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Firms' resilience to financial constraints

The role of trade credit

Isaac Marcelin, Daniel Brink, and Wei Sun

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Corresponding author: imarcelin@umes.edu

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Isaac Marcelin,[1] Daniel Brink,[2] and Wei Sun[3]

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Abstract: We study the role of trade credit in enhancing the resilience of financially constrained firms from 2010 to 2017. Implicit borrowing in trade finance allows financially constrained firms to bridge the financing gap, expand employment by 8.26 per cent, and increase average firm profits significantly. Trade finance suppliers, not financially constrained firms, experience a surge of 7.99 per cent in the average rate of sales growth. Corporate resilience to financial constraints occasioned by trade credit is quite robust to controlling for relevant factors and employing various estimation techniques. While countries strive to develop their financial sector to fund economic activity and growth, they need to facilitate a business environment that promotes trade credit flows among firms as a second-best alternative to bank financing.

Key words: financial constraints, trade credit, employment, firm profits, sales growth

JEL classification: E24, G32, L25, O5

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[1] School of Business, Management and Technology, University of Maryland Eastern Shore, Princess Anne, MD, USA, corresponding author: imarcelin@umes.edu; [2] UNU-WIDER, Helsinki, Finland, danebrink08@gmail.com; [3] Department of Finance, Insurance and Real Estate, University of Memphis, Memphis, TN, USA, wsun1@memphis.edu

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Whereas greater access to finance fosters investment and growth, firms' relative inability to tap into investible resources is ubiquitous. Evidence abounds that the expansion of firms drives nations' economic gains through accelerated capital build-up, increased economic activities, and job creation. Lack of access to financial resources constitutes an acute problem for small and financially constrained firms plagued with information asymmetry problems, and it may entail real effects such as lower employment and weaker firm performance. Although the financial sector efficiently reallocates investible resources between projects with the highest returns across the economy, this allocative function may also operate through suppliers' credit, allowing firms with liquidity shortages to take up investment opportunities or become more resilient to relative lack of access to traditional credit channels. Worldwide, firms supply goods to their customers, allowing them to defer payment—alleviating buyers' liquidity problems. Evidence suggests that financially constrained firms are more likely to resort to trade credit (Biais and Gollier 1997; Petersen and Rajan 1997) because, unlike large firms, small and medium-sized enterprises (SMEs) are more prone to credit rationing (Aghion et al. 2007; Beck et al. 2005).

Differences arise in industry trade credit intensiveness and liquidity needs, perhaps consequent to firms' reliance on external finance, size, and input mix. Fisman and Love (2003) report a robust industry-specific element to obtaining trade credit, and Ng et al. (1999) find that trade credit exhibits significant inter-industry fluctuations but great inter-temporal stability within an industry. The literature's central reasoning stems, perhaps, from Rajan and Zingales (1998), who find that firms in industry sectors that rely more heavily on external finance tend to develop faster in countries with well-developed financial sectors.

When the flow of bank credit tightens, firms bypass intermediation hurdles and find alternative sources of finance in the form of trade credit (Fisman and Love 2003; Levine et al. 2018; Petersen and Rajan 1997)—a financing facility employed more extensively in countries with less-developed financial markets or weak bank–firm relationships (Biais and Gollier 1997; Booth et al. 2002).[1] Firms with financing needs in such countries tend to fall back on supplier financing as a means of funding growth (Fisman and Love 2003; Petersen and Rajan 1997). Financially constrained firms in some industries may be more inclined to pivot to supplier financing to generate and stabilize profits and finance growth in order to remain resilient.[2] This paper tests whether informal lending facilities sustain employment and improve corporate profits and sales growth. It seeks to bridge a vital research gap, since firms of all sizes across the industry spectrum present differing needs for external finance; thus, they utilize trade credit to varying degrees.

The resilience of liquidity-strapped and financially constrained firms occasioned by trade credit has not received much attention in the incumbent literature. The firm's resilience relative to systematic barriers to external finance, which may stem from balance sheet weaknesses, size, industry, and poor banking relationships, is of utmost importance. To what extent does informal lending offset the decline in bank loans for small firms that face steep barriers to external finance and allow them

[1] Trade credit may prop up the financially constrained firm in crucial need of liquidity and short-term financing by providing an alternative source of funds that mitigates the adverse effects of in inaccessibility of bank credit.

[2] A firm's resilience consists of its ability to sustain operations and employment, generate profits, and grow despite setbacks such as the adverse effect of inaccessible formal credit markets.

to sustain employment, generate profits, and expand?[3] Informal lending implies credit obtained outside a country's formal financial and regulatory institutions (Levine et al. 2018). It refers to firms receiving trade credit without the pledge of collateral or promissory notes, subject to formal judicial enforcement mechanisms (Ayyagari et al. 2010; Marcelin and Mathur 2014; Mathur and Marcelin 2014).

