

The effect of stability and concentration of upstream and downstream relationships of focal firms on two-level trade credit

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ARTICLE INFO

Keywords:

Buyer–supplier relationship

Stability

Concentration

Two-level trade credit

ABSTRACT

The stability and concentration of the buyer–supplier relationships are crucial factors in the realm of supply chain finance. Previous studies have focused on the impact of a single characteristic of the buyer–supplier relationships on the trade credit of focal firms. In this study, we investigated 973 A-share listed firms in China from 2012 to 2021 and adopted ordinary least squares regression to analyze the effects of stability and concentration in both upstream and downstream relationships on two-level trade credit. Our findings indicate that supplier stability has a positive impact, while concentration negatively impacts focal firms' access to trade credit. Furthermore, customer stability and concentration positively affect the focal firms' provided trade credit. In addition, focal firms' market power mitigates the impact of supplier stability and concentration on focal firms receiving trade credit while amplifying the impact of customer concentration on focal firms providing trade credit. A higher supplier concentration is a disadvantage for focal firms, whereas customer stability is an advantage for focal firms to reduce the cost of trade credit. Our study offers comprehensive insights for promoting supply chain financial flows via supply chain relationship management.

1. Introduction

Trade credit, which allows customers to delay payment rather than at the time of sale, is universally recognized as an indispensable component of supply chain finance globally (Liu et al., 2016; Lee et al., 2018). As business relationship is two-sided, meaning that there are two-level of trade credits (Bi et al., 2021). To put it another way, a firm receives trade credit from its suppliers and extends it to customers. According to statistics, accounts payable have accounted for 20% of the world's GDP over the last 25 years and represent one-third of all outstanding corporate bonds and bank loans to non-financial firms (Al-Hadi and Al-Abri, 2022). Meanwhile, accounts receivable for non-financial firms totaled more than US \$2.8 trillion (Abdulla et al., 2020). Considering that trade credit is a relationship investment (Dass et al., 2015; Astvansh and Jindal, 2022), or even a strategic investment in a supply chain relationship (Wu et al., 2019). Thus, understanding how to manage relationships with Upstream and Downstream (UD) is vital for focal firms to broaden their financing channels and better manage financial flows collaboratively with supply chain partners.

The growing intricacy of the supply chain poses a challenge for focal firms to effectively handle their connections with UD. As the most critical feature of the buyer–supplier (BS) relationship, stability and concentration are widely believed to imply differential dependence and power of parties (Liu et al., 2022). Stability places more emphasis on the long-term nature of the connections among firms (Foerstl et al., 2015), while concentration typically represents the bargaining power of one party. To some extent, the party with lower bargaining power is likely to experience lower benefits and greater dependence on the others (Irvine et al., 2016). It is worth noting that the establishment of a long-term relationship between focal firms with UD does not necessarily indicate the existence of a large number of transactions between them, and the distinct yet interconnected dimensions attract extensive attention in the supply chain management field.

Most of the existing literature has confirmed that a stability or concentration of BS relationship can facilitate effective coordination, sharing of information, pursuit of mutually beneficial objectives, and advancement of the firm's financial and non-financial performance

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<https://doi.org/10.1016/j.ijpe.2024.109173>

Received 12 March 2023; Received in revised form 25 January 2024; Accepted 1 February 2024

Available online 5 February 2024

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(Jääskeläinen, 2021; Zhu et al., 2021; Gu et al., 2022). Despite the critical role of stability and concentration in the BS relationship, limited research has explored how these factors influence a focal firm's two-level trade credit. Thus, when aiming for focal firms' two-level trade credit, should stable and concentrated UD relationships be better?

To figure out the question, we explore the focal firms' two-level trade credit from the perspective of characteristics of the UD relationship, which include stability and concentration. First, we delve into the upstream relationship as the subject of our initial research question: what impact do supplier stability and concentration have on trade credit received by focal firms? Is there a difference in the extent of this impact? Second, we address the research issue by focusing on the downstream: how do customer stability and concentration affect trade credit provided by focal firms? Is there a difference in the extent of this impact? Then, it is crucial to acknowledge that the trade credit of a focal firm is shaped not only by the characteristics of UD relationships but also by its market power within the industry. Consequently, our third research query delves into elucidating the significance of focal firms' market power in shaping the influence of stability and concentration of UD relationships on two-level trade credit. Last, Given that trade credit models differ in terms of financing costs. Thus, we put forward our last research question: what impact does the stability and concentration of UD relationships have on the focal firms' trade credit models?

Based on the research questions outlined above, we selected a sample of listed firms from the China Stock Market Accounting Research Database (CSMAR), which was used as a common data source. Our final datasets consisted of 973 A-shared listed firms observed from 2012 to 2021, including 3137 upstream and 3655 downstream observations. The findings of this study suggest that focal firms should be cautious about relying on major suppliers and attach importance to building solid, long-term relationships. Specifically, stable upstream is positive, while with concentration upstream is negative for focal firms to receive trade credit. Conversely, the stable and high-level concentration of downstream is positive for focal firms to provide trade credit. Moreover, in instances involving focal firms with substantial market power, the positive impact of supplier stability and the negative impact of supplier concentration on the trade credit received by the focal firms are attenuated, whereas the positive impact of customer concentration on the trade credit they extend is amplified. Particularly, focal firms need to put more emphasis on their connections with stable customers, which is an advantage for focal firms to choose the low cost of trade credit, while a high level of supplier concentration does not offer the same advantages.

This study expands the current literature by investigating three components of BS interaction, including the stability and concentration of UD relationships, two-level trade credit, focal firms' market power, and trade credit models. Accordingly, our study makes three primary contributions to supply chain finance. First, it expands the literature about trade credit. Prior research explored firms' trade credit mainly focuses on the cost of equity capital (Dhaliwal et al., 2016), knowledge spillover (Song et al., 2019), and product network (Adelino et al., 2023). However, in this study, we comprehensively examine for the first time how the stability and concentration of UD relationships affect the focal firms' two-level trade credit. Second, it contributes to most of the previous studies considering the BS interaction from a bilateral perspective (Kim, 2017; Kwak and Kim, 2020). Compared to previous studies, our research stands out as it delves into the interplay between focal firms and their UD. Based on the framework of Gu et al. (2022), we comprehensively evaluate the two-level trade credit of focal firms by considering the stability and concentration. Meanwhile, we introduce market power in the industry to unpack the contingent factors. Last, considering that various models incur varying costs, we explore trade credit models from the perspective of stability and concentration. In summary, our study provides valuable insights into the intricacies of trade credit and underscores the significance of factoring in UD

relationships when devising trade credit strategies in supply chain management.

The subsequent sections of this study proceed as follows: Section 2 presents the related literature and our hypothesis. Section 3 outlines the steps of the sample selection, measures, and empirical model. The findings from the empirical analysis and robustness tests are detailed in Section 4, while Section 5 delves into additional analyses. Finally, Section 6 provides conclusions and discusses the study's implications.

2. Literature review and hypothesis development

2.1. Trade credit

Trade credit is one of the most widely used types of supply chain finance (Wang et al., 2020). Previous studies predominantly emphasized the substitutive function of trade credit, particularly as a substitute for bank loans to alleviate firms' financing challenges (Cai et al., 2014; Murro and Peruzzi, 2022). Nevertheless, recent studies have offered insights indicating that trade credit serves a dual function, encompassing not solely financial facilitation but also serving as a strategic instrument employed by firms to preserve their competitive edge, thus underscoring the divergent dimensions of BS relationships (Lee et al., 2018).

In terms of firms' received trade credit, existing literature mainly focused on the structural embeddedness, the contrasting power, and the transparency of relationships. Constructing a longitudinal dataset of manufacturing firms, Jhang et al. (2021) argued that the structural positions in supply chain networks, such as network interconnectedness and network integration, have different effects on firms' received trade credit. Liu et al. (2020) suggested market share is the main power source, thus the buyer firm with a high market share increases trade credit from suppliers. Drawing from the framework of social exchange theory, Wang et al. (2023) revealed that, within the context of less supply chain transparency, firms enjoy more trade credit from suppliers.

From the perspective of provided trade credit, the negotiating capacity of the parties and dependence level are also critical factors that cannot be ignored in the characteristics of BS relationships. For example, Fabbri and Klapper (2016) found that suppliers with little negotiation strength often offer more goods on credit and are more likely to provide trade credit to their customers. Chod et al. (2019) found that the large suppliers had a greater willingness to provide trade credit facilities to their customers. Peng et al. (2019) confirmed that large customer also receives more trade credit from their suppliers.

In summary, while previous studies demonstrated that the characteristics of BS relationships are critical factors that affect focal firms' received and provided trade credit, most of them are only from a bilateral rather than three-tier supply chain perspective. Given this research gap, we take focal firms, suppliers, and customers into account and investigate the impact of characteristics of UD relationships on focal firms' two-level trade credit.

2.2. Stability and concentration in BS relationships

Stability and concentration in BS relationships have been a hot topic in academic literature, particularly emphasizing the financial success and innovation performance resulting from BS interactions (Padgett et al., 2020; Kwak and Kim, 2020). Aligning the objectives or interests between the focal and UD is more conducive to maintaining a stable relationship (Kim and Choi, 2021). Thus, trust and effective communication are particularly important factors in forming a stable relationship (Zhang et al., 2011). focal firms prefer stable relationships with less opportunistic suppliers (Cho et al., 2019a), and service quality is primary predictor in maintaining customer stability (Baumann et al., 2017). The business environment was also identified as a crucial factor influencing the stability of the relationships. Eggert and

Ulag (2010) suggested that the larger the customer share, the more favorable it is to stabilize the relationship with the supplier. Hiebl and Pielsticker (2022) found that customers' transformational leadership improved the stability of supplier relationships, while global business trends may endanger this stability. Regarding the consequences, firms' financial performance and operational performance attracted more attention (Peng et al., 2020; Gu et al., 2022), and firms with stable relationships have greater benefits. Nonetheless, there is a relative lack of exploration into stability within the realm of supply chain finance.

Concentration typically represents the bargaining power of one party in contrast to stability. Regarding the influential factors, Leung and Sun (2021) discovered that economic-policy uncertainty has a detrimental impact on firms' customer-base concentration. Regarding the consequences, most scholars are negative and claim that the concentration relationships are detrimental to the operational efficiency (Chen et al., 2023; Jiang et al., 2023), financial performance (Crawford et al., 2020; Chang et al., 2022) and CSR performance (Zhu et al., 2021). However, these adverse effects may also be transformed. Kim (2020) suggested that customer concentration initially negatively and then positively affected a supplier firm's innovation quantity. In the area of supply chain finance, Schwieterman et al. (2018) measured portfolio dependence based on concentration and revealed that supplier portfolio balance does not serve as a significant predictor of credit risk, whereas well-balanced customer portfolios are linked to more robust credit ratings. Liu et al. (2022) argued that customer concentration limits suppliers' factoring.

