

Luu, Lap; Nguyen Thanh Liem

## Article

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\*Corresponding author: Liem Nyugen,  
University of Economics and Law, Ho  
Chi Minh City, Vietnam  
E-mail: [liemnt@uel.edu.vn](mailto:liemnt@uel.edu.vn)

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# Short-term debt and trade credit: Evidence on a non-linear relationship

Lap Luu<sup>1,2</sup> and Liem Nguyen<sup>1,2\*</sup>

**Abstract:** The literature on the relationship between bank credit and trade credit is mixed between the substitution and complementarity effects. The extant studies only investigate the linear relationship between the two factors, thus missing some important implications from any non-linear relationship that could exist. The current study investigates the linear and non-linear impacts of short-term bank debt on trade credit, using a sample of 622 listed non-financial firms in Vietnam from 2011 to 2019. The research results contribute to reconciling the mixed findings about the impact of short-term debt on trade credit by showing that short-term debt tends to reduce the use of the latter at high levels of short-term debt. However, at lower levels, the substitution effect is weaker. Together, the pattern between the two factors depicts an inverted U-shaped relationship. This implies that in the relation between the two short-term funding sources, the levels of short-term debt could indicate financial constraints firms face when accessing capital markets.

**Subjects:** Corporate Finance; Business, Management and Accounting; Entrepreneurial Finance

**Keywords:** trade credit; non-linear effect; Vietnam; pecking order

## 1. Introduction

In general, a firm has a number of incentives to extend trade credit to their buyers, e.g., to save transaction costs and/or generate higher sales (Bastos & Pindado, 2007; Deloof & Overfelt, 2011). For buyers, trade credit is an important source of short-term funding (Levine et al., 2018; Seifert et al., 2013). Trade credit allows firms to realize growth opportunities (Fisman & Love, 2003), or even to secure their livelihood (McGuinness et al., 2018). Trade payables could account for as much

## ABOUT THE AUTHOR

PhD Liem Nguyen is a lecturer of Faculty of Finance and Banking cum research fellow of Center for Economic and Financial Research, University of Economics and Law, Hochiminh City, Vietnam. Liem has several research interests including corporate governance, corporate social responsibility, and earnings management. Liem has published on several notable journals including *Heliyon*, *Pacific Accounting Review*, *Cogent Economics and Finance*, *Cogent Business & Management*, *Sustainability*, and *Asia-Pacific Journal of Business Administration*. PhD student Lap Luu has strong interests in earnings management and trade credit. Lap has conducted several studies on trade credit and the current study is one of his series.

## PUBLIC INTEREST STATEMENT

The linear relationship between bank credit and trade credit has been examined extensively, and the literature cannot offer decisive statements about it. We argue that the link between the two funding sources could feature a non-linear pattern. Using a sample of 622 listed non-financial firms in Vietnam from 2011 to 2019, we find that short-term debt tends to reduce the use of trade credit at high levels of short-term debt. On the other hand, the substitution effect is not as strong at low levels of short-term debt. The evidence here points to the need to examine the non-linear relationship between the two funding sources, since this would be insightful to reconcile the mixed findings in the literature.

as a quarter of the average total debt liabilities for a sample of firms in 34 countries from 1990 to 2011 (Levine et al., 2018). Yazdinejad and Jokar (2019) document that for half of Iranian manufacturing firms in 2017, nine out of ten businesses use trade credit and trade debt accounts for circa three-quarters of liabilities. Not only firms in developing countries, U.S. corporations also depend on trade credit as an important source of short-term financing (Jory et al., 2020). This is interesting, given the omnipresence of the official lending channel—financial intermediaries in developed markets.

