag{A.1}$$

$$Z_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 Leverage_{it} + \beta_3 \left(\frac{CashDiv}{TA}\right)_{it} + \beta_4 MB_{it} + \beta_5 \left(\frac{NWC}{TA}\right)_{it} + \beta_6 \left(\frac{EBIT}{TA}\right)_{it} \tag{A.2}$$

Data availability

Data will be made available on request.

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