The literature outlined above underscores the insufficiency of solely examining the stability or concentration of BS relationships. Thus, building upon Gu et al. (2022) framework, our study combines stability and concentration with a specific focus on two-level trade credit. The findings of this study emphasize the necessity of understanding a comprehensive grasp of the intricate and multifaceted aspects of BS relationships, which identifies pivotal factors that contribute to the success of such supply chain relationships and facilitates the development of effective strategies aimed at enhancing their outcomes within the supply chain.

2.3. Impact of supplier stability and concentration on received trade credit

In the BS relationships theory, cooperative and competitive are two typical sides (Choi and Wu, 2009). Within a cooperative relationship, both parties involved in a transaction align as strategic allies, working together towards a shared goal of mutual benefit. Conversely, in a competitive relationship, the parties transition into competitors, emphasizing their interests, such as financial risk and cost, and profit maximization (Wu and Choi, 2005). Understanding the differences between these two types of relationships can help firms navigate their supply chain dynamics effectively and strategically.

Stable relationships indicate, to some extent, dependence among firms. Building on the resource dependence theory, it has been discovered that the dependence is strengthened if vital resources are shared. Elevated interdependence between the involved parties augments their commitment to the relationship, subsequently enhancing its overall stability (Saleh et al., 2015). Thus, once a collaborative relationship is established, suppliers make greater commitments to product quality (Lai et al., 2005), ultimately improving competitiveness on both sides.

Due to familiarity with each other, stable suppliers with a better understanding of the buyer firms' needs can optimize the production processes and reduce costs, resulting in a more efficient supply chain. In instances where both parties have cultivated a stable relationship, their inclination leans towards prioritizing a long-term partnership over perceiving their interactions as singular, isolated events. Furthermore, in their pursuit of bolstering the sustainability of such stable relationships, dependable suppliers often exhibit a propensity to prioritize harmony, sometimes even willing to make short-term concessions in pursuit of

long-term advantages derived from the partnership. As a result, the focal firm can benefit from greater access to trade credit based on its long-term business relationship with its stable suppliers. Thus, we propose:

- **H1a.** The suppliers' higher stability positively affects the trade credit received by focal firms.

However, supplier concentration does not necessarily imply such benefits for focal firms. As major suppliers grasp the critical resource, the high-level concentration of suppliers represents the focal firms' reliance on major suppliers. Moreover, as the concentration of suppliers increases, it poses a greater obstacle to the growth of focal firms and diminishes their ability to withstand environmental pressures. This ultimately drives up the cost of capital for the focal firms and exacerbates the volatility of cash flows. For example, in the short- and medium-term periods following the Wuhan lockdown, Cheng et al. (2022) discovered that a higher level of supplier concentration is associated with substantial declines in stock prices. Although a focal firm could theoretically terminate a major supplier and find a new one, the switching costs of seeking new suppliers are relatively high for focal firms (Krolikowski and Yuan, 2017). Thus, in cases where there is a high-level concentration of suppliers, the balance of power or dependence between the two sides is not equal. Major suppliers with higher bargaining power may seek to speed up the cash flows and reduce the trade credit they provide to focal firms. Thus, we propose:

- **H1b.** The suppliers' higher concentration negatively affects the trade credit received by focal firms.

2.4. Impact of customer stability and concentration on provided trade credit

Due to the high stability of the relationships, customers are more loyal and less likely to switch to the competitors of the focal firms (Baumann et al., 2017). According to goal interdependence theory, stable customers also strengthen their interdependence with focal firms, facilitating communication and enhancing mutual commitment. Thus, a community of interest is more likely to form among focal firms and stable customers. Additionally, focal firms have better familiarity, trust, and happiness with dependable customers (Keisidou et al., 2013), which can enhance the ability of customer stock returns to forecast firm stock returns (Shi et al., 2020). To improve sustainable competitiveness and win in the market, focal firms are willing to meet the desires of stable customers by providing them with more favorable terms during sales. Therefore, the formation of stable relationships incentivizes focal firms to provide trade credit to stable customers. Thus, we propose:

- **H2a.** The customers' higher stability positively affects the trade credit provided by focal firms.

However, except for the characteristics of customer stability, the concentration can also not be ignored. Focal firms often prioritize the needs of their major customers and may make relationship-specific investments, such as providing customized products, that result in a "lock-in" effect. From the cooperative relationship perspective, the major customers also contribute to the supply chain stability. Previous studies found that firms with higher customer concentration tend to experience consistent and higher revenues (Saboo et al., 2017) and higher IPO results (Peng et al., 2020). Thus, to maintain and expand customer base (Giannetti et al., 2021), and increase and improve their market performance, focal firms are motivated to provide trade credit to major customers. From a competitive perspective. When highly concentrated, customers tend to possess greater bargaining power and financial control over the focal firms (Kim and Zhu, 2018). This makes the focal firms more reliant on these major customers, as the costs of switching to other major customers are prohibitively high or there are no suitable alternatives available (Najafi-Tavani et al., 2020). Thus, major customers may control focal firms and compel them to make concessions in a variety of areas, including obtaining trade credit. Thus, whether in terms of cooperation or competition, we expect that:

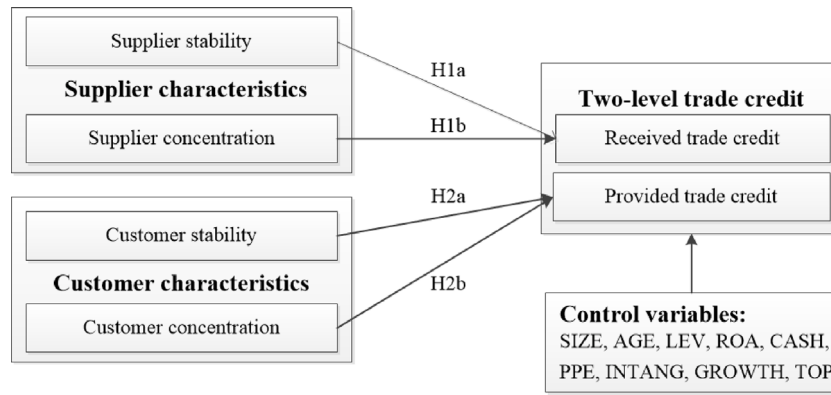


Fig. 1. Research model.

- **H2b.** The customers' higher concentration positively affects the trade credit provided by focal firms.

The research model is shown in Fig. 1.

3. Methodology

3.1. Sample selection and data description

There are two reasons for choosing Chinese-listed firms as the research sample. First, trade credit is a useful financing option for firms globally but is especially critical for firms in emerging economies, such as China (Liu et al., 2020). Indeed, as the largest developing country, China has faced challenges in aligning its financial infrastructure with its rapid economic expansion. Due to insufficient support from financial institutions, many Chinese firms rely significantly on trade credit to finance their expansion (Albuquerque et al., 2015), making it essential to examine the various factors that affect trade credit in China.

Second, from the perspective of data availability and applicability, compared with other countries, The Chinese government promotes transparency among listed companies by urging them to disclose their annual reports, which should include the top five suppliers and customers, along with relevant sales information, which provide considerable and detailed supply chain data.

We selected the data of A-share listed firms from 2012 to 2021, and the major data source is CSMAR. To enhance the quality of the data, we then excluded the following firms from the sample: (1) Firms in the banking and insurance industry; (2) Firms with special treatment (ST); (3) Firms with missing supply chain data and financial data. Finally, we obtained the 973 listed firms with 3137 firm-year observations of upstream and 3655 firm-year observations of downstream. The steps of data cleaning involving the producer are displayed in Table 1. It is noteworthy that, notwithstanding firms' disclosure of transactional details involving their primary suppliers or customers, certain entities opted for selective divulgence of the identities of these principal counterparts. For instance, in the original dataset, entries were denoted merely as "Supplier 1", "Supplier 2", "Customer 1", "Customer 2", and analogous designations. Given that the assessment of stability necessitated a direct correlation of supplier and customer names, this resulted in a more restricted dataset for our study.

3.2. Measures

3.2.1. Dependent variables

RTC: In line with earlier research (Wu et al., 2021), the received trade credit is calculated as the percentage of the total amount of accounts payable and notes payable to the total assets. The higher the value, the more trade credit that focal firms receive from their suppliers.

PTC: Referencing D'Mello and Toscano (2020), accounts receivable are basic for provided trade credit. Meanwhile, considering that notes receivable are similar to accounts receivable, both represent trade credit extended by suppliers to their customers. Thus, the entire amount of accounts receivable and notes receivable divided by the sum of assets is what we used to describe provided trade credit. The higher the value, the more trade credit that focal firms offer to their customers.

3.2.2. Independent variables

The stability of the relationships is measured by cohesiveness over a period, which indicates whether there is long-term cooperation between the firms. In line with Liu et al. (2022), we calculated the repeats of the supplier's name as a binary variable, which takes the value of 1 if the supplier's name remains unchanged compared to the last year; otherwise, 0. Supplier stability (*SUS*) was defined as the ratio of stable suppliers divided by the number of supplier names disclosed. Similarly, customer stability (*CUS*) was defined as the ratio of stable customers to the total number of customer names disclosed.

Referring to prior studies (Irvine et al., 2016; Campello and Gao, 2017; Zhu et al., 2021), Supplier Concentration (*SUC*) is measured by the ratio of purchases from major suppliers (top five suppliers) to total purchases, while Customer Concentration (*CUC*) is measured by the ratio of major customers (top five customers) to total sales. Eqs. (1) and (2) outline the calculation of *SUC* and *CUC* in detail.

$$SUC_{i,t} = \frac{\sum_{j=1}^5 p_{i,j,t}}{\sum_{j=1}^5 p_{i,t}} \quad (1)$$

$$CUC_{i,t} = \frac{\sum_{j=1}^5 s_{i,j,t}}{\sum_{j=1}^5 s_{i,t}} \quad (2)$$

In Eqs. (1) and (2), $p_{i,j,t}$ and $p_{i,t}$ represent the i th focal firm's purchases from major suppliers and its total purchases in t th year, respectively. $s_{i,j,t}$ and $s_{i,t}$ represent the i th focal firm's sales to major customers and its total sales in t th year, respectively. The higher the value of *SUC* and *CUC*, the more dependent focal firms are on their major suppliers or customers.