There has been ample interest in examining the relationship between short-term bank loans and trade credit, but the results tend to be mixed at best. On the one hand, Meltzer (1960), Petersen and Rajan (1997), Schwartz (1974), Huang et al. (2011), and Psillaki and Eleftheriou (2015) put forward and find evidence in support of the *substitution hypothesis*, which implies a negative relationship between payables and bank credit. This hypothesis is based on pecking order theory: firms prefer short-term bank loans because trade credit is generally more expensive, and only when firms are unable to collect more loans from banks will they resort to trade credit as a substitute. In fact, Jory et al. (2020) find that trade credit's implied interest rates could be as high as 43.9% for a 2/30 trade term. Consistently, Petersen and Rajan (1997) argue that U.S. firms use more trade credit if bank credit is not available. Other studies find that shocks that thwart bank credit availability tend to lead to firms using more trade credit (Choi & Kim, 2005; Love et al., 2007; Nilsen, 2002). Yazdinejad and Jokar (2019) find that as firms in metropolitans have more opportunities to utilize different types of bank loans, they have less need for finance from suppliers. Lin and Chou (2015) and Tang and Mora (2020) investigate the relationship between bank credit and trade credit in China, and also find empirical evidence supporting the *substitution hypothesis* between the two financing sources.

On the other hand, firms may pursue a diversification strategy for financing: they can employ both payables and bank loans such that the two financing options complement each other (Andrieu et al., 2018). Ono (2001), Tsuruta (2015), and Kestens et al. (2012) also find support for diversification motive. The results from these studies suggest a complementary relationship, rather than a substitution one, between trade payables and short-term bank loans. Even though trade credit imposes extra costs, firms can consider it as “insurance premium” paid to address the holdup issue and to ensure that adequate alternative sources of financing are active (Cunat, 2007).

We argue that the inconclusive findings may be due to the levels of short-term debt. In the relationship between short-term debt and trade payables, low levels of short-term debt may indicate that firms have low ability to obtain bank loans; as a result, they may have to rely on trade credit as a complementary source, even though they are in demand of bank short-term loans. On the other hand, firms with high levels of short-term debt may be those that are capable of obtaining much short-term debt. Consequently, they continue to prioritize short-term debt as a cheaper funding source and will switch to trade credit only when they are unable to obtain more short-term debt. The argument in the case of high levels of short-term debt is highly consistent with the substitution hypothesis that is based on pecking order theory (Petersen & Rajan, 1997; Schwartz, 1974). This is interesting because high levels of short-term debt should be associated with higher liquidity risk (Diamond, 1991), or should imply that these firms may have used up the credit line, which may incentivize them to switch to other funding sources, including trade credit. The evidence here would clearly indicate the different preferences of short-term debt versus trade credit at different levels of short-term debt. Both of these arguments point to potential non-linear relationships between the two funding sources. Surprisingly, the non-linear effect has not been examined in previous studies, even though this could help reconcile the inconclusive findings about the relationship between the two sources of short-term financing.

The present study seeks to fill the gap by investigating the (non-linear) link between short-term bank credit and trade credit in Vietnam. Vietnam houses an interesting setting for the current study for a number of reasons. First, the association between short-term debt and trade credit has not been investigated much in Vietnam. Second, Vietnam has a dominating banking system in comparison with stock and bond markets. The ratio of bank credit provided to private sector to GDP

from World Bank Indicator in 2019 is rather high, at 137.91%. For comparison, the same figure for the world average is 54.77%. Meanwhile, the sizes of local bond market as well as stock are pretty low compared to those of other regional countries, such as Thailand and Indonesia. The relatively short-term nature of deposits thwarts banks' ability to provide long-term credit to firms in Vietnam. This might lead to a strong preference for short-term debt among Vietnamese firms. In fact, listed firms which are supposed to have access to multiple funding sources still employ a high proportion of short-term debt. Meanwhile, due to few choices of external financing and high levels of information asymmetry in this developing market (Vo, 2018), firms might also have to rely on the supplier's financing. Therefore, it is interesting to examine whether firms rely more on short-term debt or supplier financing in this setting.