While Klapper et al. (2012) insist trade credit is a closer substitute for a firm's short-run liquidity needs than it is for long-term capital investments; Fisman and Love (2003) and Petersen and Rajan (1997) maintain that trade credit can be loaded up and rolled over to finance investment for firms with no other source of funds. The trade credit's resilience-enhancing effect may be the greatest among firms that depend heavily on liquid funds or have significant short-term funding or working capital needs but cannot obtain traditional financing. As a remedy for cash-strapped firms with financing constraints, trade credit may prevent the firms from resorting to fire-sales, which could impact long-run operations, thereby its sustainability. Therefore, we expect firms in industries that depend more on trade credit to exhibit higher profits, employment, and sales growth rates sensitivities. We anticipate a more significant effect associated with highly financially constrained firms. Such a result would suggest that trade credit, at least, partially fills in the financing gap left by financial intermediaries.

Levine et al. (2018) report that trade credit represents a large portion of debt financing, accounting for 25 per cent of the average firm's total debt liabilities in their sample. If trade credit offsets the reduction in bank loans (Levine et al. 2018) then it alleviates the adverse effect of credit inaccessibility on profits, growth, and employment. However, since firms might prefer bank loans (Ayyagari et al. 2014) and choose banks as their primary liquidity providers (Gatev et al. 2009), the supplier–customer relationships established through informal financing may mitigate agency problems induced by small firms' information asymmetry challenges. Thus, trade credit may remove some barriers to external finance in future periods; this, in turn, may allow firms to acquire valuable inputs to redeploy their assets more efficiently. As this relationship solidifies, suppliers and banks compete for comparable loan contracts. Nevertheless, it remains costlier for the bank to invest in the technology necessary to gather and transform firm- and industry-specific soft information and exploit it efficiently than it is for trade creditors. It may become too costly for any of the parties to switch when specific inputs and product markets entail high sunk costs and tied-up capital, especially in the presence of tailor-made products involving unique supplier–customer relationships.

Rajan and Zingales (1998) provide a roadmap to determining cross-industry differences in external liquidity needs, employing US industries as a proxy, arguing that US financial markets and institutions are well developed enough for cross-industry differences in the external liquidity needs of US industries to reflect technological differences across industries in demand for such funds around the world. Fisman and Love (2003) maintain that even the most constrained American firms face far less of a shortage in funding from formal institutions than companies in many other countries, where stock markets are embryonic and formal lenders scarce. We implement the methodology proposed by Rajan and Zingales (1998), applied by Claessens and Laeven (2003), Fisman and Love (2003), and Levine et al. (2018), among others, on administrative data obtained from the South African National Treasury. We derive industry benchmarks on trade credit employing US firm-level data from 2010 to 2017. The use of a single country to benchmark

[3] Traditional and formal credit markets price out firms that cannot post collateral (Mathur and Marcelin 2014).

industries' technological liquidity needs is beneficial, since an industry's liquidity needs may vary across countries due to differences in capital market development (Rajan and Zingales 1998).

The study proposes a classification of firms' financial constraints that encompasses three classes, including firms that are never financially constrained (NFC), possibly financially constrained (PFC), and financially constrained (FC). We employ an ordered logit model to examine the probability that a firm that receives a financial constraint status in the classification scheme falls into the assigned category, with NFC receiving a value of 1, the lowest status, and FC a value of 3, the highest status. We then apply the Euler equation to confirm the presence of financing constraints as classified. Finally, we use the fixed-effects estimator followed by the GMM-type (generalized method of moments) estimator on firm-level data extracted from the CIT-IRP5 panel dataset tabulated by the South African National Treasury (National Treasury and UNU-WIDER 2020), combined with COMPUSTAT data (S&P n.d.), to examine whether trade credit alleviates the effects of financing constraints and boosts employment, profits, and sales growth in financially constrained firms. Trade credit is measured using US data and applied exogenously to South African industries.

In addition to addressing several potential challenges to identifying the impact of trade credit on enhancing corporate resilience to financing constraints, examining debt capacity in conjunction with trade credit—benchmarked exogenously—provides a unique setting for robust econometric tests. All of the results hold to various tests, estimation techniques, and controlling for firms' characteristics or other features of the economy that could account for differences in the severity of financing constraints, including size, macroeconomic indicators, and unobserved specific and common factors.