3.2.3. Control variables

In our study, a number of feature factors from three aspects that possibly affect trade credit are controlled: First, we controlled the firm characteristic factors (Cao et al., 2022; Wang et al., 2023). With size and age increasing, the position in transactions of firms has a greater impact on funds flows within the supply chain. Thus, we controlled firm size (*SIZE*) and firm age (*AGE*). *SIZE* is measured as the logarithm of total assets. *AGE* is measured as the logarithm of numbers years since the establishment of the firm. Second, we controlled variables that reflect firms' financial status (Lee et al., 2018; Liu et al., 2020; Murro and Peruzzi, 2022). Since financial status is also an important factor that affects firms' demand for trade credit. Total debt over total assets

Table 1
Data cleaning procedure.

Steps	Processing	Focal firms' reduction	Focal firms' remainder
Step 1	Original supply chain information data from CSMAR	–	4656
Step 2	Removing firms that do not disclose the names of the main suppliers and customers, and calculated the supplier (customer) stability and concentration	3064	1592
Step 3	Integrating data from CSMAR and removing firms with the missing value of trade credit	432	1160
Step 4	Removing firms in the banking and insurance industry and firms with special treatment	17	1143
Step 5	Removing firms with missing values of control variables	170	973

Table 2
Summary statistics.

Variable	N	Mean	SD	Min	P25	Median	P75	Max
<i>RTC</i>	3137	0.1198	0.095	0	0.0482	0.0941	0.1647	0.5444
<i>PTC</i>	3655	0.1358	0.1199	0.0001	0.0375	0.1052	0.2047	0.5192
<i>SUS</i>	3137	0.5131	0.3265	0	0.2	0.5	0.8	1
<i>SUC</i>	3137	39.9524	23.1113	0	21.79	34.6	55.66	100
<i>CUS</i>	3655	0.5586	0.354	0	0.2	0.6	1	1
<i>CUC</i>	3655	36.9105	26.4148	1.65	15.57	29.93	54.2	99.94
<i>SIZE</i>	38153	22.0955	1.296	19.7143	21.1551	21.9048	22.8305	26.1129
<i>AGE</i>	38153	2.7768	0.3931	1.3863	2.5649	2.8332	3.0445	3.4657
<i>LEV</i>	38153	0.4237	0.2086	0.0506	0.2555	0.4161	0.5808	0.8986
<i>ROA</i>	38153	0.0538	0.0671	−0.2529	0.0286	0.0532	0.0849	0.2381
<i>CASH</i>	38153	0.9452	1.6381	0.0199	0.1937	0.3983	0.9111	10.9026
<i>PPE</i>	38153	0.2109	0.1613	0.0021	0.0845	0.1767	0.3021	0.6983
<i>INTANG</i>	38153	0.0454	0.0507	0	0.0157	0.0324	0.0562	0.3209
<i>GROWTH</i>	38153	0.3905	1.0543	−0.7325	−0.0315	0.1337	0.4228	7.47
<i>TOP</i>	38153	34.6337	14.983	8.73	22.9	32.46	44.81	74.98

constitutes the firm asset–liability ratio (*LEV*). To control financial performance, we measured *ROA* as the ratio of net profit divided by total assets. It is clear to understand that firms with more cash flow may be able to pay for goods in time. Therefore, *CASH* is concluded as a control variable, which is calculated as net operating cash flow divided by total assets. To capture the rate of revenue growth, we control *GROWTH*. Since the proportion of investment in assets affects the internal liquidity of the firms, we further control the proportion of fixed assets and intangible assets. *PPE* is measured as fixed assets divided by total assets. *INTANG* is measured as intangible assets divided by total assets. Finally, we take corporate governance into account (Liu et al., 2022), which uses *TOP* to regulate the largest shareholder's shareholding ratio. Shareholding ratio is reported to influence the way of firms' financing (Tang et al., 2022).

3.3. Model specification

We adopt the following multivariate OLS regression models to test the hypotheses. Linear regression was used for the following reasons: first, linear regression is a widely recognized regression model (Soni and Kodali, 2012). Considering the exploratory nature of our study and the desire to reveal the initial relationship between the variables, we believe that the linear model is sufficiently complete. Second, linear regression generates coefficients that provide direct insight into the magnitude and direction of the relationship of the variables (Kim et al., 1996; Murdoch et al., 2019). Third, we aimed to assess the validity of the hypothesis and exclude non-linear relationships in the robustness.

In model (3), we explore the focal firms' received trade credit from suppliers. In model (4), we explore the focal firms' provided trade credit to customers.

$$RTC_{i,t} = \beta_0 + \beta_1 SUS_{i,t}(SUC_{i,t}) + \beta_2 Controls_{i,t} + YEAR_{dummies} + IND_{dummies} + \varepsilon_{i,t} \quad (3)$$

$$PTC_{i,t} = \alpha_0 + \alpha_1 CUS_{i,t}(CUC_{i,t}) + \alpha_2 Controls_{i,t} + YEAR_{dummies} + IND_{dummies} + \varepsilon_{i,t} \quad (4)$$

where the dependent variable *RTC* represents the trade credit received by focal firms from their suppliers, and *PTC* represents the trade credit

provided by focal firms to their customers. The firm and year are described by the subscripts *i* and *t*, respectively. *Controls* represents the variables introduced in Section 3.2.3. In addition, we controlled the unobserved year-fixed effects and industry-fixed effects. ε is the error term.

4. Main results and discussion

4.1. Descriptive statistics and correlation

Descriptive statistics for the aforementioned variables are presented in Table 2. The mean value and Standard Deviation (SD) of *RTC* are 0.1198 and 0.0950, respectively, while the mean value and SD of *PTC* are 0.1358 and 0.1198, respectively. This suggests that the sample firms have less variation in two-level trade credit scales. The averages of *SUS* and *SUC* are 0.5131 and 39.9524, respectively. These results demonstrate that among our sample firms, almost 51.31% of the suppliers are stable, and the average purchase share of the top five suppliers is 39.95%. *CUC* and *CUS* mean values are 0.5586 and 36.9105, respectively. It demonstrates that the customers of more than 55.86% of focal firms are steady, and the average sales share held by the top five customers amounts to 36.91%.

The correlation coefficients for the variables are presented in Table 3. The majority of these are below the threshold of 0.3. Furthermore, it is worth noting that none of the models in our analysis exhibit Variance Inflation Factor (VIF) values exceeding 4, indicating the absence of a pronounced multicollinearity issue.

4.2. Stability and concentration of UD relationships and focal firms' two-level trade credit

The regression results for the hypotheses are presented in Table 4. In column (1), *SUS* is positive and significant (0.0086, t-value = 2.0160). Thus, H1a is supported. In column (2), *SUC* is negative and significant (−0.0005, t-value = −7.8859). Thus, H1b is supported. In addition, we put *SUS* and *SUC* into the models in column (3). The estimated coefficients of *SUS* and *SUC* are 0.0121 and −0.0005, respectively,

Table 3
Correlation coefficient.

	RTC	PTC	SUS	SUC	CUS	CUC	SIZE	AGE	LEV	ROA	CASH	PPE	INTAGE	GROWTH	TOP
RTC	1														
PTC	0.5028***	1													
SUS	0.0167	0.0123	1												
SUC	-0.2576***	-0.2184***	0.1123***	1											
CUS	-0.0001	0.0418**	0.3487***	0.0461**	1										
CUC	-0.0420**	0.0519*	-0.0363*	0.2439***	0.1891***	1									
SIZE	0.1310***	-0.1732***	0.0994***	-0.1398***	0.1013***	-0.0114	1								
AGE	-0.0287	-0.2286***	0.0154	0.1124***	-0.0459**	0.0422**	0.1493***	1							
LEV	0.4000***	0.0118	-0.0865***	-0.0722***	-0.0660***	0.0065	0.3938***	0.1531***	1						
ROA	-0.0670***	0.0108	0.0746***	-0.0327	0.1106***	-0.0597***	0.1678***	-0.0706***	-0.2809***	1					
CASH	-0.2920***	-0.1047***	0.0191	0.0613***	0.0058	0.0501**	-0.2582***	-0.0885***	-0.5637***	0.1619***	1				
PPE	-0.1383***	-0.2552***	0.1120***	0.1069***	0.1793**	0.2307***	0.2106***	-0.0493**	0.0954***	0.0211	-0.1098***	1			
INTAGE	-0.1194***	-0.1515***	-0.0192	0.0275	0.0075	0.0100	-0.0505**	0.0523**	-0.0730***	-0.0450**	-0.0133	0.0602***	1		
GROWTH	0.0010	-0.0439**	-0.0892***	0.0897***	-0.1432***	-0.0172	-0.0261	0.0815***	0.0692***	-0.0245	-0.0289	-0.1349***	-0.0553***	1	
TOP	0.0928***	-0.0837***	0.0459**	-0.0101	0.0797***	0.0165	0.3462***	-0.0778***	0.0924***	0.1297***	-0.0370*	0.2251***	-0.0045	-0.0104	1

Table 4
Regression results for H1a-H2b.

Variables	(1) RTC	(2) RTC	(3) RTC	(4) PTC	(5) PTC	(6) PTC
SUS	0.0086** (2.016)		0.0121*** (2.8215)			
SUC		-0.0005*** (-7.8859)	-0.0005*** (-8.0696)			
CUS				0.0177*** (3.7156)		0.0156*** (3.2609)
CUC					0.0003*** (4.4106)	0.0003*** (4.0231)
SIZE	-0.0030* (-1.9315)	-0.0052*** (-3.2935)	-0.0056*** (-3.5247)	-0.0184*** (-11.1196)	-0.0170*** (-10.3876)	-0.0173*** (-10.5570)
AGE	0.0013 (0.2619)	0.0028 (0.5768)	0.0032 (0.6493)	-0.0323*** (-5.9174)	-0.0343*** (-6.2351)	-0.0331*** (-6.0275)
LEV	0.1736*** (16.6184)	0.1693*** (16.6849)	0.1712*** (16.9058)	0.0588*** (4.8991)	0.0558*** (4.6776)	0.0586*** (4.8863)
ROA	0.0864*** (4.1812)	0.0843*** (4.14)	0.0832*** (4.1009)	0.1792*** (6.2725)	0.1913*** (6.6779)	0.1854*** (6.4843)
CASH	-0.0113*** (-8.7110)	-0.0112*** (-8.9211)	-0.0112*** (-8.8783)	-0.0189*** (-12.6223)	-0.0193*** (-12.8641)	-0.0192*** (-12.8057)
PPE	-0.0644*** (-6.6921)	-0.0606*** (-6.3064)	-0.0609*** (-6.3502)	-0.1970*** (-18.9281)	-0.1971*** (-19.1882)	-0.1984*** (-19.2487)
INTANG	-0.1332*** (-6.8327)	-0.1303*** (-6.6942)	-0.1304*** (-6.7153)	-0.3481*** (-15.7421)	-0.3405*** (-15.2988)	-0.3392*** (-15.2902)
GROWTH	0.0011 (1.5342)	0.0014* (1.9099)	0.0015** (2.0735)	-0.0001 (0.1095)	-0.0005 (0.5174)	-0.0002 (-0.2026)
TOP	0.0006*** (6.6367)	0.0006*** (6.8774)	0.0006*** (6.8704)	0.0001 (0.6989)	0.0001 (0.8816)	0.0001 (0.792)
Constant	0.0830** (2.3632)	0.1425*** (3.9707)	0.1458*** (4.0538)	0.5658*** (15.6304)	0.5381*** (14.8379)	0.5351*** (14.7665)
YEAR	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES
Observations	3137	3137	3137	3655	3655	3655
adj.R-squared	0.4013	0.4137	0.4152	0.4077	0.4088	0.4105