Our evidence suggests that there is a negative association between trade credit and bank credit, supporting the substitution hypothesis for a sample of non-financial listed firms in Vietnam from 2011 to 2019. Furthermore, we document an inverted U-shaped relationship between the two factors, indicating that at low-levels of short-term debt, the substitution effect is not obvious; whereas, at higher levels of short-term debt, this effect becomes dominant. This evidence suggests that, in the relation between the two funding sources, levels of short-term debt can signify corporate ability to access bank loans and thus have low financial constraints. Therefore, firms with a high volume of short-term bank debt should have little incentive to be concerned about the insurance effect. This is the first study examining the non-linear relationship between trade credit and bank credit, and its findings can help to identify channels to reconcile the mixed conclusions in the literature.

The remains of the paper are structured as follows: Section 2 presents the review of the literature and builds hypotheses. Section 3 discusses the estimation method, while section 4 provides empirical results and interpretations. Section 5 concludes the research.

## 2. Literature review and hypothesis development

Bank credit is provided to firms in the form of short-term loans, invoice discounting, overdrafts, and so on. Loans are granted after banks have evaluated firms' creditworthiness, and this could prove problematic in an environment with high levels of information asymmetry (Tang & Mora, 2020). Trade credit is catered to buyers through payment extensions, and this grace period typically ranges from 30 to 90 days. Compared to banks, suppliers generally have fewer problems in mitigating information asymmetry due to their intimate knowledge about a regular buyer and their ability to repossess, remodel and resell the products in the event of the buyer's default (Ono, 2001).

Schwartz (1974) shows that suppliers with relatively low financing costs are able to obtain more bank credit during a contractionary period, which enables them to extend trade credit to financially constrained buyers that face more challenges in borrowing from banks (Huang et al., 2011), a phenomenon referred to as the redistribution effect. In contractionary periods, banks are prone to be more conservative, while trade creditors might be more willing to support buyer firms that experience temporary liquidity difficulty (Love, 2011). As to why suppliers are interested in providing financing, Wilner (2000) and Cunat (2007) explains that a dependent supplier is more likely to extend credit to a distressed business partner in order to sustain a long-term relationship that involves sunk costs. Kestens et al. (2012) found that the behavior of Belgian non-listed firms features both the substitution and redistribution effects related to trade credit. McGuinness et al. (2018) found that the substitution effect, not the redistribution effect, is supported for Irish SMEs during the financial crisis.

Trade credit is typically more expensive due to a higher direct cost of funds compared to banks (Atanasova, 2007; Jory et al., 2020; Petersen & Rajan, 1997; Tang & Mora, 2020). This results in a pecking order in terms of short-term financing sources: firms prioritize bank credit to keep financing costs low, and will use trade credit only when they are unable to take on bank loans. Consistent with this pecking order, Meltzer (1960), Schwartz (1974), and Petersen and Rajan (1997) provide early evidence on the substitutional relationship between bank credit and trade credit.

Similarly, Danielson and Scott (2004), Petersen and Rajan (1997), and Nilsen (2002) find that bank credit rationing leads to an increase in trade credit use for more opaque firms.

Chen et al. (2019) show that with the deregulation of bank interest rate ceiling and floor that allows banks to compete more freely, firms in China show their strong preference for short-term bank debt compared to trade credit. Tang and Mora (2020) investigate the relationship between payables and short-term bank debt using a sample of 1,525 Chinese small and medium-sized listed non-financial firms from 2008 to 2016 to see whether SMEs in China follow a substitution or complementarity pattern in financing investments. The research points out several notable points. First, firms use both bank credit and payables to finance receivables and an increase in inventory. Second, even though firms use both sources for financing, the two substitute each other and this substitution effect is enhanced among constrained firms that are struggling to fund their growth using bank debt.

Therefore, it is quite clear that the literature offers considerable evidence supporting the view that trade credit and bank short-term credit are alternative financing options. In line with the mainstream findings, we establish the following testable hypothesis:

### **2.1. Hypothesis H1: trade credit is negatively associated with bank short-term credit**

According to Kabir and Zubair (2015), when investigating the role of trade credit, researchers examine both views: trade credit could either be a substitute or a complement to bank credit. Blasio (2005) provides indecisive evidence on the ability of trade credit as a substitute to bank loans. Nadiri (1969) found that U.S. manufacturing firms saw their trade credit decrease when they had lower bank credit in periods of tight money policies, which means it is not always a negative relationship between the two sources of short-term financing.

