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Financial constraints and trade credit: Evidence from Ethiopian firms

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Abstract: There is an extensive literature that links firms' access to formal financial services and trade credit. This is more relevant for firms operating in financially less developed countries. These firms could potentially face a binding bank loan constraint due to the distortions related to information asymmetry and moral hazard. Against this backcloth, this paper will explore the relationship between trade credit and financial constraints for Ethiopian firms. The main objective of this study is to explore the relationship between trade credit practice and financial constraints for Ethiopian manufacturing and service firms. We exploit the repeated cross-sectional data of 2011 and 2015 made available by the World Bank's Ethiopian Enterprise Survey. To address the endogeneity problem between financial constraint and trade credit, the paper employs an instrumental variable (IV) approach. We find a negative relationship between financial constraint and trade credit use. In particular, financially constrained firms have a trade credit use which is about 10 to 18 percentage points lower than unconstrained firms, suggesting that bank credit constrained firms are also trade credit constrained. One policy implication is that addressing constraints in formal financing is more likely to increase the availability of alternative forms of finance such as trade credit.

Subjects: Corporate Finance; Banking; Credit & Credit Institutions

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PUBLIC INTEREST STATEMENT

Firm financing through a trade credit (the purchase/sale of good and services without upfront payment/receipt of cash) is prevalent worldwide. This kind of financial arrangement is more relevant for some firms than the others. There are two lines of argument in relation to the importance of trade credit. One line of argument suggests that firms tend to use trade credit when they face constraints in the formal financial markets, such as bank. The second argument upholds that trade credit and bank credit move in the same direction, providing a suggestive evidence that trade credit is not available if bank credit is not available. Motivated by this competing arguments, we use the World Bank's Enterprise Surveys for Ethiopian firms to examine the relationship between trade credit and financial constraints. Following a plausible methodology, we find that firms that are unable to access bank credit are very less likely to use trade credit. The results have a veritable policy implication which is highlighted in the paper.

Keywords: trade credit; Ethiopia; financial constraint; control function

1. Introduction

There is an extensive literature that focuses on the relationship between firms' access to financial services and firm growth. However, small firms and firms operating in financially less developed countries are constrained by limited access to formal finance, such as bank loan.[1] These firms , usually, heavily rely on their internal funds/retained earnings (Regasa et al., 2020) and/or seek credit purchase (trade credit) from their suppliers (Atanasova, 2007; Casey & O'Toole, 2014; Cunningham, 2005; Marcelin & Brink, 2020). The existing finance literature provides inconsistent evidence on the relationship between trade credit and bank credit. One line of empirical result supports the notion that trade credit is an alternative source of finance suggesting firms exhibit higher demand for trade credit when they face credit constraints imposed by conventional banks, see for example, Chen et al. (2019), Casey and O'Toole (2014), Danielson and Scott (2004), and Fisman and Love (2003)—providing an evidence consistent with the substitution hypothesis.

On the other hand, Lin and Chou (2015) note a complementary effect between bank credit and trade credit, particularly for small firms. Similarly, Petersen and Rajan (1997) report that firms with better access to alternative funds and stronger relationships with financial institutions provide more trade credit. Other earlier studies that support a complementary hypothesis include Biais and Gollier (1997), Burkart and Ellingsen (2004), and Giannetti et al. (2011). Besides, Hill et al. (2019) find that suppliers headquartered in an environment with increased access to bank credit provide increased trade credit to their customers, supporting the redistribution view of trade credit originally suggested by Meltzer (1960).

Firms can also be constrained in access to trade credit. Tsuruta (2013) reports that firms offer a limited amount of trade credit during the recession period, when faced with financial distress or charged a high interest rate by banks. However, it further suggests some suppliers reduce their provision of trade credit due to their lower cash holdings. Similar to bank loan, the provision of trade credit sometimes requires information about the possibility that the customer will not fail to repay the credit (Hermes et al., 2015). Another gripping evidence shows that the provision of trade credit could greatly be influenced by the quality of countries' legal system (Li et al., 2018) and the degree of creditor protection (Shi et al., 2020). It suggests that trade credit may not always available as a substitute to a bank credit.

This paper explores the relationship between trade credit and financial constraints in Ethiopia. Ethiopia provides a good case study for at least three reasons. First, compared to firms in other parts of the world, Ethiopian firms extensively complain that access to institutional financing is the biggest business obstacle.[2] According to the World Bank's recent enterprise survey, about 40% of Ethiopian manufacturing firms cite access to financing as the main obstacle to their business operation. This figure is substantially different for firms in some selected countries of Africa. For instance, only about 10% of firms in Kenya, 12% in Uganda, 10% in Burundi, and 2% in Djibouti report that access to finance is the biggest obstacle. Second, although Ethiopia has registered strong economic performance over the last decade, the country's financial system is poorly developed. The system is subjugated by the banking sector which by itself is dominated by state-owned banks; there is no standardised capital market; foreigners are strictly prohibited to invest in the financial sector. Hence, it is possible to think that the nature of the Ethiopian financial system features limited access to formal financial services. This would potentially push firms to opt for informal finance such as trade credit. Third, most of the previous studies were extensively carried out in financially developed countries (Alphonse et al., 2006; Fisman & Love, 2003; Hasan & Habib, 2019; Rajan & Zingales, 1995). The only paper we are aware of is Beck et al. (2020), which examines the relationship between trade credit and access to finance among a sample of Ethiopian retailers. Our study digresses from theirs in many ways. Conceptually, we identify firms' credit constraints using a direct elicitation approach, while in Beck et al. (2020) access to formal finance is measured with the information about households' loans from bank or microfinance.