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

which both are significant at the 1% level. The results show that suppliers' stability positively and considerably influences a firm's ability to provide trade credit, whereas suppliers' concentration adversely and significantly affects it. To gauge the comparative magnitude of the influence exerted by *SUS* and *SUC* on the *RTC*, and drawing from insights gleaned from prior research (Yan et al., 2022), we conducted a Wald test to scrutinize the disparities between the coefficients of *SUS* and *SUC*, and the outcomes reveal statistically significant differences ($p = 0.000$). Consequently, the positive effects of *SUS* on the *RTC* surpass the negative effects of *SUC*. This underscores the strategic imperative for focal firms to accord precedence to cultivating enduring relationships with their suppliers when striving to optimize access to trade credit.

In column (4), *CUS* is positive and significant (0.0177, t-value = 3.7156), Thus, H2a is supported. In column (5), *CUC* is positive and significant (0.0003, t-value = 4.4106), Thus, H2b is supported. In column (6), we put *CUS* and *CUC* into the same model, the estimated coefficients of *CUS* and *CUC* are 0.0156 and 0.0003, respectively, which both are significant at the 1% level. Similarly, to ascertain the magnitude of the impact of *CUS* and *CUC* on the *PTC*, we conducted a Wald test to investigate the disparities between their coefficients. The results of the test confirm statistically significant differences in the standardized coefficients of *CUS* and *CUC* ($p = 0.014$). Therefore, the relative strengths of the positive effects of *CUS* outweigh *CUC* on the *PTC*, indicating that focal firms tend to prioritize extending trade credit to stable customers.

Table 5
Results of Heckman two-stage method.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>RTC</i>	(4) <i>PTC</i>	(5) <i>PTC</i>	(6) <i>PTC</i>
<i>SUS</i>	0.0106** (2.2464)		0.0139*** (2.9286)			
<i>SUC</i>		−0.0005*** (−5.9947)	−0.0005*** (−6.1983)			
<i>CUS</i>				0.0240*** (3.4814)		0.0219*** (3.1946)
<i>CUC</i>					0.0005*** (4.6913)	0.0005*** (4.4559)
<i>IMR</i>	0.6055*** (16.5583)	0.6109*** (17.0744)	0.6121*** (17.1204)	0.1959*** (4.9133)	0.1937*** (4.8652)	0.1945*** (4.9493)
<i>SIZE</i>	0.0120*** (5.5177)	0.0102*** (4.6476)	0.0099*** (4.4743)	−0.0174*** (−6.3869)	−0.0161*** (−5.9991)	−0.0162*** (−6.0405)
<i>AGE</i>	−0.1700*** (−14.2568)	−0.1696*** (−14.6394)	−0.1698*** (−14.6167)	−0.0400*** (−5.0950)	−0.0424*** (−5.3649)	−0.0403*** (−5.1232)
<i>LEV</i>	0.3662*** (24.4378)	0.3627*** (24.6158)	0.3653*** (24.8434)	0.0892*** (4.8492)	0.0901*** (4.9165)	0.0921*** (5.032)
<i>ROA</i>	0.0656*** (2.8241)	0.0636*** (2.7992)	0.0624*** (2.7511)	0.2396*** (5.1363)	0.2512*** (5.3882)	0.2455*** (5.3111)
<i>CASH</i>	−0.0192*** (−11.0757)	−0.0190*** (−11.0753)	−0.0189*** (−10.9119)	−0.0214*** (−8.3406)	−0.0216*** (−8.5141)	−0.0219*** (−8.5823)
<i>PPE</i>	−0.0208* (−1.7163)	−0.0148 (−1.2115)	−0.0154 (−1.2646)	−0.2161*** (−13.8958)	−0.2183*** (−14.3521)	−0.2217*** (−14.4907)
<i>INTANG</i>	−0.2740*** (−11.9334)	−0.2745*** (−11.9021)	−0.2767*** (−11.8916)	−0.4352*** (−11.5012)	−0.4140*** (−10.9016)	−0.4171*** (−11.0592)
<i>GROWTH</i>	0.0011 (1.2407)	0.001 (1.1808)	0.0012 (1.3624)	0.0009 (0.5595)	0.0004 (0.2499)	0.001 (0.6222)
<i>TOP</i>	−0.0002 (−1.3475)	−0.0001 (−1.0380)	−0.0001 (−1.0443)	0 (0.1082)	0 (0.0183)	0 (0.0868)
<i>Constant</i>	0.1543*** (4.0546)	0.2065*** (5.2133)	0.2087*** (5.2602)	0.5757*** (10.4087)	0.5432*** (9.7227)	0.5350*** (9.6555)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES	YES
<i>Observations</i>	2351	2351	2351	1796	1796	1796
<i>adj.R-squared</i>	0.4732	0.4818	0.4838	0.4084	0.4119	0.4153

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

4.3. Robustness tests

4.3.1. Heckman two-stage method

The lack of information about main suppliers and customers, in turn, causes our study sample selection issues. Therefore, we used Heckman's two-stage to mitigate the potential impact of this issue on the conclusions as much as possible.

In the first-stage regression, the disclosure of supplier and customer information by focal firms is established as a binary variable, the control variables in Model (3) and the proportion of the firm's product sales to the total sales of the industry are used as the exclusionary constraint variable to run the regression. The second-stage regression incorporates the resulting inverse Mills ratio in Model (3). The results are shown in Table 5. The inverse Mills coefficients are significantly positive, indicating an endogenous problem in the original regression analysis. In column (1), the estimated coefficient of *SUS* is 0.0106, which is significant at the 5% level. In column (2), the estimated coefficient of *SUC* is −0.0005, which is significant at the 1% level. Similarly, in column (3), *SUS* (0.0139, t-value = 2.9286) is positive, but *SUC* (−0.0005, t-value = −6.1983) negatively affects focal firms' received trade credit. In column (4), the estimated coefficient for *CUS* is significant at the 1% level, with values of 0.0240. In column (5), the estimated coefficient for *CUC* is significant at the 1% level, with values of 0.0005. In column (6), when we put *CUS* and *CUC* into models, *CUS* and *CUC* still positively and significantly affect focal firms' provided trade credit. The results of Table 5 indicate that after considering the endogeneity problem caused by sample selection bias, our results are still robust.

4.3.2. The role of lagged time effect

Consistent with prior literature (Krolikowski and Yuan, 2017), to mitigate the potential endogeneity problem arising from reverse causality, current period data (in year t) on the *RTC* and *PTC*, while *SUS*, *SUC*, *CUS* and *CUC* for the previous year (in year $t-1$), was included in our study. The findings in Table 6 demonstrate the reliability of our findings about the main effects.

In column (1) of Table 6, *SUS* (0.0125, t-value = 2.5673) positively affects focal firms' provided trade credit. In column (2), *SUC* (−0.0004, t-value = −5.5964) has a negative effect on focal firms' received trade credit. In column (3), the same conclusions can still be drawn when we put *SUS* and *SUC* into the models. Similarly, in column (4), *CUS* (0.0165, t-value = 3.4781) positively affects focal firms' provided trade credit. In column (5), *CUC* (0.0002, t-value = 2.9255) positively affects focal firms' provided trade credit. In column (6), our results are still robust even if *CUS* and *CUC* are put into the same models.

4.3.3. Other measurements of the focal firms' received and provided trade credit

Following Abdulla et al. (2020), we re-measured the *RTC* and *PTC*. Specifically, *RTC* is calculated as the natural logarithm of one plus the accounts payable and notes payable, while *PTC* is calculated as the natural logarithm of one plus the accounts receivable and notes receivable. The results are shown in Table 7. In column (1), we can find *SUS* (0.1115, t-value = 2.5675) positively and significantly affects the focal firms' received trade credit, whereas in column (2), *SUC* (−0.0059, t-value = −8.0336) negatively and significantly affects the focal firms' received trade credit. Meanwhile, in column (3), considering *SUS* and

Table 6
Results of lagged time effect.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>RTC</i>	(4) <i>PTC</i>	(5) <i>PTC</i>	(6) <i>PTC</i>
<i>SUS</i>	0.0125** (2.5673)		0.0158*** (3.2015)			
<i>SUC</i>		−0.0004*** (−5.5964)	−0.0005*** (−5.8508)			
<i>CUS</i>				0.0165*** (3.4781)		0.0154*** (3.228)
<i>CUC</i>					0.0002*** (2.9255)	0.0002*** (2.6184)
<i>AGE</i>	0.0002 (0.047)	0.0009 (0.1952)	0.0011 (0.2397)	−0.0264*** (−5.9583)	−0.0273*** (−6.1179)	−0.0269*** (−6.0411)
<i>LEV</i>	0.1852*** (15.0515)	0.1812*** (14.9161)	0.1838*** (15.23)	0.0716*** (6.0866)	0.0695*** (5.9313)	0.0722*** (6.1301)
<i>ROA</i>	−0.0055 (−0.1899)	−0.0068 (−0.2341)	−0.009 (−0.3104)	0.1285*** (4.0139)	0.1361*** (4.232)	0.1322*** (4.1143)
<i>CASH</i>	−0.0081*** (−8.4891)	−0.0078*** (−8.0903)	−0.0077*** (−7.9651)	−0.0098*** (−11.4758)	−0.0101*** (−11.7007)	−0.0099*** (−11.5564)
<i>PPE</i>	−0.0916*** (−7.9611)	−0.0879*** (−7.6047)	−0.0882*** (−7.6516)	−0.2070*** (−19.0077)	−0.2059*** (−19.0445)	−0.2077*** (−19.1404)
<i>INTANG</i>	−0.1579*** (−6.1131)	−0.1589*** (−6.0425)	−0.1615*** (−6.1722)	−0.3507*** (−14.2947)	−0.3466*** (−14.0553)	−0.3446*** (−14.0380)
<i>GROWTH</i>	0.0015 (0.983)	0.0015 (1.0191)	0.0017 (1.1532)	0.0008 (0.5403)	0.0004 (0.2999)	0.0008 (0.5278)
<i>TOP</i>	0.0007*** (6.5069)	0.0007*** (6.8591)	0.0007*** (6.9431)	0.0002** (1.9925)	0.0002** (2.0565)	0.0002** (1.9879)
<i>Constant</i>	0.2074*** (4.9119)	0.2478*** (5.7159)	0.2564*** (5.8945)	0.5673*** (16.0158)	0.5474*** (15.4235)	0.5495*** (15.483)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES	YES
<i>Observations</i>	2522	2522	2522	3924	3924	3924
<i>adj.R-squared</i>	0.3714	0.3786	0.381	0.371	0.3703	0.372

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

SUC in the same model, the results still hold. In columns (4) and (5), *CUS* (0.2618, t-value = 4.767) and *CUC* (0.0037, t-value = 4.2966) positively affect focal firms' provided trade credit. In column (6), we can still take the same conclusions. Thus, our hypotheses are supported again.