Ono (2001) believes in a complementary relationship between the two sources. Ono (2001) investigates the determinants of trade credit for a sample of Japanese manufacturing firms, and finds a positive association between trade payables and bank loans. Ogawa (2003) argues that trade credit and bank loans are substitutes for large and medium-sized companies, while smaller firms need both of the funding sources. The author suggests that trade credit is insufficient to compensate for a decrease in bank loans for smaller firms in Japan in the 1990s. More recently, Tsuruta (2015) found that small businesses increase trade credit even when bank loans are more available, using the event of credit guarantee program after 2008 as an exogenous shock that enhanced bank credit availability. This again confirms the complementary relationship between trade payables and bank loans, at least for small businesses in Japan.

There are two reasons to anticipate a positive relationship between the two financing sources. First, firms may need to diversify funding sources, i.e., they could use bank and supplier financing together to lower the risk of financing sources drying up (Andrieu et al., 2018; Tang & Mora, 2020). As per argument set in Cunat (2007), this diversification strategy can act as an insurance device to ensure that firms are solvent and not in distress. We refer to this as the *insurance effect*.

The complementarity between trade credit and bank credit is normally documented for firms that have high levels of financial constraints (Andrieu et al., 2018; McGuinness & Hogan, 2016; Ogawa, 2003; Taketa & Udell, 2007; Tsuruta, 2015; Uesugi & Yamashiro, 2008). McGuinness and Hogan (2016) found that small firms use trade credit even though they rely more on bank finance because the former helps ease financial burdens during financial crises. Firms with more credit constraints could find it essential to obtain both types of funding because they tend to be more informationally opaque and have lower creditworthiness.

We argue that there are two possible non-linear (U-shaped and inverted U shaped) relationships between the two sources. First, at high levels of short-term bank loans, firms can have higher liquidity risk (Diamond, 1991; Fung & Goodwin, 2013), as well as they are likely to use up the credit line provided by banks, which lowers the enthusiasm of banks to continue lending to their borrowers.

Short-term debt is prone to intensify the incentives to conduct earnings management in an effort to avoid the violation of loan covenants (DeFond & Jambalvo, 1994) and to tackle refinancing pressure (Fields et al., 2018). These are the disadvantages that emanate from the use of short-term debt, especially at high levels (Fung & Goodwin, 2013; Gupta et al., 2008). When there are high levels of short-term debt, firms may have to resort to more trade credit to reduce bankruptcy risk. This pattern would lead to a U-shaped relationship between short-term loan and trade credit.

However, if high levels of short-term debt indicate the ability to access bank credit; then, firms with high levels of bank credit should be less concerned about the insurance effect. This is because they are not financially constrained and still wish to use bank credit in place of payables to minimize the financing costs. On the contrary, firms with low levels of short-term debt may be financially constrained, so the insurance effect may play a more important role, lending support to the substitution effect. This possible pattern is highly consistent with the findings from a number of studies that document the complementarity between trade credit and bank credit for firms that have high levels of financial constraints (Andrieu et al., 2018; McGuinness & Hogan, 2016; Ogawa, 2003; Taketa & Udell, 2007; Tsuruta, 2015; Uesugi & Yamashiro, 2008).