We are unaware of any extant studies addressing the role of trade credit in enhancing the financially constrained firm's resilience. Our contribution to this embryonic thread of literature is manifold. First, we pinpoint the group of firms along the financing constraint spectrum that benefit most from access to the trade finance facility. Second, we show that financially constrained firms' access to trade credit leads to a healthy 8.26 per cent surge in employment along with a 0.44-percentage-point growth in average profit rates. Third, we show that NFC firms, apparently acting as trade credit suppliers, experience a 7.99 per cent increase in average sales growth rates owing to trade finance. While NFC and PFC firms do not increase employment or profits, their corresponding results still convey important policy information because they do not evidence the existence of job losses and decline in corporate profits attributable to trade finance.

The findings on employment for NFC and PFC firms reveal a more rigid labour market whereby it is costlier for companies to adjust labour forces. If managers of larger and financially more stable firms in the economy believe it is more economical to maintain current employment levels and fund production through market expansion, they might lay off fewer workers; that is, trade credit may succeed in saving jobs in less financially constrained firms. Our findings add to the thriving literature on finance and employment and the burgeoning thread on trade finance and firms' resilience. The results have relevant policy ramifications concerning the quality of a country's prevailing institutional arrangements and the strength of creditor and contracting rights institutions. The results suggest that while countries strive to develop financial markets, they need to foster a business environment that facilitates trade credit flow among firms as a second-best alternative to bank financing. With trade credit crucial for small and financially constrained firms close to the informal sector, there may exist forward leakages between trade credit and the informal sector.

The remainder of the paper is structured as follows. Section 2 discusses the various theories of trade credit provision and financial constraints and links these theories with expected firm-level

outcomes. Section 3 presents the various datasets employed in the analysis. Section 4 addresses our methodological approach. Section 5 discusses the results, and Section 6 concludes.

2 Theoretical background

Firms resort to trade credit for several reasons. For instance, economic crises or downturns induce external shocks that cause banks to cut off credit flow (Cornett et al. 2011). Financial theory suggests that small firms, plagued with information asymmetry problems, face steeper external finance barriers, resulting in credit rationing (Marcelin and Mathur 2014, 2015; Mathur and Marcelin 2014; Petersen and Rajan 1997; Stiglitz and Weiss 1981). As a result, firms turn to an alternative form of financing, such as trade credit (Atanasova and Wilson 2003; Danielson and Scott 2004; Nielsen 2016; Nilsen 2002). Petersen and Rajan (1994) assert that credit-rationed firms are more likely to use trade credit even if they prefer other short-term external finance sources. Scholars have explored several theories to explain why non-financial firms hamstring financial intermediaries by providing credit to the buyers of their products. Among the theories extensively examined include lending relationship (Berger and Udell 2002), distribution, price discrimination (Ng et al. 1999; Petersen and Rajan 1997; Pike et al. 2005), signalling (warranty for product quality) (Klapper et al. 2012), product standardization and differentiation (Giannetti et al. 2008), and bonding (Bastos and Pindado 2007). These theories are unified in this study to show that it can be optimal for the wholesaler or manufacturer to extend informal lending to the credit-constrained retailer.

2.1 Trade credit and the financing channel

Trade credit theory maintains that by providing credit, trade creditors have a financing advantage over financial institutions (Schwartz 1974). Proponents of this view enumerate at least three primary sources for this advantage: (1) information gathering, (2) monitoring the buyer, and (3) salvaging value from existing assets (see Petersen and Rajan 1997, among others). Implied in trade credit is a lending relationship whereby trade creditors have accumulated a stock of private information concerning business customers. This relationship allows wholesalers to provide trade credit more cheaply than bank loans. However, retailers become bonded as a result of high switching costs deterring them from breaking up relationships painstakingly built over time, often involving tailor-made products, learning-by-doing, and high levels of sunk costs—thus discouraging default and increasing the amount of trade credit (Cunat 2007). This deterrence reduces retailers' opportunism and shields suppliers, who became more willing to extend trade credit (Burkart and Ellingsen 2004; Giannetti et al. 2008).

Firms in industries heavily dependent on external finance that cannot adequately resolve agency problems will have limited ability to raise finance from traditional financial markets and draw disproportionately on informal financing facilities. The consequent policy stems from trade creditors' (1) in-depth knowledge of the industry, (2) desire to increase trade volume, and (3) ability to repossess, refurbish, and resell the good. In some industries, there is value in salvaging and restoring the sold merchandise, an apparent shortcoming of financial intermediaries. Furthermore, trade creditors may want to send a signal about the quality of their product. Finally, trade creditors have the advantage of cutting off supplies to possibly bonded customers. Bastos and Pindado (2007) argue that when the customer has no alternative to acquiring a specific input, the supplier of that input can act as a monopolist with the power to threaten its buyers.