4.3.4. Other measurements of the supplier (customer) stability and concentration

In this section, we further changed the measurements of independent variables: *SUS*, *SUC*, *CUS*, and *CUC*. For the measurement of stability, instead of evaluating changes over one year, we examine changes over two years, extending the time frame for considering the stability of customers and suppliers. The new *SUS* and *CUS* are denoted as *NSUS* and *NCUS*. For the measurement of concentration, following prior studies (Chen et al., 2023), the Herfindahl index is used to represent supplier and customer concentration, *SHHI* and *CHHI* of the *i*th firm in year *t* can be described by the Eqs. (5) and (6):

$$SHHI_{i,t} = \sum_{j=1}^5 \left(\frac{p_{i,j,t}}{p_{i,t}} \right)^2 \quad (5)$$

$$CHHI_{i,t} = \sum_{j=1}^5 \left(\frac{s_{i,j,t}}{s_{i,t}} \right)^2 \quad (6)$$

In Eq. (5), $p_{i,j,t}$ and $p_{i,t}$ is the same as Eq. (1). In Eq. (6), $s_{i,j,t}$ and $s_{i,t}$ is the same as Eq. (2). The higher value of *SHHI* and *CHHI* indicates focal firms have a more concentrated relationship with UD. Table 8 shows the results of alternative *SUS*, *SUC*, *CUS*, and *CUC*.

In column (1) of Table 8, we can find *SUS* (0.0092, t-value = 1.8163) positively and significantly affects the focal firms' received trade credit, whereas in column (2), *SUC* (−0.0007, t-value = −4.9411) negatively and significantly affects the focal firms' received trade credit. Meanwhile, in column (3), considering *SUS* and *SUC* in the

same model, the results are consistent with the hypotheses. In columns (4) and (5), *CUS* (0.0178, t-value = 3.0691) and *CUC* (0.0005, t-value = 4.3045) positively affect focal firms' provided trade credit. In column (6), we can still take the same conclusions. Thus, the results are consistent with the hypotheses in this research.

4.3.5. Cluster at firm-level

In this section, considering the problems of heteroscedastic and serial correlation, we re-test our hypotheses by using the robust error model, which is clustered at the firm level (Shang, 2020). The results are presented in Table 9. In columns (1) and (2), we find that the *SUS* (0.0122) is positive while *SUC* (−0.0005) is negative and significantly affects the focal firms' received trade credit. In column (3), the results are undifferentiated considering *CUS* and *CUC* in the same model. In columns (4) and (5), *CUS* (0.0177) and *CUC* (0.0003) positively affect focal firms' provided trade credit, respectively. In column (6), the results are still robust considering *CUS* and *CUC* in the same model. Thus, the hypotheses in this research are supported again.

4.3.6. Non-linearity test

To exclude the potential non-linear relationship between the supplier (customer) stability and concentration and focal firms' two-level trade credit, we introduce an alternative model based on Bellamy et al. (2014) works. This model integrates squared terms for stability and concentration of UD relationships in the regression analysis. As shown in Table 10, the squared terms of *SUS*, *SUC*, *CUS*, and *CUC* are not significant. Thus, there is no non-linear relationship between the stability and concentration of UD relationships and focal firms' two-level trade credit, and our linear regression model setting is reasonable.

Table 7
Results of alternative dependent variables measures.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>RTC</i>	(4) <i>PTC</i>	(5) <i>PTC</i>	(6) <i>PTC</i>
<i>SUS</i>	0.1115** (2.5675)		0.1518*** (3.5368)			
<i>SUC</i>		−0.0059*** (−8.0336)	−0.0061*** (−8.3425)			
<i>CUS</i>				0.2618*** (4.787)		0.2378*** (4.3396)
<i>CUC</i>					0.0037*** (4.2966)	0.0033*** (3.8181)
<i>SIZE</i>	0.9675*** (62.7685)	0.9429*** (63.9397)	0.9379*** (63.5247)	0.8883*** (46.0581)	0.9060*** (46.5247)	0.9010*** (46.4514)
<i>AGE</i>	−0.073 (−1.5191)	−0.0558 (−1.1846)	−0.0513 (−1.0854)	−0.3457*** (−5.8117)	−0.3716*** (−6.2244)	−0.3538*** (−5.9143)
<i>LEV</i>	1.3824*** (12.0661)	1.3312*** (11.9274)	1.3550*** (12.1661)	0.2527* (1.7853)	0.2048 (1.4548)	0.2496* (1.7654)
<i>ROA</i>	0.9734*** (4.4183)	0.9498*** (4.393)	0.9358*** (4.3609)	1.2948*** (3.9433)	1.4568*** (4.4202)	1.3651*** (4.1449)
<i>CASH</i>	−0.2304*** (−11.7055)	−0.2293*** (−11.9528)	−0.2291*** (−11.9489)	−0.2021*** (−8.8581)	−0.2059*** (−9.0295)	−0.2050*** (−9.0381)
<i>PPE</i>	−0.3212*** (−3.2127)	−0.2771*** (−2.7948)	−0.2810*** (−2.8444)	−1.7130*** (−12.3366)	−1.7105*** (−12.4807)	−1.7304*** (−12.5930)
<i>INTANG</i>	−1.1580*** (−4.7900)	−1.1250*** (−4.7490)	−1.1265*** (−4.7650)	−3.7264*** (−9.5039)	−3.6414*** (−9.0252)	−3.6261*** (−9.0703)
<i>GROWTH</i>	0.0230*** (3.1012)	0.0260*** (3.5674)	0.0275*** (3.7777)	0.0024 (0.1399)	−0.0033 (−0.1917)	0.0013 (0.0759)
<i>TOP</i>	0.0038*** (3.6317)	0.0039*** (3.8173)	0.0039*** (3.8066)	0.0002 (0.1622)	0.0004 (0.3539)	0.0003 (0.2366)
<i>Constant</i>	−2.2813*** (−6.6589)	−1.5998*** (−4.7878)	−1.5597*** (−4.6639)	0.4835 (1.1412)	0.1671 (0.391)	0.1261 (0.2948)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES	YES
<i>Observations</i>	3135	3135	3135	3627	3627	3627
<i>adj.R-squared</i>	0.7998	0.805	0.8057	0.6079	0.6076	0.6096

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

5. Additional analysis

5.1. Moderating effects of focal firms' market power

For focal firms' two-level trade credit, although we put stability and concentration into consideration, another crucial factor that cannot be neglected is the firms' market power established in product markets. Market power, being a dynamic change and relative concept (Touboulic et al., 2014), is wielded by actors in the supply chain to maximize profits from their BS relationships (Lee et al., 2018). Firms could change the transaction relationships in the supply chain by enhancing the market power in product markets, which implies that the market power would influence the relationships of the supply chain. Therefore, investigating the interplay between market power, stability and concentration of UD relationships becomes crucial for a deeper understanding of implementing trade credit in practical business scenarios.

First, from the perspective of upstream, focal firms possessing significant market power typically command a substantial portion of supply chain profits. However, if suppliers encounter liquidity challenges due to extending excessive trade credit, the focal firm might likewise experience adverse consequences, thereby impacting subsequent cooperation. Particularly when there is a need to establish cooperative relationships with partners, focal firms may actively limit their use of power (Cho et al., 2019b). Therefore, focal firms with significant market power may contemplate reducing trade credit from their suppliers to mitigate the potential for supply chain disruptions and risks. We suspect the situation is more likely to occur with stable suppliers. Regarding dominant focal firms within their industry, their potential loss could adversely affect concentrated suppliers. In other words, focal firms might struggle

against concentrated suppliers and hence demand greater trade credit thanks to the high market power.

Second, from the perspective of downstream, focal firms' market power can influence provided trade credit. On one hand, focal firms with high market power may have a strong willingness to provide trade credit to stable and concentrated customers, as trade credit can be a competitive tool to attract new customers and retain existing stable and concentrated customers (Lee et al., 2018). For stable and concentrated customers, an extended credit term or a substantial cash discount serves as an equivalent to a price reduction, particularly in situations where antitrust laws prohibit direct price discrimination. On the other hand, focal firms with high market power have the ability to provide trade credit to their stable and concentrated customers. High market power implies that fewer firms can compete within the industry (Fabbri and Klapper, 2016), resulting in stronger bargaining leverage with their customers, also alleviating the customers' effort hold-up problem. Consequently, focal firms may be inclined to offer more trade credit to their customers.