To summarize, the literature has documented both negative (substitution) and positive (complementarity) relationships between the two financing sources. In an effort to uncover channels to reconcile the mixed findings, we examine the non-linear effect of short-term bank loans on payables. Since there are two possible patterns of non-linear relationships between bank credit and trade credit, we establish the following hypothesis without specifying the direction:

**Hypothesis H2: there exists a non-linear relationship between short-term bank credit and trade credit.**

### 3. Research methodology

To test Hypothesis H1 on the linear relationship, the model in this research is based on Garcia-Teruel and Martinez-Solano (2010), Ge and Qiu (2007), and Kabir and Zubair (2015), which is as follows:

$$\text{Paya}_{it} = \beta_0 + \beta_1 \text{size}_{it} + \beta_2 \text{cflow}_{it} + \beta_3 \text{shortdebt}_{it} + \beta_5 \text{longdebt}_{it} + \beta_5 \text{receiv}_{it} + \beta_6 \text{salegrow}_{it} + \beta_7 \text{liquid}_{it} + \varepsilon_{it} \quad (1)$$

Where: *Paya* is the ratio of trade payables to total assets, *Receiv* is the ratio of accounts receivable to sales (Garcia-Teruel & Martinez-Solano, 2010; Ge & Qiu, 2007; Petersen & Rajan, 1997). *Shortdebt* is the ratio of short-term bank debt to total assets, and this explanatory variable of interest is included to test whether the substitution effect or complementarity effect dominates (Garcia-Teruel & Martinez-Solano, 2010).

*Size* is the natural logarithm of total assets (Garcia-Teruel & Martinez-Solano, 2010; Ge & Qiu, 2007; Mateut et al., 2006). Large firms are more likely to have higher creditworthiness and better access to capital markets than small firms; as a consequence, they are expected to depend less on the credit from suppliers. As a result, we can expect a negative relation between firm size and firm payables. However, Petersen and Rajan (1997), Garcia-Teruel and Martinez-Solano (2010), and Ge and Qiu (2007) also point to another view that larger firms may have better access to trade credit thanks to their reputation. *Cflow* is calculated as the ratio of cash flow to total assets, and cash flow is the sum of net profits and depreciation (Garcia-Teruel & Martinez-Solano, 2010). This variable is included to control for the capability of the firm to generate internal funds. Firms with better capacity to create internal resources are expected to demand less supplier credit (Garcia-Teruel & Martinez-Solano, 2010; Ge & Qiu, 2007; Huang et al., 2011).

*Longdebt* is measured as the ratio of long-term debt from banks to total assets and is introduced to examine the substitution effect between long-term financing and trade credit (Deloof & Jegers, 1999;



Garcia-Teruel & Martinez-Solano, 2010). *Salegrow* and *Liquid* are added, in line with Kabir and Zubair (2015) and Garcia-Teruel and Martinez-Solano (2010), and  $\epsilon$  is the error term in the regression. Sales growth (*Salegrow*) is calculated as the ratio of the change in revenue between period  $t$  and period  $t-1$  to the revenue from period  $t-1$ . Firms with stronger sales growth rates might have better growth opportunities, and this will lead to higher consumption of funds to realize these investment opportunities. If official external sources like bank loans are not sufficient to cover the needs, firms would have to seek trade credit as an additional source (Garcia-Teruel & Martinez-Solano, 2010). *Liquid* is measured as the ratio between current assets and current liabilities. Garcia-Teruel and Martinez-Solano (2010) argue that firms may want to match the maturity of short-term liabilities and assets, so more investment in current assets could be financed by payables.

To test Hypothesis H1, we rely on estimation techniques for panel data, including ordinary least squares (OLS), fixed effects model (FEM) and random effects model (REM). Especially, the use of fixed effects model is conventional for panel datasets, since it is able to deal with individual-fixed effects that do not change over time, one source of potential endogeneity. In order to ensure that the use of fixed effects model is appropriate, we conduct Hausman test to compare the estimates between fixed effects and random effects and F test to compare between fixed effects and pooled Ordinary Least Squares (Pooled OLS). Furthermore, we will conduct Wald test and Woolridge test to verify whether heteroskedasticity and autocorrelation problems exist. If yes, we will use robust standard errors for statistical inferences. We collect data from Thomson Reuters for the sample of 622 listed non-financial firms in Vietnam, for the period from 2011 to 2019.