Nonetheless, manufacturers/wholesalers may subject retailers to the cash price applicable to bank financing or the wholesale price applicable to trade credit financing. The trade creditor has the

power to price-discriminate. This feature is invaluable for recipients of trade credit if it reduces the price of delivered inputs. Ng et al. (1999), Petersen and Rajan (1997), and Pike et al. (2005) provide support for the price discrimination theory of trade credit. Petersen and Rajan (1997) contend that trade credit suppliers may employ such an instrument to discriminate and provide a price reduction to customers with more elastic demand. In the long haul, they may also use trade credit to support financially troubled buyers, and in doing so they guarantee future demand for their products.

While Garcia-Appendini and Montoriol-Garriga (2013) find evidence of non-financial firms extending substantial trade credit to their customers when bank credit is scarce, Love et al. (2007) cannot affirm whether trade credit compensates much of the contraction in bank credit during crises. However, Beck et al. (2008) and Levine et al. (2018) concur that social trust mitigates the effects of crises by allowing firms to tap into informal financing facilities without collateral.

Firms in industries dominated by specific input and product mixes may be highly responsive to trade credit. Also, many SMEs' operations rely on owners' managerial and marketing skills, knowledge of product markets, and relationships with creditor-suppliers, nurtured through time, to sustain operations. While Petersen and Rajan (1997) explain how relationships can be valuable, Wilner (2007) holds that long-term trade creditor/firm relationships and concessions in debt renegotiations become expected to a greater extent by less financially stable firms, but such firms agree to incur a higher interest rate. Evans (1998) observes that unlike lenders in a competitive credit market, trade creditors desiring to uphold an enduring product-market relationship tend to grant concessions to financially distressed buyers.

Ancillary to the finance relationship is a signalling effect whereby banks—would-be lenders—may use the presence of trade credit as a screening device when supplying credit to a trade credit recipient. In other words, loaded-up, rolled-over trade credit establishes a credit history, which may be employed to pre-screen credit seekers who, in turn, may obtain bank loans on better terms. Signalling theory proponents, including Emery and Nayar (1998) and Lee and Stowe (1993), underscore the quality assurance conveyed in trade credit. Long et al. (1993) view trade credit extension as a product quality requirement, a guarantee, in many industries. With trade credit terms set uniformly within industries and heterogeneously across industries (Ng et al. 1999; Smith 1987), it may be possible to exploit this cross-industry variation to capture the intensiveness of the effect of industry-specific trade credit elements on firms' specific outcomes.

Schwartz (1974) explains that trade credit suppliers have an information advantage over banks because they are better informed than banks are about the business and the credit risk involved in their industry, and many face fewer barriers than their customers to external finance. The consequent informational wedge between banks and trade creditors may be more acute when it comes to financing small, opaque, and financially challenged firms, which may cause bank loans to be exorbitant for such firms. While some trade creditors may find themselves on the early part of the learning curve at the outset of the lending relationship, if buyers of specialized goods find it difficult to subvert, this may result in transactional lending, which Berger and Udell (2002) qualify as one of the most powerful ways to reduce information problems in small firm finance.

2.2 Financial constraints and trade credit

It is implied in the extant finance literature that firms with financing constraints will turn to trade creditors as ultimate lenders. In a competitive market, financial intermediaries have strong incentives to overcome barriers to efficient allocation and fund any investments with expected returns greater than the marginal costs of intermediation. If the banking system overlooks financially constrained firms, they will have little incentive to operate transparently. Larger firms with easier access to external finance can raise funds on the commercial paper market on a rolling

basis and, in turn, supply trade credit to their smaller business partners, thus sustaining their operations and market share. Increased financial frictions impair the ability of financial markets to channel funds efficiently to productive investments, which may slow down the economy. When market frictions and distortions overtake competitive forces, this can undermine the ability of borrowers and lenders ability to create arm's-length financing contracts. Thus, trade credit remains an invaluable financing facility, even in competitive markets with specialized financial intermediaries when traditional credit tightens. Wilner (2007) documents that in 1997, the US Internal Revenue Service estimated that for every dollar in short-term financing provided by credit markets, US$1.94 in trade credit was outstanding.

Credit is provided based on a borrower's creditworthiness and projects' expected returns. Petersen and Rajan (1997) state that small firms with less well-established banking relationships hold significantly higher accounts payable, implying that trade credit is employed more as a financing source of last resort by very financially constrained firms. Presumably, if a bank can earn acceptable returns by lending to less informationally challenged and well-established firms, it may neglect to acquire the technology necessary to perform the lending that is most likely to be problematic. For instance, Peek and Rosengren (1995) find small business loans to be uneconomical, owing to many overhead costs. However, lenders may face interest rate ceilings disallowing them from fully pricing agency costs, which results in stricter lending standards. This view implies that trade credit relaxes financial constraints by easing the flow of credit to firms and suggests that the policy may have a broader impact on the enterprise's bottom line and its ability to redeploy its assets efficiently.