Methodologically, our identification uses an instrumental variable estimation strategy in the context of the control function approach. In addition, our sample includes not only retail businesses but also it includes firms in manufacturing and non-retail services.

Contrary to the conventional view that trade credit provides a substitute to bank credit, particularly in a financially constrained business environment, we find a negative relationship between financial constraint and trade credit use. Specifically, according to our preferred specification, we find that financially constrained firms have a trade credit use which is about 10 to 18 percentage points lower than unconstrained firms. Our findings suggest that bank credit constrained firms are also trade credit constrained in Ethiopia. It further suggests that suppliers are themselves more likely to be credit constrained; when banks cannot lend, suppliers may not be able to lend as well. This is in contrast with Beck et al. (2020), who report better access to bank finance reduces the use of trade credit among Ethiopian retail firms.

Our analysis contributes to the literature on financial constraints and trade credit use in at least two ways. First, we add on an ongoing discussion on the association between financial constraints and trade credit by exploiting a unique estimation strategy that adopts industry-level variation of financial-constraint as instrument for firm-level financial constraints. It also utilises a control function approach to capture the non-linear nature of our explanatory variables (financing constraints). Second, unlike most of the previous studies, we document that financially constrained firms have a lower access to trade credit compared to their counterparts.

The remainder of the paper is structured as follows: In the next section, we review related literature. In section 3, we describe theoretical model and the firm-level data, and section 4 presents the modelling techniques. Section 5 presents empirical results and discussions, and section 6 concludes.

2. Related literature

2.1. Financing constraint and trade credit use

There is no one single theory that explains the relationship between trade credit and bank credit rationing. Modelling this correlation started with the macroeconomic model by Meltzer (1960). The model establishes that in periods of monetary contraction, firms with greater liquidity extend trade credit to those that have restricted access to bank loans, thereby mitigating credit rationing. Under financial tightening, suppliers of goods and services can act in two ways. Firstly, suppliers with sufficient accumulated cash (with large cash balances on their balance sheet) provide longer maturity date on the outstanding collectibles. Secondly, credit-worthy suppliers redistribute the credit they can raise from the financial institution to the relatively less credit-worthy firms in the form of trade credit. The latter action is commonly known as the *redistribution view of trade credit* in the extant literature (Hill et al., 2019). However, it has been challenged that trade credit facilitates efficient redistribution (Cosci et al., 2019).

Many studies have since related these two financial variables by considering the effect of bank lending over trade credit, regardless of monetary policy. On the one hand, the substitution hypothesis shows that firms tend to employ trade credit to a greater degree when credit from financial institutions becomes constricted (Giannetti et al., 2011; Huyghebaert, 2006; Nilsen, 2002; Petersen & Rajan, 1997; Shi et al., 2020; Tang & Moro, 2020; Yang et al., 2020). The explanation for this hypothesis is that suppliers are able to lend when banks cannot, acting as financial intermediaries, due to certain advantages obtained during the course of their business. Among these advantages, we can highlight the greater speed and lower costs in acquiring customer financial information due to the asymmetric information financial theory (Smith, 1987), greater control over the customer due to the potential threat of cutting off the supply (Cuñat, 2007) and the ability to recover unpaid goods supplied to the customers (Mian & Smith, 1992). In general, supplier may be

better than banks in terms of being aware of the financial situation of their customers and regarding the management of credit payment (Petersen & Rajan, 1997).

On the other hand, Biais and Gollier (1997) announced complementary view by challenging the substitution view, arguing that banks may agree to lend if suppliers also lend to their customers. This complementary relation implies that the use of trade credit acts as a signal and reveals suppliers' information to the banks (Cook, 1999), which cannot always assess the financial quality of a firm when information on the firm appears opaque. Therefore, the application of trade credit reduces the information asymmetry between the firm and the bank, thereby improving the reputation and access to loans for the firm (Alphonse et al., 2006) and making a complementarity hypothesis between trade credit and bank credit possible. Several other studies have presented empirical evidence consistent with complementarity view, see for example, Deloof and La Rocca (2015), Tsuruta (2015), Psillaki and Eleftheriou (2015), and Yazdanfar and Öhman (2017), Andrieu et al. (2018).

The relationship between financial constraint and trade credit becomes an overriding question for firms of developing economies, due to their opacity which exacerbates information asymmetries and results in credit rationing (Stiglitz & Weiss, 1981) and to their very limited possibilities for access to alternative financing other than bank credit and trade credit, such as financial markets (Berger & Udell, 1998; Naidu & Chand, 2012).