#### 4. Research results and discussions

Table 1 provides descriptive statistics of the variables in the model. The mean value of *Paya* is 0.115, while *Shortdebt* is 0.17, indicating that short-term debt is not high in terms of the portions to total assets, but the absolute size of short-term debt is twice that of long-term debt. The ratio of cash flow to total assets (*Cflow*) is about 6.5%. *Recei* has the average value of 0.18, or about 20% of the total revenue is from sale on credit. Sales growth rate is fine, at 8% per year. Finally, *Liquid* has the mean of 2.123, indicating that current assets are twice the size of current liabilities.

Table 2 provides pairwise correlation coefficients of the variables in the model. The coefficient of interest (between *shortdebt* and *paya*) is  $-0.07$ , in line with the substitution hypothesis. Nonetheless, as correlation coefficients fail to constitute a valid base for establishing the link between short-term debt and trade payables as opposed to multiple regression. Therefore, regressions will be performed to ascertain the relationship.

Table 3 presents the regression results using Pooled OLS, Fixed effects model (FEM) and Random effects model (REM). To determine which model to rely on for statistical inferences, we perform

**Table 1. Descriptive statistics of the variables**

Variable	Obs	Mean	Std. Dev.	Min	Max
Paya	4,151	0.115	0.103	0.000	0.902
Size	4,151	27.143	1.519	23.330	32.254
Shortdebt	4,151	0.170	0.160	0.000	0.738
Longdebt	4,151	0.071	0.118	0.000	0.759
Cflow	4,151	0.065	0.138	-1.100	1.903
Recei	4,151	0.180	0.161	0.000	0.839
Salegrow	4,151	0.081	0.223	-0.499	0.800
Liquid	4,151	2.123	2.405	0.143	33.151

Source: Author's calculation from research sample.



conventional tests, including F test and Hausman test. The p-values of both tests are significant at 1%, indicating that FEM is the best model of the three. The p-values of the Wald test and Woolridge test are under 5%, indicating that there exists both heteroskedasticity and autocorrelation problems. Therefore, we further perform fixed effects estimation with standard errors that are corrected for these issues.

Short-term debt is negatively and significantly related to trade credit and is significant at 10%, supporting the hypothesis H1 about the substitution effect. Therefore, this study again confirms that trade payables act as a substitute for short-term debt for listed firms in Vietnam. Since the cost of trade credit could be higher compared to that of bank short-term debt, firms may find it more appealing to use as much short-term debt as possible. This forms a pecking order in terms of financing preferences. The result is also in agreement with a large number of empirical papers in this field (Bastos & Pindado, 2013; Choi & Kim, 2005; Love et al., 2007; Nilsen, 2002).

There are several studies that document the complementarity between trade credit and bank credit and they tend to find that this effect is enhanced for firms with high levels of financial constraint (Andrieu et al., 2018; McGuinness & Hogan, 2016; Ogawa, 2003; Tsuruta, 2015). Especially, McGuinness and Hogan (2016) found that small firms use trade credit even though they may favor bank credit because trade credit would be helpful to mitigate the burdens during financial crisis. We suppose that this complementarity effect also exists but it requires a more careful analysis based on the levels of short-term debt.

To examine the non-linear effect of short-term debt on trade payables, we perform regression using fixed effects model on the first and fourth quartiles. This would allow the verification of the impact of short-term bank loans on trade credit at very low and very high levels of short-term debt, respectively (Table 4).

Table 4 presents the fixed effects regression for quartiles 1 and 4, based on short-term debt distribution. Quartile 1 indicates observations with the lowest levels of short-term debt, while quartile 4 is for observations with the highest levels of short-term debt. We use the exact model (1) in columns 1 and 2, while we modify model (1) to replace current *shortdebt* with the lagged *shortdebt* variable to control for the possible endogeneity caused by the two-way relationship between trade credit and bank credit as stated in the complementarity and substitution hypotheses.