Existing empirical evidence suggests that trade credit drives a firm's growth rates (Cunat 2007; Tsuruta 2008). Notably, Cunat (2007) reports that firms with high growth rates tend to display strong reliance on trade credit relative to other finance sources when faced with liquidity shocks. Trade credit can be an exorbitant type of short-term financing for firms that cannot take advantage of the prompt payment discount leaving them to bear the full borrowing costs for stretching payables or leaning disproportionately on the trade. Trade credit rates may not exceed bank loan rates markedly. If banks refuse credit to some firms, trade creditors may impose the rate that compensates them for the perceived credit risk. Howorth and Reber (2003) find that fast-growing firms bend towards the habitual late payment of trade credit.[4]

Whereas financially weak trade credit recipients tend to exploit the financing facility (Wilner 2007), slow payers can be cut off from further delivery until they pay all outstanding debts, or future shipments may require advance payments, which may seize up the financially constrained firm's operations. Whether trade credit allows the financially constrained firm to expand and remain profitable is an inquiry of empirical relevance.

Trade credit suppliers employ the facility to price-discriminate (Ng et al. 1999; Petersen and Rajan 1997) against the most price-elastic segment of the market where trade creditors may have a long-term interest in the survival of the business partner (Petersen and Rajan 1997). Notwithstanding this, problems in capital markets, especially asymmetric information, can make it very costly for trade credit users. Trade credit costs may weigh down a firm's profits and its ability to purchase new investments. Wilner (2007) models trade creditors as having market power and earning

[4] Suppliers often extend trade credit under the standard '2/10 net 30' condition. The credit terms suggest a 2% penalty for not paying promptly, the invoiced amount representing 98% of the goods' full price. The discount provides the debtor with 20 days of trade credit-with an implied cost of 36.5%, i.e. 365/20 * 0.02 * 100. A short-term bank loan with an equivalent APR may be classified as usury and illegal in countries with an interest rate ceiling. The extent of trade credit utilization may adversely affect financially constrained firms' profits.

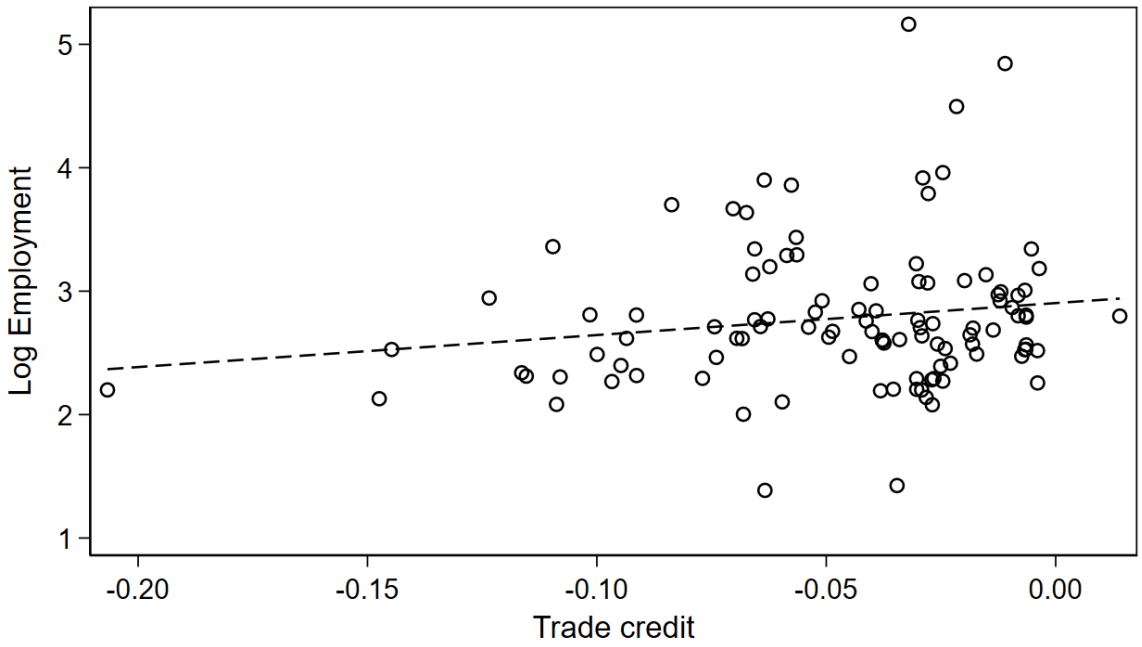
positive expected profits, which forces the debtor firm's dependence. Thus, trade credit may have diverging effects on the financially constrained firm's profit, employment, and growth.