2.2. Firm characteristics and trade credit

In the literature, several firm characteristics are shown to be associated with trade credit use and its financial constraint. Therefore, it is crucial to review some of these characteristics. It is often argued that the success of a business will depend on the *owner's/manager's ability* to obtain the necessary resources including financial capital (Aldrich & Zimmer, 1985). The more managers or owners are educated and experienced in the business the more they will bargain and raise different financial resources including trade credit (Cole, 2011; Kimuyu & Omiti, 2000). Similarly, a great deal of literature emphasizes about the effect of *firm size* on trade credit. Nilsen (2002) indicates that small firms are credit-rationed; these potentially demand more trade credit from larger corporations. For small firms, trade credit is often used to demonstrate their creditworthiness before obtaining a bank loan. Alphonse et al. (2006) provide evidence that small firms in the US use trade credit to improve their creditworthiness; in which trade credit serves as a signal about firms' credit quality and the availability of bank credit increases.

The *age of the firm* is also another source of heterogeneity explaining a variation in access to finance. Start-up and younger firms need capital to finance investment and growth. But also, they are less creditworthy, more opaque, and less diversified than older firms, so they feature greater probabilities of financial distress (Fatoki & Odeyemi, 2010). Accordingly, these firms may exhibit greater demand for trade credit. Petersen and Rajan (1997) show that trade credit has been practiced during business start-up compared to when they become able to generate sizable profit. It has also been indicated that trade credit is more practiced in *private firms* compared to the state-owned firms (Oh & Kim, 2016). *Foreign-owned* firms have a potential access external fund easily and at a reasonable cost (Tran, 2021). *Profitability* is another factor determining trade credit (Petersen & Rajan, 1997). It could be argued that firms generating more internal cash will find it easier to obtain credit from their suppliers, resulting in a positive relationship between profitability and trade credit. In contrast, more internal cash means less demand for trade credit, which may lead to a negative relation between the two. Our modelling strategy controls for firm characteristics discussed above and other observable firm characteristics that are supposed to affect both financing constraint and trade credit.

3. Theoretical framework and data

3.1. Theoretical framework

To relate firm's financial constraint with its trade credit use, we build on the Burkart and Ellingsen's (2004) model. Let us consider a credit market consisting of risk-neutral firm, formal banks and

suppliers who provide trade credit. The firm is endowed with observable wealth, $\omega_F \geq 0$ and has some deterministic investment opportunity, $Q(I)$, where I is the investment volume. The production function is concave, increasing, and satisfies $Q(0) = 0$ and $Q'(0) = \infty$. In a perfect credit market with interest rate r, the firm would like to attain first-best investment given by $Q'(I*) = 1 + r$. However, due to wealth constraint, $\omega_F < I*(r)$, the firm turns to the bank and/or the trade credit for the remaining funds.

Essential to the model is that credit is limited as the firm is unable to commit to invest all available resources into its project. We assume that it may use (some of) the assets to generate non-verifiable private benefits. Non-diligent behavior resulting in diversion of funds denotes any activity that is less productive than investment, for example, using available resources for consumption or financial saving. The diversion activity yields benefit $\phi<1$ for every unit of cash diverted, while the firm only obtains $\beta\phi$ units of private benefit for each unit of input diverted. Creditor vulnerability is captured by ϕ (where a higher ϕ implies weaker creditor protection of banks), whereas $\beta \in [0, 1)$ is a measure of input liquidity. Larger β means that the input can be easily diverted and smaller β means the input is less diverted. Compared to cash an input is not easily diverted for several reasons. For example, it may have a very specific application (like a service or like special purpose machinery). Another compelling reason is that it may be easy for the suppliers of trade credit to monitor the use or resale of input transactions or the input may have a lower second-hand value. Thus, due to these differences, suppliers are better-off in extending trade credit compared to commercial banks loan.

Consistent with the redistribution theory of trade credit, the supplier with wealth, $\omega_S \geq 0,$ also use bank funding for her own investment including investment on the trade credit. Following the same logic as above, we assume that the supplier cannot commit to lend her bank loan and that diversion yields private benefits equivalent to $\phi<1$ for every unit diverted. While lending (trade credit provision) is unverifiable, the outcome of the supplier's operation may be verified. The supplier thus faces the following trade-off: either she lends the bank credit to the firm in the form of trade credit, realizing the net-lending profit after compensating the bank, or she benefits directly from diverting the bank loan.

Banks now have to consider the possibility of diversion on part of both the firm and the supplier. Poor firms and poor suppliers will be credit rationed by the bank as their stake in the financial outcome is too small. Since the surplus of the bank transaction accrues entirely to the firm and the supplier, the residual return to investment increases if both take bank credit. Specifically, the firm exhausts its bank credit line and uses the maximum amount of trade credit made available by the supplier. Similarly, the supplier utilizes all available bank funds and his own capital to service the firm. It entails that these firms could potentially be constrained in both bank credit and trade credit. We put these insights to test using a firm-level data that is fairly representative of Ethiopian business sector.