From Table 4, it is clear that the coefficient of *shortdebt* is significantly negative only for the sample in quartile 4. This evidence supports Hypothesis H2 on a non-linear relationship between short-term bank credit and payables. At the lowest levels of short-term debt, more short-term debt use is positively related to payables, while it is the opposite at higher levels of short-term debt. This pattern is highly consistent with the view that, in the relation between short-term bank debt and trade credit, the higher levels of bank debt might be associated with firms with better access to bank loans, thus having low financial constraints, and vice versa. If firms have few constraints, they should not be much concerned about maintaining multiple financing sources (complementarity effect) or hold-up problem from banks (Cunat, 2007) or liquidity risk (Diamond, 1991). Therefore, unconstrained firms (with high levels of short-term debt) could focus more on benefiting on the minimization of financing costs, that is, continue to use short-term debt whenever possible. On the other hand, firms that have low levels of short-term debt are supposed to be highly constrained. These firms should be more concerned about the insurance effect from having multiple sources of financing (Kestens et al., 2012; Tsuruta, 2015); thus, paying more at least to not drop trade credit when using bank credit (Andrieu et al., 2018; Cunat, 2007). This argument could explain why at low levels of short-term credit, the coefficient of bank short-term debt is not significant, while at high levels, it is negative and significant.

## 5. Robustness check

We further perform two robustness checks to ascertain the findings. First, we employ another measure for the dependent variable, which is the ratio of accounts payable to cost of goods sold

**Table 2. Correlation matrix**

	Paya	Size	Shortdebt	Longdebt	Cflow	Recei	Salegrow
Paya	1.000						
Size	−0.0034	1.000					
Shortdebt	−0.0699	0.1955	1.000				
Longdebt	−0.1804	0.3713	−0.0615	1.000			
Cflow	−0.0891	−0.0386	−0.2658	0.003	1.000		
Recei	0.1299	−0.0073	0.073	−0.0393	−0.2407	1.000	
Salegrow	0.0452	0.0692	0.012	0.0446	−0.0114	−0.1018	1.000
Liquid	−0.269	−0.2076	−0.3667	−0.1798	0.0813	−0.0829	−0.0641

Source: Author's calculation from research sample.

(Garcia-Teruel & Martinez-Solano, 2010). We perform fixed effects regression with the new dependent variable (Table 4). We find that the results are basically similar to Table 4, meaning that *shortdebt* is not significant at quartile 1 but is significant at quartile 4. Second, we modify model (1) to add the squared value of shortdebt variable (*shortdebt2*), because this is a proper specification to test whether we have a U-shaped or an inverted U-shaped relationship between bank credit and payables. In estimating this model, we test the multicollinearity problem and find that including both *shortdebt* and *shortdebt2* makes this problem worth considering. Therefore, we remove *shortdebt* and perform the hypothesis testing for the coefficient of *shortdebt2*. We find that *shortdebt2* has a significantly

**Table 3. Panel data regression results for model (1)**

	OLS	REM	FEM	FEM_ROBUST
Size	0.002 (0.001)	0.007*** (0.002)	0.011*** (0.002)	0.011* (0.005)
Shortdebt	−0.054*** (0.011)	−0.136*** (0.011)	−0.170*** (0.012)	−0.170*** (0.025)
Longdebt	−0.241*** (0.014)	−0.157*** (0.014)	−0.145*** (0.015)	−0.145*** (0.020)
Cflow	−0.052*** (0.011)	0.000 (0.007)	0.004 (0.007)	0.004 (0.009)
Recei	0.069*** (0.010)	0.059*** (0.009)	0.057*** (0.010)	0.057** (0.021)
Salegrow	0.024*** (0.007)	0.021*** (0.004)	0.021*** (0.004)	0.021*** (0.004)
Liquid	−0.013*** (0.001)	−0.008*** (0.001)	−0.007*** (0.001)	−0.007*** (0.001)
Constant	0.105*** (0.030)	−0.031 (0.046)	−0.142* (0.064)	−0.142 (0.129)
No of observations	4151	4151	4151	4151
Hausman test p-val			0.000	
Wald test p-val			0.000	
Woolridge test p-val			0.000	

Source: author's calculation from research data. \*, \*\* and \*\*\* denote significance at 10%, 5% and 1%, respectively. Numbers in brackets are standard errors.