2.3 Financial constraints, trade credit, liquidity, and firm performance

While financial constraints have clear implications for a firm's performance, it is less clear whether alleviating such constraints through trade credit strengthens many of its outcomes. Since a significant subset of firms face financing constraints, their behaviour may explain aggregate investment movements (Fazzari et al. 1988). Insofar as the firm disposes of insufficient internal funds to finance its operations and acquire profitable investments, it may be subjected to less-favourable credit conditions or locked out of loan markets altogether. Although trade credit has become expected in many industries, disparities in firms' financial constraints and ability to tap into external credit imply that many firms may access this funding facility under the most restrictive conditions, which may weigh down on profits and growth. In some cases, management may lay off non-essential employees, which may have significant macroeconomic impacts.

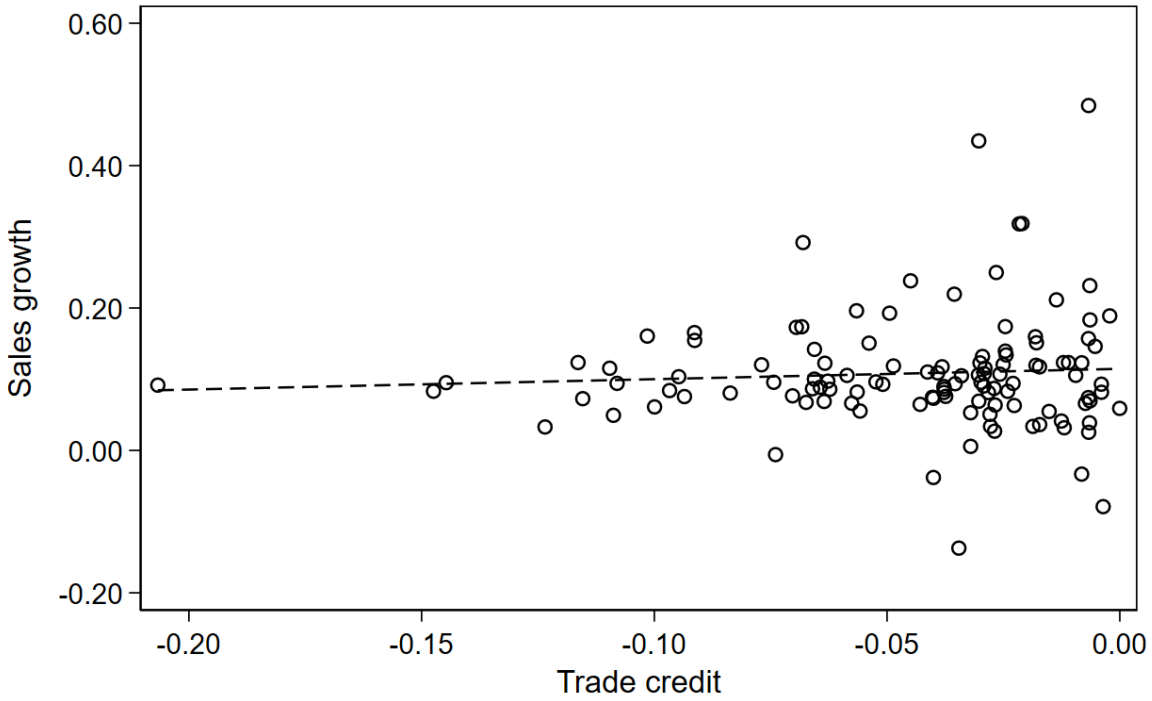
In Figure 1, each marker is an industry median of natural logarithm in employment and trade credit. We average trade credit across all of the firms within each industry and plot the average difference in an industry against its level of employment. In Figure 2, each marker is an industry median of growth sales and trade credit. We average trade credit across all of the firms within each industry and plot the average in an industry against its level of sales growth.

Figure 1: Employment and trade credit



Source: authors' construction based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2020).

Figure 2: Sales growth and trade credit



Source: authors' construction based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2020).

Figures 1 and 2 provide prima facie evidence that trade credit drives employment and sales higher. The upward slope of the line in Figure 1 implies that the amount of new trade credit received by a purchaser relieves some of the constraints related to bank credit and allows the firm to maintain (expand) its current employment. As expected, Figure 2 exhibits an upward-sloping relationship between sales and trade credit, suggesting that trade credit suppliers preserve or expand their customer base, which may support employment and profitability and thereby the firm's resilience.