3.2. Data

The data for this paper comes from the World Bank's Ethiopian Enterprise Survey (WBEES) of 2011 and 2015.[3] WBEES follows a standardised data collection methods across the time period and across jurisdiction. Specifically, it applies a stratified random sampling technique. Three levels of stratification were employed (industry, firm size, and regional stratifications). The firms are randomly drawn from manufacturing and service industries spread over six regions of the country. Stratification by size follows three levels of strata: small (5 to 19 employees), medium (20 to 99 employees), and large (100 or more employees). The data for this survey consists of 1,492 firm-year observations collected from the various regions as follows: *Addis Ababa (919), Amhara (112), Dire-Dawa (27), Oromia (219), Southern Nations Nationalities and Peoples' Region (SNNPR) (71) and Tigray (144)*. The data set contains some missing values for some variables of some firms, which slightly reduces our sample size in the estimation models.

We measure our main variables by referring to a series of questions included in the WBEES. The measure of trade credit (trade-credit) is based on the survey question K.1, "*in last fiscal year, what percentage, as a proportion of the value of total annual purchases of material inputs or services was purchased on credit?*" Likewise, to construct measures of financial constraint, we refer to a survey questions on the credit history of the firm as in Leon (2015) and Kuntchev et al. (2012) by tracing to a number of questions in a survey. In particular, questions K.16 asks, "*in last fiscal year, did establishment apply for new loans/lines of credit?*"; question K.17, "*the main reason for not applying for new loans or new lines of credit*", and K.20, "*referring only to this most recent application for a line of credit or loan what was the outcome of that application*?". If the response to K.16 was "yes", we have considered the follow-up question, which is K.20, for the outcome of a loan's application. Firms that are applied for a loan and their loan has been approved are treated as not credit constrained, otherwise, they are classified as credit constrained. Similarly, if the response to K.16 was "no", we have a subsequent question (K.17) for the main reasons for not applying for a loan. Firms are treated as non-borrowing (not credit constrained) if the reason for not applying is that they "do not need a loan/had sufficient capital", otherwise they are considered as credit constrained.[4] Thus, we construct an indicator variable, *credit-constraint = 1* if a firm does not apply because of discouraging factors and/or its loan application was not approved, and 0 otherwise. According to this classification, about 45% of firms in our sample are credit constrained.

In addition, we construct an alternative variable as a proxy of financial constraint, *finance-obstacle*. This variable is based on the information about the share of firms that report access to finance as a "biggest obstacle", among other elements of the business environment. Accordingly, *finance-obstacle* is an indicator variable equals to "1" if a firm has cited access to finance is the biggest business obstacle, and "0" otherwise. About 30% of firms consider access to finance is their biggest obstacle.

Table 1 presents the summary statistics, and a full set of variables definitions is given in Appendix Table A1. As can be seen, the proportion of trade credit in the firms' total purchase is 14%, on average. A study by Beck et al. (2020) reports very similar figure, in which trade credit ratio, defined as account payable to sales ratio is 14.2%, on average, for the sample of Ethiopian retailers. As mentioned earlier, credit constrained firms account for about 45%, while firms reporting access to finance as the biggest obstacle to their business operation account for 30%. The average firm age is about 15 years, and on average, the top manager's business experience is about 14 years. The average annual sales is about ETB 4.7 million. Of the total output sales, 6% is generated from exporting while the remaining (94%) is sold in a domestic market. Similarly, the import share of total purchases represents about 12%, on average. For average firms, the input inventory turn-over period is about 27 days. 39% of firms made investment in fixed assets within a year prior to a survey, and the firms' average profit-to-assets ratio is about 14%. Innovating firms (firms that introduced new or significantly improved products/services) constitute about 40% of the sample. In terms of ownership, most firms (about 87%) denote firms that are mainly (>50%) owned by private domestic investors. Sectoral-wise, 44% of firms are manufacturing, 24% are retail services, and the remaining (32%) are non-retail services.

4. Modelling trade credit and financial constraint

In order to estimate the effect of financial constraint on the probability of trade credit use, one can follow a binary outcome modelling approach, such as probit or logit models. However, in our data set trade credit use is defined as the proportion of total purchase ranging from 0 to 100%, which makes the direct estimation of binary models problematic because this is not a 0–1 binary scale. Similarly, linear models such as Ordinary Least Squares (OLS) do not provide a correct estimation procedure when the response variable is fractional due to the fact that linear models allow predicted values to lie outside the bounded interval and produce the constant partial effects of unit changes in the explanatory variables. Therefore, we need to fit the fractional probit model given by Papke and Wooldridge (1996) that handle a continuous dependent variable bounded between 0 and 1. Under the exogenous assumption, we can estimate the following model:

Table 1. Summary statistics

Variables	Mean	Std. Dev.	Min	Max
trade-credit	0.14	0.27	0.00	1.00
credit-constraint	0.45	0.50	0.00	1.00
finance-obstacle	0.30	0.46	0.00	1.00
firm-age	14.60	11.70	0.10	90.00
experience	14.06	9.94	0.00	60.00
sales-level (in millions)	4.720	2.460	0.00	22.670
export-share	0.06	0.21	0.00	1.00
import-share	11.57	27.13	0.00	100.00
inventory-days	27.26	55.17	0.00	365.00
investment	0.39	0.49	0.00	1.00
profit-margin	0.14	0.22	−4.33	0.25
innovation	0.40	0.49	0.00	1.00
domestic-firm	0.87	0.33	0.00	1.00
foreign-firm	0.07	0.26	0.00	1.00
manufacturing	0.44	0.50	0.00	1.00
retail	0.24	0.43	0.00	1.00

Source: Authors' calculation from WBEES of 2011 and 2015.

$$\begin{aligned} \mathrm{P}(\textit{trade credit}_i = 1) = \; & \alpha_i + \vartheta_{xy}\textit{financial constriant}_i^{xy} + \beta_1 \mathrm{firm\ age}_i + \beta_2 \mathrm{experience}_i \\ & + \beta_3 \mathrm{sales\ level}_i + \beta_4 \mathrm{export\ share}_i + \beta_5 \mathrm{importshare}_i \\ & + \beta_6 \mathrm{inventorydays}_i + \beta_7 \mathrm{investment}_i + \beta_8 \mathrm{profit\ margin}_i \\ & + \beta_9 \mathrm{innovation}_i + \beta_{10} \mathrm{domestic\ firm}_i + \beta_{11} \mathrm{foreign\ firm}_i \\ & + \beta_{12} \mathrm{manufacturing}_i + \beta_{13} \mathrm{retail}_i + \varepsilon \mathrm{rror}_i \end{aligned} \tag{1}$$

where $\textit{financialconstriant}_i^{xy}$ denotes two measures of financial constraint, i.e., *credit-constraint, finance-obstacle*; ϑ_{xy} and $\beta_1, \beta_2, \beta_3, \ldots \beta_{13}$ are model parameters to be estimated while α_i denotes a model constant term. We note that estimating the effect of financial constraint with the direct application of equation (1) will lead to inconsistent and biased estimates due to the possible endogeneity of financing constraint variables. One source of potential endogeneity could be related to unobserved heterogeneity that affects both financing constraint and trade credit use, and this leads to the correlation with the error term.

Another endogeneity concern could be that not only financially constrained firms will use trade credit but also firms that could not obtain trade credit may increase demand for bank loans (Atanasova, 2007)—where financing constraint can be partially explained by trade credit constraint. This would potentially create a reverse causality in the relationship. In this case, an instrumental variable approach provides a way to generate consistent parameter estimates. However, it is not easy to find variables that can serve as a valid instrument (i.e., a variable that only affects the outcome variable through its effect on the endogenous regressor). Our instrumental variables are identified following the work of Rajan and Zingales (1998) where industry-level financial dependence was used to explain firm-level financial needs and constraints. Therefore, we use industry-level financing constraint as an instrument for firm-level financing constraints. Specifically, we use the mean-credit-constraint and mean-finance-obstacle in the firm's industry where these means exclude the specific firm under consideration.

The instrumental variable (IV) approach estimation, also known as two-stage least squares (2SLS) procedure involves the two-step procedure. In the first stage, the endogenous explanatory variable in

the equation of interest, usually referred to as structural equation, is regressed on all the exogenous variables in the model, including both exogenous covariates in the equation of interest and the excluded instruments. The fitted values from these regressions are obtained. In the second stage, the regression of interest is estimated as usual, except that in this stage, the endogenous covariate is replaced with the fitted values obtained from the first stage. However, this estimation procedure, (i.e., the plug-in with fitted values approach) in the second stage inconsistently estimates both parameters and the partial effects if the first-stage modeling follows nonlinear specification. An appropriate estimation strategy of modeling the structural equation that encompasses nonlinear endogenous variable is to adopt the control function approach (Wooldridge, 2015). Originally, in the context of program evaluation, Heckman and Robb (1985) describe a Control Function (CF) as a variable that, when conditioned on, makes an intervention exogenous in a regression equation. In its modern application, CF requires the adoption of one or more instrumental variables because CF is essentially a complement to an instrumental variables method (Wooldridge, 2015).

The control function approach demands the same way of estimation as in two-stage least squares; the difference is that the endogeneity correction term is captured in reduced form error term.

Now we consider the model:

$$tc_i = \delta.z_i + \vartheta.x_i + u_{i,} \tag{2}$$

where, tc_i is the trade credit for firm i; x_i is now an endogenous financial constraint variables {*credit-constraint; financing-obstacle*}, and z_i is a vector of exogenous variables {*firm-age, experience, sales-level, export-share, import-share, inventory-days, investment, profit-margin, innovation, domestic-firm, foreign-firm, manufacturing, retail*} including instrument variables {*industry-credit-constraint, industry-finance-obstacle*}; u_i is a random error term, δ *and* ϑ are parameters to be estimated.