**Table 4. Fixed effects model for the first and fourth quartiles of shortdebt**

	QUARTILE 1	QUARTILE 4	QUARTILE 1	QUARTILE 4
Size	0.028*** (0.006)	0.019*** (0.004)	0.003 (0.004)	−0.001 (0.006)
Shortdebt	−0.269 (0.388)	−0.416*** (0.024)		
Longdebt	−0.239*** (0.063)	−0.307*** (0.035)		
Cflow	0.055** (0.018)	−0.035** (0.011)	0.024* (0.010)	0.047*** (0.014)
Recei	0.132*** (0.028)	0.065*** (0.018)	0.074*** (0.015)	0.107*** (0.023)
Salegrow	0.028** (0.009)	0.020** (0.006)	0.032*** (0.006)	0.032*** (0.008)
Liquid	−0.005*** (0.001)	−0.114*** (0.010)	−0.006*** (0.001)	−0.065*** (0.012)
L1.shortdebt			−0.001 (0.020)	−0.123*** (0.023)
L1.longdebt			−0.093*** (0.018)	−0.174*** (0.038)
Constant	−0.641*** (0.161)	−0.085 (0.113)	0.047 (0.097)	0.255 (0.150)
No of obs	1032	1067	2463	953
Hausman test p-val	0.000	0.000	0.000	0.000

Source: author's calculation from research data. \*, \*\* and \*\*\* denote significance at 10%, 5% and 1%, respectively. Numbers in brackets are standard errors.

negative coefficient. We also replace the current value of *shortdebt2* with the lagged *shortdebt2* to deal with endogeneity issue as above. The result again shows a significantly negative coefficient of the lagged *shortdebt2*. This evidence is in line with the above results that substitution effect is stronger at high levels of short-term debt. For the sake of brevity, we do not post the estimation results here.

## 6. Conclusions and implications

Trade credit could be a potential substitute for short-term bank debt, but the link between these two types of short-term financing is not conclusive because there is also evidence of complementarity effect. The current study investigates the linear and non-linear impacts of short-term bank debt on trade credit, using a sample of 622 listed firms in Vietnam from 2011 to 2019. The results from the study contributes to partly reconciling the mixed evidence about the impact of short-term debt on trade credit, through providing evidence which suggests a non-linear relationship between these two factors. The extant studies only focus on linear relationship between the two factors, thus skipping the important findings.

Consistent with a vast number of previous studies, our results imply that firms tend to follow a substitution relationship between short-term bank loans and trade credit. However, we extend the literature in investigating the non-linear impact of short-term debt on payables and find that in the relation between these two financing sources, high and low levels of short-term debt could indicate ability to access capital markets. Therefore, at low levels of short-term debt (typically constrained firms), there is less evidence in support of substitution effect, because these firms are more likely to seek multiple financing sources to enjoy insurance effect. At high levels of short-term debt (typically

unconstrained firms), there is strong evidence of the substitution effect, and this is in line with a number of studies that document the complementarity effect for constrained firms. The findings are robust to two measures of trade credit (the dependent variable) and several specifications and methods of estimation.

Such evidence suggests that constrained firms enjoy the security that both sources of financing can bring. Therefore, governments may need to provide more practical sources of financing to ease the constraints for firms in accessing bank loans, or make a bid to lower the cost of trade credit so that this source is more attractive to borrowers.

Future studies could elaborate more on the nature of the non-linear effect of short-term debt on firm's use trade credit by partitioning samples based on governance mechanisms. This would allow us to see whether corporate governance affects firms' tendency to follow the complementarity or substitution effect at different levels of short-term debt.

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#### Author details

Lap Luu<sup>1,2</sup>

Liem Nguyen<sup>1,2</sup>

E-mail: [liemnt@uel.edu.vn](mailto:liemnt@uel.edu.vn)

<sup>1</sup> University of Economics and Law, Ho Chi Minh City, Vietnam.

<sup>2</sup> Vietnam National University, Ho Chi Minh City, Vietnam.

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