The firm's long-term path depends, among other things, on factors such as its ability to generate free cash flow, the availability of internal finance, and its ability to circumvent market imperfections to tap into adequate resources, in particular credit markets, to fund profitable investments. The firm that cannot raise finance at reasonable costs is failure-bound. A firm that is too reliant on leverage may become unprofitable as internal cash flow dries up and the cost disadvantage of additional external finance units widens. However, firms operating in highly trade-credit- and liquidity-dependent industries may display different performance trends than those in industries that are less dependent on trade credit and less liquidity-intensive. Since trade credit may be considered a closer substitute for a firm's short-run liquidity needs than for long-term capital investments (Klapper et al. 2012), its resilience-enhancing effects should be the most significant for the most financially constrained firms and those heavily dependent on liquid funds.

3 Data

We employ yearly firm-level data from the CIT-IRP5 panel dataset (National Treasury and UNU-WIDER 2020), created through a joint initiative between South African Revenue Services (SARS), the National Treasury, and UNU-WIDER. The dataset is rich in firm financial and accounting information spanning from 2008 to 2018. It represents the universe of South African firms and consists of tax administrative information. Ebrahim et al. (2017), Marcelin et al. (2019), and Pieterse et al. (2016) provide a more detailed description of the data. We augment the CIT-IRP5 panel with US firm-level data obtained from the COMPUSTAT database (S&P n.d.). To deal with outliers, we remove observations that lie outside the three-standard-deviation range for the natural logarithm of total assets, sales, liabilities, and inventory. After applying several filters, we retain a final unbalanced panel of 67,215 firm-year observations from 2010 to 2017. Table 1 shows the variables used in this study, along with their definition.

Table 1: Variable definitions

1. Industry-level variables, measures of trade credit	
APAY/TA	Indicator of stock measure of industry dependence on trade credit, derived as account payable to total assets; we retain the industry medians for all years over the sample period as the indicator of industry dependence on trade credit
INV/SALES	Stock of inventory, i.e. beginning minus ending deflated by total sales; industry medians of firm-level measures retained for all years
INV/COGS	Stock of inventory, i.e. beginning minus ending deflated by cost of goods sold; industry medians of firm-level measures retained for all years
2. Firm-level variables, measures of financial constraints	
NFC	Yearly indicator of NFC firms, derived as a dummy variable equal to 1 for firms that fall in the top decile of total assets and employment, 0 otherwise
PFC	Yearly indicator of PFC firms, designated as those located between the fourth and sixth deciles of total assets and employment
FC	Yearly indicator of FC firms, designated as those located in the bottom decile of total assets and employment
CONST	Dummy variable equal to 1 for firms classified as NFC and PFC, 0 for firms classified as FC
3. Firm-level variables: control variables	
DEBT/TA	Total debt (long term and short term) scaled by beginning-of-year book value of total assets
SIZE	Natural logarithm of book value of total assets
∆SALES	Difference in the log of ending period sales less the log of sales at the beginning of period
K	Capital stock or property, plant, and equipment and other fixed assets, calculated at start-of-period
I	Growth in investment, or capital expenditure or funds used to acquire fixed assets (total assets less current assets). In other terms, $I = Kt - Kt-1$
CASH	Cash, cash equivalent, and near-cash items, weighted by K in regressions
TOBIN'S Q	Book value of total assets minus book value of equity plus market value of equity weighted by book value of total assets
CAPEX	Natural logarithm of K, defined above
COGS	Direct costs of producing the goods sold, including cost of materials and labour directly employed to produce the goods
EMPLOYMENT	Natural logarithm of a firm's number of employees
PROFITABILITY	Natural logarithm of a firm's net income
4. Country-level variables	
Inflation	Annual rate of inflation based on CPI
GDP growth	Annual rate of GDP growth

GDP_PER_capita	Natural logarithm of per capita GDP

Source: authors' construction based on COMPUSTAT (S&P n.d.) for industry-level variables; South Africa National Treasury for firm-level variables (Pieterse et al. 2016); World Development Indicators (World Bank n.d.) for country-level variables.

3.1 Firms' financing constraints

The literature proposes various techniques for identifying firm-level financial constraints. Seemingly, there does not exist a single proxy for financial constraints. Almeida and Campello (2007), Denis and Sibilkov (2010), and Fazzari et al. (1988) use a multilevel classification whereby firms fall into three groups based upon retained earnings, where higher pay-out ratios proxy for lower financial constraints and firms in the bottom three deciles are deemed the most financially constrained. Korajczyk and Levy (2003) split their sample into two subsets where financially constrained firms are those that lack sufficient cash to undertake investment projects, employing retention rates and investment opportunities as proxies.