In the context of the control function, we can write the model as:

$$tc_i = \delta.z_i + \vartheta.x_i + \rho.\hat{u}_i + v_{i,} \tag{3}$$

where, $\hat{u}_i = x_i - z\hat{\theta}_i$ are residuals from the first-stage regression of x_i on z_i. The OLS estimates from equation (3) are control function estimates—which corrects endogeneity bias and requires the residuals are not statistically different from zero. Since the predicted residual from the first stage is included in the second-stage regression as an additional regressor, the standard errors need to be corrected. Hence, we implement a bootstrapping procedure to calculate the standard errors in the structural models.

5. Estimation results and discussions

The first estimation results of the effects of financing constraint on the intensity of trade credit use is provided by fractional probit estimation based on equation (1). As presented in Table 2. We run two separate regressions: one in which financing constraint is proxied by credit-constraint, and the other in which finance-obstacle provides a measure of financing constraint. In both specifications, the coefficients are the same in size and direction of effect, but in the latter case, it is significantly different from zero at a 10% level of significance. Note that, we do not consider the endogeneity issues in this baseline specification. As to the specification bias for this baseline model, we performed Ramsey RESET test using powers of the fitted values of trade credit. In both cases, there is no evidence that model suffers from misspecification bias (Prob > F = 0.79 and 0.83, respectively).

Regarding the effects of other controls, firm age, manager's experience, fraction of import, number of inventory days, and investment in fixed assets, profitability, and innovative activities are found significant determinants of trade credit use. A one-year increase in the age firm is associated with about one percentage point increase in trade credit use. This effect is significant at a 5% level of significance in both specifications. Likewise, the number of years of top manager's business

Table 2. Fractional probit model estimation results

Dependent variable: trade-credit

	[A]		[B]	
Variables	**AME**	**t-ratio**	**AME**	**t-ratio**
credit-constraint	−0.01	*−1.38*		
finance-obstacle			−0.01	*−1.86**
firm-age	0.01	*2.03***	0.01	*2.34***
experience	0.05	*2.01***	0.07	*2.07***
sales-level	0.00	*1.07*	0.00	*−1.41*
export-share	−0.02	*−1.68*	−0.01	*−1.41*
import-share	0.03	*−2.79***	0.04	*−2.89***
inventory-days	0.01	*1.91**	0.01	*1.86**
investment	0.06	*4.89****	0.06	*4.98****
profit-margin	−0.04	*−2.19***	−0.05	*−2.58***
innovation	0.11	*1.73**	0.13	*1.79**
domestic-firm	−0.02	*−1.59*	−0.02	*−1.70*
foreign-firm	−0.02	*−1.53*	−0.02	*−1.53*
manufacturing	−0.01	*−1.49*	−0.01	*−1.36*
retail	−0.01	*−1.43*	−0.01	*−1.43*
observations	1,151		1,151	
R^2	0.438		0.445	
RESET	0.663 (0.790)		0.714 (0.832)	

AME denotes the average marginal effects. *,**. And *** denote statistical significance at 10%, 5%, and 1% respectively. t-ratios are estimated from heteroskedasticity robust standard errors. All regressions include year fixed effects.

experience is positively associated with the level of trade credit. A ten-year extra experience of managers is associated with about 5–7 percentage point rise in the level of trade credit use, the effect that is significant at 5% level. The input inventory turn-over days are also positively correlated with trade credit use. A one-day increase in inventory turnover is correlated with about one percentage point increase in trade credit use. These coefficients are significant at 10%. The effect of investing in fixed assets has strong positive effects. Firms that made investment in long-term assets use trade credit about six percentage points higher than equivalent firms that do not make any investment in fixed assets. The coefficients of the effect are significantly different from at a 1% level. Similarly, innovative firms are more likely to use trade credit compared to non-innovative counterparts. On the other hand, import-share of input purchased, and the ratio of net profit to assets are inversely related to trade credit use. A one percent increase in importing of inputs from foreign markets reduces trade credit use by about 3–4 percentage points. The effects are significant at a 5%. Analogously, a one percent increase in the ratio of profit to assets reduces trade credit by about 4–5 percentage points. The effect is again significant at a 5% level of significance.