To verify the moderating effects of focal firms' market power, we add the interaction term of focal firms' market power and supplier stability and concentration in Model (2), and then add the interaction term of focal firms' market power and customer stability and concentration in Model (3), and construct the following models:

$$RTC_{i,t} = \lambda_0 + \lambda_1 SUS_{i,t}(SUC_{i,t}) + \lambda_2 MP_{i,t} + \lambda_3 SUS_{i,t}(SUC_{i,t}) * MP_{i,t} + Controls_{i,t} + YEAR_{dummies} + IND_{dummies} + \epsilon_{i,t} \quad (7)$$

$$PTC_{i,t} = \theta_0 + \theta_1 CUS_{i,t}(CUC_{i,t}) + \theta_2 MP_{i,t} + \theta_3 CUS_{i,t}(CUC_{i,t}) * MP_{i,t} + Controls_{i,t} + YEAR_{dummies} + IND_{dummies} + \epsilon_{i,t} \quad (8)$$

In the existing literature, the Lerner Index is commonly used to measure the level of market power or market competition, which equals

Table 8
Results of alternative independent variables measures.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>RTC</i>	(4) <i>PTC</i>	(5) <i>PTC</i>	(6) <i>PTC</i>
<i>NSUS</i>	0.0092* (1.8163)		0.0104** (2.045)			
<i>SHHI</i>		−0.0007*** (−4.9411)	−0.0007*** (−4.9895)			
<i>NCUS</i>				0.0178*** (3.0691)		0.0168*** (2.9164)
<i>CHHI</i>					0.0005*** (4.3045)	0.0005*** (4.1649)
<i>SIZE</i>	−0.0025 (−1.3758)	−0.0033* (−1.8235)	−0.0036** (−1.9618)	−0.0162*** (−8.5201)	−0.0151*** (−7.9934)	−0.0154*** (−8.1202)
<i>AGE</i>	0.0038 (0.6379)	0.0044 (0.7427)	0.005 (0.8271)	−0.0389*** (−5.4562)	−0.0419*** (−5.8764)	−0.0407*** (−5.7000)
<i>LEV</i>	0.1740*** (14.4673)	0.1714*** (14.5469)	0.1730*** (14.6866)	0.0462*** (3.3374)	0.0416*** (3.0384)	0.0446*** (3.2374)
<i>ROA</i>	0.0977*** (4.2894)	0.0959*** (4.2486)	0.0964*** (4.285)	0.1411*** (4.5892)	0.1455*** (4.7319)	0.1412*** (4.5852)
<i>CASH</i>	−0.0104*** (−6.5647)	−0.0100*** (−6.5027)	−0.0100*** (−6.4895)	−0.0208*** (−10.4467)	−0.0215*** (−10.8293)	−0.0213*** (−10.6641)
<i>PPE</i>	−0.0661*** (−6.0711)	−0.0643*** (−5.8740)	−0.0644*** (−5.8927)	−0.1879*** (−15.5240)	−0.1907*** (−15.7944)	−0.1927*** (−15.8966)
<i>INTANG</i>	−0.1401*** (−6.5030)	−0.1421*** (−6.6129)	−0.1416*** (−6.6011)	−0.3362*** (−13.6768)	−0.3309*** (−13.4201)	−0.3279*** (−13.3291)
<i>GROWTH</i>	0.0009 (1.3714)	0.0009 (1.4531)	0.001 (1.5767)	0.0001 (0.1835)	0.0001 (−0.0720)	0.0002 (0.2538)
<i>TOP</i>	0.0007*** (6.5175)	0.0007*** (6.5302)	0.0007*** (6.4803)	0 (0.3881)	0.0001 (0.4384)	0.0001 (0.4232)
Constant	0.0755* (1.8128)	0.0964** (2.3014)	0.0968** (2.3086)	0.5528*** (12.9146)	0.5453*** (12.828)	0.5389*** (12.6574)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES	YES
<i>Observations</i>	2407	2407	2407	2714	2714	2714
<i>adj.R-squared</i>	0.4129	0.4191	0.42	0.3961	0.3974	0.3994

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

the ratio of (OI-OC-SE-AE)/OI, where OI, OC, SE, and AE are operation income, operation cost, selling expenses, and administrative expenses, respectively. To account for industry differences, we calculated a focal firm's market power by the ratio of its primary product revenue to the industry's total revenue and then weighted it by its Lerner Index. A higher value on this metric indicates that the focal firm has more control and influence in its specific industry.

The regression results are shown in Table 11. In column (1), the coefficient of *SUS*MP* is significantly negative. In column (2), the coefficient of *SUC*MP* is significantly positive. In column (3), we put the *SUS*MP* and *SUC*MP* into the same model, and the same conclusions can be drawn. Note that the *SUS* is significantly positive, whereas *SUC* is significantly negative. This indicates that the positive impact of supplier stability and the negative effect of supplier concentration on focal firms' received trade credit are weakened when focal firms possess high market power. Perhaps considering the security and stability of the supply chain, focal firms with high market power would reduce the trade credit received from stable suppliers. However, faced with a high-level concentration of suppliers, focal firms could receive more trade credit depending on their dominant position in the industry.

Similarly, in column (4), the coefficient of *CUS*MP* is positive but not significant. In column (5), the coefficient of *CUC*MP* is significantly positive. In column (6), we put the *CUS*MP* and *CUC*MP* into the same model, and the same conclusions can be drawn. Note that the *CUC* is positive and significant, indicating that the positive impact of customer concentration on focal firms' provided trade credit is strengthened when focal firms have high market power. In other words, focal firms with substantial market power enhance the advantages of extending trade credit to concentrated customers, such as enlarging their primary customer base.

To illustrate the moderating effect of focal firms' market power between *SUS* and *RTC*, *SUC* and *RTC*, and *PTC*, we created a conditional effects graph as shown in Fig. 2(a), (b) and (c), respectively.

5.2. Trade credit model

Next, we explore the impact of UD relationship stability and concentration on trade credit models. We suspect that stable suppliers are beneficial for focal firms in the lower-cost trade credit model, whereas a high-level concentration of suppliers leads to the opposite conclusion. Moreover, customer stability and concentration are also beneficial for focal firms to select the lower-cost trade credit model. We arrive at this conclusion for two main reasons.

First, from the upstream perspective, a stable relationship with the upstream represents there are more familiarity, trust, and satisfaction with stable suppliers (Keisidou et al., 2013). Trust plays a crucial role in providing stable expectations for the parties involved and reducing transaction costs, particularly in the case of trade credit. The lack of synchronization between the delivery of goods and payment is a critical characteristic of trade credit. Establishing long-term business ties with a dependable supplier enhances credibility and lowers the cost of trade credit for focal firms. However, suppliers with a high level of concentration are more concerned about their profits and tend to synchronize delivery and payment, which can be a disadvantage for focal firms seeking to select the lower-cost trade credit model by relying on their stronger bargaining power.

Second, from a downstream perspective, when focal firms have more stable and concentrated customers, it conveys a positive signal to suppliers that focal firms have a bright sales situation and huge market potential. Suppliers are usually willing to extend focal firms more

Table 9
Results of the cluster at firm-level.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>RTC</i>	(4) <i>PTC</i>	(5) <i>PTC</i>	(6) <i>PTC</i>
<i>SUS</i>	0.0122** (2.0078)		0.0121** (1.9867)			
<i>SUC</i>		−0.0005*** (−4.3585)	−0.0005*** (−4.4514)			
<i>CUS</i>				0.0177** (2.433)		0.0156** (2.107)
<i>CUC</i>					0.0003** (2.2895)	0.0003** (2.0879)
<i>SIZE</i>	−0.0028 (−0.8966)	−0.0052* (−1.6932)	−0.0056* (−1.8214)	−0.0184*** (−6.1594)	−0.0170*** (−5.6777)	−0.0173*** (−5.7945)
<i>AGE</i>	−0.0045 (−0.4651)	0.0028 (−0.2927)	0.0032 (−0.3299)	−0.0323*** (−2.8362)	−0.0343*** (−2.9860)	−0.0331*** (−2.8871)
<i>LEV</i>	0.1724*** (9.0136)	0.1693*** (9.2521)	0.1712*** (9.4047)	0.0588*** (2.6221)	0.0558** (2.5001)	0.0586*** (2.6188)
<i>ROA</i>	0.0831*** (2.8811)	0.0843*** (3.0272)	0.0832*** (3.0107)	0.1792*** (4.3867)	0.1913*** (4.6225)	0.1854*** (4.5223)
<i>CASH</i>	−0.0123*** (−5.7674)	−0.0112*** (−5.3956)	−0.0112*** (−5.4441)	−0.0189*** (−8.0881)	−0.0193*** (−8.1485)	−0.0192*** (−8.1146)
<i>PPE</i>	−0.0654*** (−3.4541)	−0.0606*** (−3.2942)	−0.0609*** (−3.3224)	−0.1970*** (−9.9088)	−0.1971*** (−10.1898)	−0.1984*** (−10.2285)
<i>INTANG</i>	−0.1523*** (−4.2760)	−0.1303*** (−3.7622)	−0.1304*** (−3.7828)	−0.3481*** (−8.1698)	−0.3405*** (−7.7439)	−0.3392*** (−7.8102)
<i>GROWTH</i>	0.0007 (0.7176)	0.0014* (1.7169)	0.0015* (1.8837)	−0.0001 (−0.0975)	−0.0005 (−0.4367)	−0.0002 (−0.1707)
<i>TOP</i>	0.0006*** (3.2694)	0.0006*** (3.463)	0.0006*** (3.459)	0.0001 (0.3753)	0.0001 (0.4768)	0.0001 (0.4286)
<i>Constant</i>	0.1477** (2.1875)	0.1425** (2.0079)	0.1458** (2.0569)	0.5658*** (8.4659)	0.5381*** (7.8806)	0.5351*** (7.8504)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES	YES
<i>Observations</i>	3137	3137	3137	3655	3655	3655
<i>adj.R-squared</i>	0.3855	0.4137	0.4152	0.4077	0.4088	0.4105

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

trade credit at a lower interest rate, demonstrating their dedication to sustaining relationships with focal firms (Petersen and Rajan, 1994). Therefore, focal firms with stable and highly concentrated customers have an advantage in selecting the lower-cost trade credit model.

There are three kinds of trade credit models with different transaction costs: accounting payable, notes payable, and prepayments. Each model has different costs of trade credit, with accounts payable having the lowest transaction costs, followed by notes payable and prepayments being the most expensive. With the high level of security required by the provider, the cost of trade credit increases. We measured the cost of trade credit by prepayments divided by the sum of prepayments, notes payable, and accounts payable. The cost of the trade credit utilized by the firms increases as the value of the indicators increases. Model (9) demonstrates how the stability and concentration of UD relationships affect the cost of trade credit.

$$TCC_{i,t} = \eta_0 + \eta_1 SUS_{i,t} + \eta_2 SUC_{i,t} + \eta_3 CUS + \eta_4 CUC + \eta_5 Controls_{i,t} + YEAR_{dummies} + IND_{dummies} + \varepsilon_{i,t} \quad (9)$$

In model (9), TCC represents the cost of trade credit. The remaining variables are consistent with the previous regression models.