Table 3. presents estimation results based on the instrumental variable estimation with a control function approach. As described in the previous section, this estimation procedure corrects endogeneity bias when the reduced form equation involves a non-linear model. The estimates of the residuals (generalized-residual/control function) derived from the first-stage regression for the potential endogenous variables that include credit-constraint and finance-obstacle are presented in the array of other variables. These residuals are not significantly different from zero, suggesting that the coefficients have been consistently estimated. The estimates of the factors that influence a firm's financing constraint are presented in Appendix Table A2. In Table A3, we also report some tests for the validity of our instrumental variables. In both credit-constraint and finance-obstacle models, the

Table 3. Control function estimation results

Dependent variable: trade-credit

	[A]		[B]	
Variables	**AME**	**t-ratio**	**AME**	**t-ratio**
credit-constraint	−0.10	*−2.42***		
finance-obstacle			−0.18	*−2.26***
firm-age	0.01	*2.77***	0.01	*2.19***
experience	0.04	*2.67***	0.03	*2.14***
sales-level	0.00	*−0.34*	0.00	*−0.51*
export-share	−0.03	*−0.76*	−0.01	*−0.27*
import-share	−0.06	*−2.82***	−0.08	*−2.99****
inventory-days	0.00	*0.80*	0.00	*1.10*
investment	0.06	*3.08****	0.06	*3.50****
profit-margin	−0.04	*−2.71***	−0.04	*−2.68***
innovation	0.01	*1.73**	0.01	*2.51***
domestic-firm	−0.01	*−0.15*	0.00	*−0.13*
foreign-firm	−0.01	*−0.16*	−0.02	*−0.47*
manufacturing	−0.01	*−0.22*	0.00	*−0.07*
retail	−0.01	*−0.29*	0.00	*0.11*
generalized-residual	0.04	*0.39*	0.07	*1.18*
observations	1,151		1,151	

AME denotes the average marginal effects. *,**. And *** denote statistical significance at 10%, 5%, and 1% respectively. t-ratios are estimated from bootstrapped standard errors that allows for intra-industry correlation. All regressions include year fixed effects.

Anderson LM statistic is significant (i.e., rejection of the null that the model is under-identified), implying that instrument variables are relevant. In addition, the Cragg-Donald F-statistic confirms that the instrument variables are strongly correlated with endogenous variables in the model. The Sargan statistic indicates that we cannot reject the joint null hypothesis that the instruments are valid instruments, validating that the excluded instruments are correctly excluded from the estimated equation. Turning to the coefficient of instrument variables in the first-stage model, we find a strong positive and significant association between firm-level financing constraint and industry level financing constraints.

Conditioning on these effects, the variables representing financing constraints show a significant and negative effect on the tendency of trade credit use, suggesting that being financially constrained in the formal financial sector influences the firm's capacity to utilise trade credit. The coefficients associated with both financing constraint variables (credit-constraint and finance-obstacle) are now larger, and at the same time, the t-statistics are bigger as compared to the results reported in Table 2. We trace these differences to the endogeneity bias —thus, failing to account for the endogeneity issues in the relationship between trade credit and financial constraint understates the true effect. In particular, the estimates reveal that firms' financing constraints in the formal financial sector reduces the extent of trade credit use by 10–18%. These effects are significant at 5% level of significance. The effects of other control variables are largely the same with the results reported in Table 2.

Our results are inconsistent with Beck et al. (2020) who show that a one standard deviation increase in the share of households with a bank loan is associated with a decrease in trade credit provided to retailers over their sales by 0.25 standard deviation. Note that in their study access to bank finance is proxied by household-level access to bank loans, which may not

necessarily reflect firms (retailers) access to bank finance; thus the comparison between their findings and ours should be taken with caution. Moreover, our findings do not support the potential substitutability of trade credit and bank credit in which has been extensively supported by notable studies, such as Demirgüç-Kunt and Maksimovic (2001), Fisman and Love (2003). Our results, rather tend to be in line with the complementary hypothesis and seem to support the redistribution view where more financial credit leads to higher levels of private sector funding, as a result, an increased trade credit that is distributed from suppliers to customers (Hill et al., 2019).

6. Robustness check

We check the robustness of our results employing an alternative approach to identification proposed by Lewbel (2012).[5] This is similar to the linear instrumental variable approach. However, it does not rely on any exclusion restrictions but exploits heteroskedasticity for identification. In the following, we first provide a brief intuitive discussion of the approach. Lewbel (2018) further verified that the assumptions required for Lewbel's (2012) estimator held valid when the endogenous regressor is binary.

Identification can be achieved without imposing any exclusion restrictions if there is a vector of exogenous variables Z and the errors are heteroskedastic. The Z vector can be a subset of the exogenous X vector included in the regression or even Z can include all variables in X (i.e., Z = X). In the first stage, each endogenous variable is regressed on the Z vector, and the vector of residuals $\hat{\varepsilon}$ retrieved. These estimated residuals are then used to construct instruments, $\left[Z-\overline{Z}\right]\hat{\varepsilon}$ $\overline{Z}$ is the mean of Z. Identification requires that the error terms in the first-stage regressions are heteroskedastic. Thus, as per the procedures described above, in the first stage, we regress our endogenous explanatory variable (*financial constraint variables: credit-constraint and finance-obstacle*) on a set of exogenous variables (Z) including the instrumental variable (industry-level financing constraint) and then retrieve the residuals ($\hat{\varepsilon}$). In the second stage, we implement an instrumental variable approach using $\left[Z-\overline{Z}\right]\hat{\varepsilon}$ as instruments. This is implemented in STATA using *ivreg2h* given by Baum and Schaffer (2012)—it generates the heteroscedasticity based constructed instruments, and then implements instrumental variable estimator. These results appear in Table 4. The results confirm our findings that use the control function approach reported in Table 3.

Another concern that could be raised regarding our interpretation that suppliers of trade credit may be themselves bank credit constrained which limits their ability to offer trade credit to their customer requires further examination. One way to test this claim is through scrutiny of the correlation between firms' credit constraint and trade credit provision. Indeed, we can exploit a survey question that asks about percentage of annual sales made on account (k2c: "*In last fiscal year, what percent of total annual sales paid for after delivery*"). We can compare this information (i.e., the trade credit supply) with the information on firms' financial constraint. Table 5 shows that both measures of financial constraints (credit constraint and finance-obstacle) are negatively correlated with the measure of trade credit provision (trade credit supply). It suggests that firms facing formal financing constraint are less likely to extend trade credit to their customers, which is consistent with our stylized model described under section 3.1 above.

7. Conclusions

This paper examined the effect of formal financing constraint on the trade credit use for the cross-section of Ethiopian firms. We construct two indicators of a firm's financial constraint: credit-constraint and finance-obstacle. A control function approach in the context of instrumental variable estimator is used to address the endogeneity bias when examining the effect of financial constraint on trade credit use within the framework of control function-probit reduced form given by Wooldridge (2015). Accordingly, industry-level financing constraint is employed to instrument firm-level financing constraints. The results of estimation models show that firm-level financial constraint has a strong correlation with the firms' industry-level financing constraint. Conditional

Table 4. Heteroskedasticity-based estimation results

Dependent variable: trade-credit

	[A]		[B]	
Variables	**coeff**	**t-ratio**	**coeff**	**t-ratio**
credit-constraint	−0.09	*−2.06***		
finance-obstacle			−0.12	*−2.22***
firm-age	0.01	*2.02***	0.01	*2.19***
experience	0.00	*0.92*	0.00	*1.00*
sales-level	0.00	*0.13*	0.00	*−0.52*
export-share	−0.02	*−0.56*	−0.01	*−0.37*
import-share	−0.04	*−1.94**	−0.07	*−1.98***
inventory-days	0.00	*0.92*	0.00	*0.97*
investment	0.07	*3.52****	0.07	*3.93****
profit-margin	−0.06	*−2.17***	−0.06	*−2.24***
innovation	0.01	*1.80**	0.01	*1.78**
domestic-firm	−0.02	*−0.34*	0.00	*−0.11*
foreign-firm	−0.02	*−0.30*	−0.01	*−0.26*
manufacturing	−0.02	*−0.61*	−0.01	*−0.33*
retail	−0.01	*−0.56*	0.00	*−0.04*
observations	1,151		1,151	

*, ** and *** denote statistical significance at 10%, 5%, and 1% respectively. t-ratios are estimated from bootstrapped standard errors that allows for intra-industry correlation. All regressions include year fixed effects.

Table 5. Correlation between financial constraint and trade credit supply

	credit-constraint	**finance-obstacle**	**trade-credit supply**
credit-constraint	1.00		
finance-obstacle	0.214**	1.00	
trade-credit supply	−0.133*	−0.052	1.00

**, and * shows that the correlation coefficients are significant at 5% and 10%, respectively.

on such effects, both firms' credit-constraint and finance-obstacle are negatively associated with the level of trade credit use. These results imply firms that are constrained in access to formal financial services are also constrained in access to trade credit. We find consistent estimates under alternative identifications: the control-function and Lewbel's (2012) approach. It implies that the main findings are unlikely to be driven by unobserved confounding factors.

In terms of policy implication, it suggests that addressing formal financing constraints would increase the availability of alternative forms of finance such as trade credit. There should be policy and institutional support to increase the number of locations with formal credit providers; this will not only alleviate formal financial constraints but also enhance informal finance such as trade credit provision. Note that our conclusion that suppliers of trade credit may be credit (liquidity) constrained which limits their ability to offer trade credit to their customer deserves further research; we do not have enough data on the supplier side financial constraint to conduct a demand-supply analysis. In general, despite Ethiopia's favourable business environment by Sub-Saharan countries' standard, it lags behind in terms of access to financial services. Therefore, improved access to formal finance is more likely to benefit the economy.

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Endnotes
1. Even in the developed countries, trade credit account for the substantial portion of firm's total assets. For example, Rajan and Zingales (1995) show that the ratio of aggregate trade credit to total assets was 17.8% for US firms in the early 1990s while Bartholdy and Mateus () find that this ratio ranges between 16% and 24% across sixteen European countries.
2. However, Ethiopia has a better regulatory environment. The latest data by the World Bank's ease of doing business ranks Ethiopia 60th in the contract enforcement.
3. The data can be downloaded at https://www.enterprisesurveys.org.
4. This method of measuring credit constraint is known as the direct elicitation method in the household financing literature.
5. It is more convincing to apply this approach, particularly if the definition of industry-level financial constraint overlaps with firm-level financial constraints.

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