The regression results are presented in Table 12. In column (5), from the upstream perspective, the SUC ($\eta_2 = 0.0020$, $p < 0.01$) is a disadvantage for focal firms to choose the low cost of trade credit. From the downstream perspective, CUS ($\eta_3 = -0.0395$, $p < 0.05$) is an advantage for focal firms to choose the low cost of trade credit, meanwhile, SUS ($\eta_1 = -0.0217$) and CUC ($\eta_4 = -0.0002$) are negative but not significant. The results suggest that focal firms should keep a stable relationship with customers, which will allow focal firms to receive trade credit with a lower interest rate. Meanwhile, focal firms should avoid over-reliance on upstream, which is disadvantageous, to reduce the cost of trade credit.

6. Discussion and conclusions

6.1. Discussion

Due to the more intense competition within the supply chain and the more complicated organizational structure caused by the interactions between more involved parties, stability, and concentration of UD relationships play a vital role in focal firms' financing, especially trade credit. Despite this, when it comes to two-level trade credit, existing research cannot answer whether stable and concentrated BS relationships are ideal.

Using 973 A-shared listed firms in China from 2012 to 2021, and by BS theory, this paper intends to analyze the impact of the stability and concentration of UD relationships on two-level trade credit. The results unequivocally demonstrate that supplier stability positively impacts the trade credit received by focal firms, whereas supply concentration exerts a negative influence. Customer stability and concentration positively affect focal firms' provided trade credit. Furthermore, stability exerts a more significant influence than concentration. The findings demonstrate the importance of positive BS interactions in enhancing focal firms' trade credit, and focal firms should be more cautious with large suppliers and customers.

We further explore the contingency conditions of this effect within the context of focal firms' market power. Focal firms' market power weakens the impact of supplier stability and concentration on focal firms' received trade credit while strengthening the impact of customer concentration on focal firms' provided trade credit. Therefore, focal firms with stronger market power can be advantageous for maintaining collaborative relationships in the supply chain. In addition, we find that a high-level concentration of suppliers is a disadvantage for focal

Table 10

Robustness check: non-linearity test.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>PTC</i>	(4) <i>PTC</i>
<i>SUS</i> * <i>SUS</i>	−0.0147 (−1.1127)			
<i>SUC</i> * <i>SUC</i>		0.0000 (1.5492)		
<i>CUS</i> * <i>CUS</i>			0.0141 (0.9436)	
<i>CUC</i> * <i>CUC</i>				0.0000 (0.4288)
<i>SUS</i>	0.0238* (1.649)			
<i>SUC</i>		−0.0008*** (−3.7556)		
<i>CUS</i>			0.0027 (0.1645)	
<i>CUC</i>				0.0004* (1.793)
<i>SIZE</i>	−0.0031* (−1.9472)	−0.0053*** (−3.3669)	−0.0184*** (−11.1210)	−0.0170*** (−10.3253)
<i>AGE</i>	0.0008 (0.1594)	0.0027 (0.5619)	−0.0318*** (−5.7561)	−0.0341*** (−6.1829)
<i>LEV</i>	0.1739*** (16.6248)	0.1687*** (16.6039)	0.0589*** (4.9032)	0.0559*** (4.6779)
<i>ROA</i>	0.0874*** (4.2162)	0.0836*** (4.1003)	0.1795*** (6.278)	0.1921*** (6.681)
<i>CASH</i>	−0.0112*** (−8.6921)	−0.0113*** (−9.0467)	−0.0189*** (−12.6336)	−0.0192*** (−12.7689)
<i>PPE</i>	−0.0653*** (−6.7510)	−0.0596*** (−6.2017)	−0.1962*** (−18.8793)	−0.1967*** (−19.1108)
<i>INTANG</i>	−0.1339*** (−6.8571)	−0.1286*** (−6.5987)	−0.3463*** (−15.6916)	−0.3408*** (−15.3201)
<i>GROWTH</i>	0.0011 (1.5752)	0.0014* (1.9493)	−0.0001 (−0.1321)	−0.0005 (−0.5124)
<i>TOP</i>	0.0006*** (6.6314)	0.0006*** (6.9567)	0.0001 (0.6691)	0.0001 (0.8966)
Constant	0.0822** (2.337)	0.1516*** (4.1387)	0.5668*** (15.6522)	0.5349*** (14.3402)
<i>YEAR</i>	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES
Observations	3137	3137	3655	3655
adj. <i>R</i> -squared	0.4013	0.4139	0.4077	0.4086

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

firms choosing a lower-cost trade credit, while stable customers have the opposite effect. Thus, focal firms should be knowledgeable about the different trade credit models available by establishing a long-term stable relationship between its UD, the lowest transaction costs for accounts payable, mutual trust can be enhanced, and the cost of trade credit can be further reduced.

6.2. Theoretical implications

This paper explores how the characterization of UD relationships, including stability and concentration, affects focal firms' two-level trade credit. The theoretical contributions of our paper to BS interaction in supply chain management include the following.

First, the results demonstrate that supplier stability has a positive impact, while concentration has an adverse effect on focal firms' received trade credit. Meanwhile, customer stability and concentration positively affect focal firms' provided trade credit. The rationale for these effects is straightforward from the theory of BS relationships. To maintain stability, focal firms and their supply chain partners frequently choose a long-term, continuing relationship approach to ensure stability instead of perceiving partner contacts as discrete, one-time

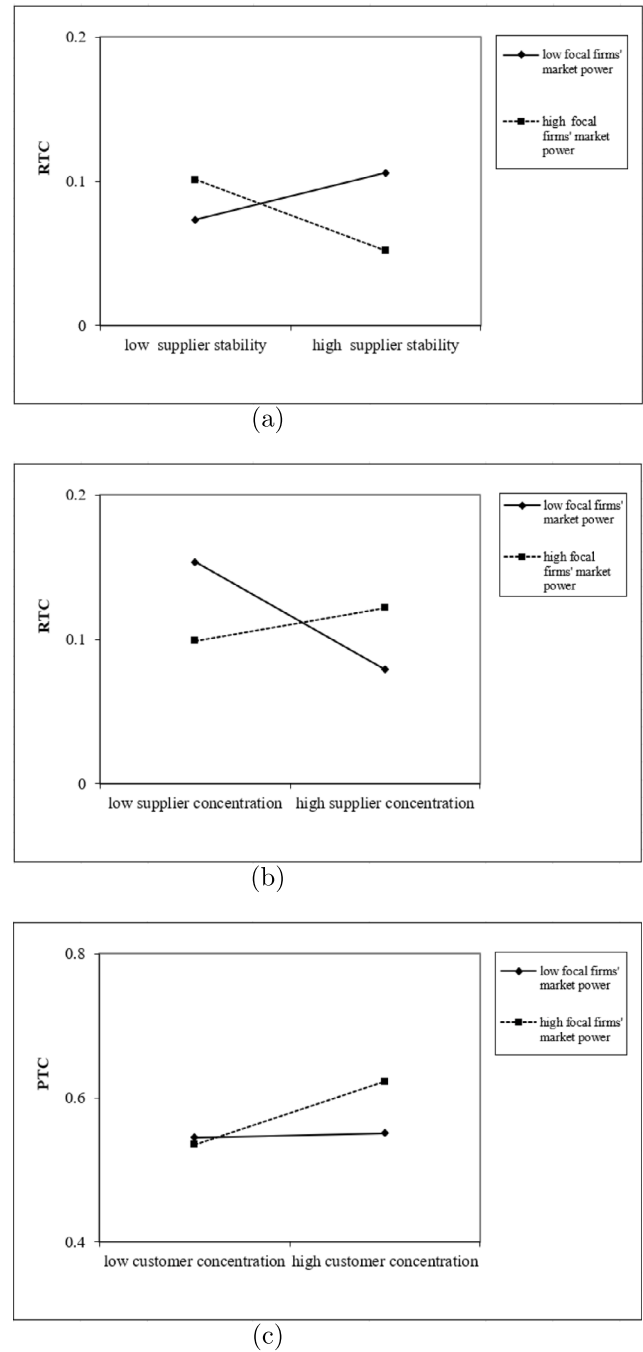


Fig. 2. Moderating effect of focal firms' market power.

events. Thus, focal firms can receive increased trade credit from their stable suppliers and extend greater trade credit to stable customers. Concentration, to some extent, represents bargaining power, thus focal firms receive less from their major suppliers and provide more trade credit to their major customers. The conclusion complements (Bi et al., 2021), which confirms marginal profit is a significant factor affecting the provision of downstream trade credit. Thus, our research is the first to provide a nuanced understanding of the effect of BS relationship characteristics on two-level trade credit.

Second, in terms of research perspective, we consider the characterization of UD relationships. Therefore, this study contributes to the research on supply chain relationships. In contrast to prior studies,

Table 11
Moderating effect of market competition.

Variables	(1) <i>RTC</i>	(2) <i>RTC</i>	(3) <i>RTC</i>	(4) <i>PTC</i>	(5) <i>PTC</i>	(6) <i>PTC</i>
<i>SUS</i>	0.0349*** (3.9804)		0.0395*** (4.545)			
<i>SUC</i>		−0.0009*** (−6.8363)	−0.0009*** (−7.0947)			
<i>CUS</i>				0.0143 (1.4695)		0.0146 (1.4798)
<i>CUC</i>					0.0001 (0.2618)	0.0001 (0.0389)
<i>MP</i>	0.0756** (2.0272)	−0.1654*** (−4.2826)	−0.0566 (−1.2407)	0.0349 (0.907)	−0.0289 (−0.8551)	−0.0341 (−0.8221)
<i>SUS*MP</i>	−0.2226*** (−3.7852)		−0.2384*** (−4.0969)			
<i>SUC*MP</i>		0.0029*** (3.9365)	0.0031*** (4.1587)			
<i>CUS*MP</i>				0.0297 (0.5017)		0.0109 (0.1809)
<i>CUC*MP</i>					0.0023*** (2.8757)	0.0023*** (2.8843)
<i>SIZE</i>	−0.0031** (−1.9655)	−0.0052*** (−3.3207)	−0.0054*** (−3.3799)	−0.0184*** (−11.0752)	−0.0170*** (−10.3235)	−0.0173*** (−10.4994)
<i>AGE</i>	0.0011 (0.2278)	0.0021 (0.4377)	0.0022 (0.4459)	−0.0324*** (−5.9422)	−0.0341*** (−6.2479)	−0.0330*** (−6.0382)
<i>LEV</i>	0.1758*** (16.8571)	0.1697*** (16.6956)	0.1716*** (16.9234)	0.0612*** (5.0667)	0.0565*** (4.7079)	0.0594*** (4.916)
<i>ROA</i>	0.0902*** (4.3674)	0.0852*** (4.1624)	0.0839*** (4.1318)	0.1750*** (6.0573)	0.1840*** (6.356)	0.1776*** (6.1333)
<i>CASH</i>	−0.0108*** (−8.3728)	−0.0112*** (−8.9149)	−0.0109*** (−8.6805)	−0.0188*** (−12.4866)	−0.0194*** (−12.8784)	−0.0193*** (−12.8212)
<i>PPE</i>	−0.0664*** (−6.9061)	−0.0621*** (−6.4833)	−0.0633*** (−6.6203)	−0.1968*** (−18.8510)	−0.2007*** (−19.2969)	−0.2021*** (−19.3567)
<i>INTANG</i>	−0.1290*** (−6.5101)	−0.1301*** (−6.6860)	−0.1254*** (−6.3480)	−0.3526*** (−15.9450)	−0.3433*** (−15.5495)	−0.3423*** (−15.5195)
<i>GROWTH</i>	0.0012 (1.5951)	0.0012 (1.64)	0.0014* (1.9343)	0.0002 (0.2232)	0 (0.0115)	0.0003 (0.3303)
<i>TOP</i>	0.0006*** (6.5407)	0.0006*** (6.986)	0.0006*** (6.8828)	0.0001 (0.737)	0.0001 (0.8835)	0.0001 (0.7948)
<i>Constant</i>	0.0727** (2.0778)	0.1601*** (4.4691)	0.1456*** (4.0585)	0.5628*** (15.3374)	0.5450*** (14.7732)	0.5429*** (14.6332)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES	YES
<i>Observations</i>	3135	3135	3135	3650	3650	3650
<i>adj.R-squared</i>	0.405	0.417	0.4214	0.4091	0.4114	0.4131

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

we comprehensively consider stability and concentration. Stable relationships have economic and sustainable benefits, while over-reliance on UD always leaves focal firms more at risk (Cen et al., 2018). The findings reveal that the stability and concentration of relationships are important factors influencing cash flows within the supply chain, complementing (Liu et al., 2020), underscoring the significance of power dynamics in BS interactions within the supply chain. Thus, our study further emphasizes the importance of maintaining a reasonable relationship of stability and concentration in supply chain finance.

Third, the study elucidates the contingent roles of the firm's market power on the vertical relationships of cooperation and competition in the supply chain on two-level trade credit, which supplements the existing literature on the supply chain finance from the perspective of market power (Liu et al., 2020; Wang et al., 2023). Specifically, focal firms' market power negatively moderates the impact of supplier stability and concentration on focal firms' received trade credit and positively moderates the impact of customer concentration on focal firms' provided trade credit. Nevertheless, we unexpectedly observe an insignificant moderating effect in the impact of customer stability on focal firms' provided trade credit. A possible explanation for that can be that stable customer relationships create interdependence of customers

and suppliers (Zheng et al., 2011), strengthening both parties' commitment to the partnership. Thus, focal firms may not need to demonstrate their own market power to test customer loyalty. In a word, The findings complement the existing literature by emphasizing the role of market power as an incentive mechanism, which not only motivates firms to enhance interdependence and trust with their partners but also expedites financial flows within the supply chain.

Fourth, this study complements the literature on supply chain finance by exploring the cost of financing. Existing literature on supply chain finance literature mainly focuses on financial characteristics (Shenoy and Williams, 2017), competition (Chod et al., 2019), and supply chain networks (Carnovale et al., 2019). In our study, as expected, supplier concentration is a disadvantage, while customer stability is an advantage for focal firms to choose the low-cost trade credit model. Cash liquidity and low cost within the supply chain are important for achieving synergistic business operations. The findings have theorized the benefits of stability and concentration of UD relationships in facilitating cash flows within the supply chain and reducing the cost of financing. In sum, our study added to the literature that explores the supply chain integration in terms of the characteristics of supply chain relationships (Tsanos and Zografos, 2016; Ak and Patatoukas, 2016).

Table 12
Results of trade credit models.

Variables	(1) <i>TCC</i>	(2) <i>TCC</i>	(3) <i>TCC</i>	(4) <i>TCC</i>	(5) <i>TCC</i>
<i>SUS</i>	−0.0172 (−1.1020)				−0.0217 (−1.3308)
<i>SUC</i>		0.0020*** (8.0454)			0.0020*** (8.2822)
<i>CUS</i>			−0.0430*** (−2.7612)		−0.0395** (−2.4048)
<i>CUC</i>				−0.0001 (−0.5398)	−0.0002 (−0.9036)
<i>SIZE</i>	0.0193*** (3.9381)	0.0266*** (5.5003)	0.0196*** (4.0107)	0.0191*** (3.8813)	0.0277*** (5.7655)
<i>AGE</i>	−0.0347* (−1.9144)	−0.0494*** (−2.8234)	−0.0362** (−1.9911)	−0.0353* (−1.9558)	−0.0501*** (−2.8473)
<i>LEV</i>	0.1491*** (4.6181)	0.1651*** (5.1692)	0.1469*** (4.5652)	0.1523*** (4.7411)	0.1565*** (4.8927)
<i>ROA</i>	0.0185 (0.2276)	0.0426 (0.5348)	0.0305 (0.3749)	0.0204 (0.2512)	0.0519 (0.6512)
<i>CASH</i>	0.0038 (0.6033)	0.0024 (0.374)	0.0035 (0.551)	0.0036 (0.5666)	0.0024 (0.3797)
<i>PPE</i>	−0.0559 (−1.6398)	−0.0775** (−2.2723)	−0.0516 (−1.5111)	−0.0590* (−1.7256)	−0.0685** (−2.0123)
<i>INTANG</i>	−0.2624*** (−3.8051)	−0.2804*** (−3.9633)	−0.2621*** (−3.7957)	−0.2583*** (−3.7669)	−0.2888*** (−4.0540)
<i>GROWTH</i>	−0.0021 (−0.7902)	−0.0038 (−1.3059)	−0.0028 (−1.0414)	−0.002 (−0.7435)	−0.0047 (−1.6392)
<i>TOP</i>	−0.0016*** (−4.6821)	−0.0016*** (−4.9330)	−0.0015*** (−4.6695)	−0.0015*** (−4.6610)	−0.0016*** (−4.9724)
<i>Constant</i>	−0.0312 (−0.2627)	−0.2076* (−1.7673)	−0.0223 (−0.1868)	−0.0359 (−0.2966)	−0.2034* (−1.7125)
<i>YEAR</i>	YES	YES	YES	YES	YES
<i>IND</i>	YES	YES	YES	YES	YES
<i>Observations</i>	2343	2343	2343	2343	2343
<i>adj.R-squared</i>	0.1274	0.1559	0.13	0.1271	0.1593

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are in the parentheses.

More importantly, the prior literature lacks a discussion of the cost of trade credit, making our research the first to reveal the stability and concentration of UD and firms' trade credit models.

6.3. Managerial implications

The study offers valuable insights for focal firms seeking to establish and maintain strong relationships with partners within the supply chain. To better use trade credit, focal firms should prioritize building and maintaining close UD relationships while avoiding becoming overly dependent on their suppliers. By balancing stability and concentration, focal firms can achieve optimal levels of trade credit, ultimately leading to improved supply chain finance and overall performance.

First, the research in this paper suggests that a healthy UD relationship should be stable and not overly concentrated. From the upstream perspective, having stable suppliers is an advantage for focal firms' access to the trade credit, whereas concentration is not. Our findings suggest that firms should pay attention to establishing a stable relationship with suppliers, including many other smaller suppliers. This suggestion was developed by Gu et al. (2022), who confirmed that stable suppliers are beneficial for focal firms' financial performance, while concentrated suppliers are not. This is consistent with the attitude of exercising restraint and avoiding over-reliance in dealing with suppliers, especially when considering financing.

Second, firms should aim to cultivate loyal customers to foster stronger cooperation. Focal firms extend trade credit to stable customers, and the utilization of trade credit mutually benefits both the supplier and customer in the process (Bi et al., 2021). As stable customers are desirable, they send a positive signal to suppliers, further reducing the cost of trade credit. Thus, focal firms should deepen the

level of cooperation with major customers and shift them to stable customers, which facilitates the efficient movement of cash and resources within the supply chain. This suggestion was developed by Chen et al. (2023), who confirmed that major customer encourages mutual reliance and trust, which facilitates the implementation of integration practices. Meanwhile, it is important to be mindful of the potential drawbacks of over-reliance on them (Hui et al., 2019). In other words, focal firms should avoid becoming "kidnapped" by major customers, as this can leave them vulnerable to the demands of major customers. By prioritizing the cultivation of loyal customers, focal firms can effectively leverage trade credit and enjoy the advantages of fortified relationships.

Third, managers should be aware of the value of market power, as our findings demonstrate that focal firms could alter financial flows through horizontal power. In other words, the influence of firms' market power in the industry also extends to their vertical relationships of cooperation and competition, consequently impacting financial flows within the supply chain. Hence, beyond the pursuit of establishing and nurturing stable supplier and customer relationships, managerial efforts should be directed towards enhancing market power and fostering a co-operative ethos among supply chain partners rather than exacerbating competition.

Last but not least, managers should adopt a more rational approach when evaluating the cost of trade credit. Stable suppliers are beneficial for the cost of trade credit, while concentration suppliers are not. Furthermore, having a stable sales channel can also benefit focal firms, as it instills confidence in suppliers regarding their ability to repay payments for goods. Thus, it is important to approach the relationship with UD collaboratively (Ma et al., 2020). Additionally, focal firms should strive to improve their competitiveness, thereby giving them more options when it comes to financing methods.

6.4. Limitations and future research

Although this study has offered a nuanced understanding of the BS interaction of stability and concentration effect focal firms' two-level trade credit, several limitations need to be considered. First, future research may contribute by exploring other characteristics of UD relationships (e.g., level of trust, transparency, geographical distance), and even supply chain network characteristics could be taken into consideration. In this way, supply chain cash flow can be explored comprehensively. Second, although we suggest that stability and concentration of UD relationships can impact the two-level trade credit of focal firms, the influence mechanism was not further examined in this study. Therefore, future studies may conduct further analysis in this regard. Finally, the context of our data is limited to Chinese-listed firms; future research may extend to other countries to further discover the impact of different political contexts or institutional differences on the results.

CRedit authorship contribution statement

Jiping Zhang: Investigation, Methodology, Visualization, Writing – original draft. **Haimiao Mo:** Data curation, Formal analysis, Supervision, Writing – review & editing, Project administration. **Zhijian Hu:** Supervision, Writing – review & editing, Resources. **Tianjiao Zhang:** Supervision, Writing – review & editing.

Data availability

The authors do not have permission to share data.

Acknowledgment

This work was supported in part by the China Scholarship Council under Grant 202106690030.

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