Almeida et al. (2005), Denis and Sibilkov (2010), Gilchrist and Himmelberg (1995), and Whited (1992) employ debt ratings as a proxy for firms' financial constraints. Acharya et al. (2007), Almeida et al. (2005), Denis and Sibilkov (2010), Marcelin et al. (2019), and Saez et al. (2019) concur that smaller and younger firms are more financially constrained. A growing consensus is to rate as financially constrained (unconstrained) firms that fall into the bottom (top) three deciles on the size distribution. Rajan and Zingales (1998) introduce five financial constraint proxies using quantitative and qualitative criteria: (1) dividend pay-out; (2) liquidity constraints; (3) firms with larger pay-out ratios but sending signals of financial difficulties to shareholders; (4) firms facing difficulties in tapping into securities markets in a timely fashion; and (5) firms in violation of financial covenants. Rajan and Zingales' (1998) expansive classification scheme utilizes a limited sample of 49 companies, allowing them to thoroughly examine the sampled firms' financial reports to account for the defined criteria.

3.2 Financing constraint status: firms' classification

Hubbard (1998) offers firm-level panel data regrouping firms into high and low information cost categories to discriminate between financially constrained and unconstrained firms similarly to studies of liquidity constraints. The author recommends employing sorting criteria based on a firm's characteristics, including size, age, bond rating, commercial paper programmes, and dividend policy, reflecting information costs for firms facing a wider spread between internal and external costs of funds. Fazzari et al. (1988) employ a model in which dividends are a residual in firm decisions to pinpoint firms facing binding financing constraints, assuming that the cost of external financing exceeds that of internal financing owing to transaction or information costs and thus preventing a firm with promising investment projects from paying out substantial dividends.

As we rank and assign firms into three financial constraint classes, we remain agnostic on whether the financially constrained firm is financially distressed. We regroup firms into three classes of financial constraints. We classify as NFC firms that fall in the top decile of total assets for the number of employees. We classify firms that fall in the fourth to sixth deciles of total assets and the fourth to sixth deciles of employment as PFC. The last group of firms, FC, encompasses those that fall in the bottom decile for total assets and employment. The conservative approach to classifying firms that are not financially constrained and those that are allows for increased reliability in allocating firms to an appropriate financial status.

Table 2: Summary of annual financing constraint status

Tax year	NFC	PFC	FC	All firms
2010	87	317	67	471
2011	18%	67%	14%	1,062
	233	719	110	
2012	22%	68%	10%	3,728
	1,226	2,211	291	
2013	33%	59%	8%	11,543
	3,387	7,159	997	
2014	29%	62%	9%	12,016
	3,712	7,306	998	
2015	31%	61%	8%	12,418
	3,915	7,472	1,031	
2016	32%	60%	8%	13,082
	4,175	7,876	1,031	
2017	32%	60%	8%	12,895
	4,343	7,449	1,103	
All years	21078	40,509	5,628	67,215
	31.3%	60.3%	8.4%	100%

Note: distribution of financing constraint status by year for the sampled firms from 2010 to 2017.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020) .

A firm can fall into one group in one year and move to another in subsequent years. We implement a dynamic classification on a year-by-year basis. We perform a descriptive analysis to inspect the distribution of certain key indicators across financial constraint categories to ensure the consistency and accuracy of this classification scheme; this, overall, should capture and reflect relative differences in the availability of finance to the sampled firms through time. Table 2 summarizes our classification of firm-years in terms of financing constraints. About 31.3 per cent of firm-years are NFC, 60.3 per cent of firm-years are PFC, and 8.4 per cent fall into the FC group. We place the firm-years for which we find no evidence of financing constraints in NFC, and we assign those firm-year observations associated with significant evidence of financing constraints to the FC group. Table 3 presents the distribution of firm-level variables by annual financing constraint status. In particular, the table exhibits firm financing constraint status for each year that the firm is NFC, PFC, and FC. The table reports the mean, the standard deviation, and the number of firm-year observations for each indicator.

In terms of variations, Table 3 shows that the mean DEBT/TA ratio increases monotonically across our three classes of financial constraints from 0.6242 (NFC) to 1.23 (FC). The monotonic increase in leverage across financial constraint classes is perhaps attributable to firms with a smaller balance sheet and with lower capital stocks or total assets. Concurrently, the mean APAY/TA, our measure of trade credit, declines from 0.4271 (NFC) to 0.28 (PFC) to 0.2935 (FC), implying a strong element of trade credit driven by larger and financially more stable firms: trade creditors expand sales on credit more than smaller firms do. The mean ΔSALES declines from 0.1017 (NFC) to 0.0779 (PFC) to 0.0139 (FC), evidencing higher sales growth amog trade creditors. Meanwhile, IVN/COGS follows the same patterns as ΔSALES across financing constraint classes. PFC firms exhibit the highest Tobin's, implying that the firms that are perceived to be genuinely financially constrained stand at a disadvantage in terms of investment opportunities. Overall,

Table 3 shows that financially constrained firms are more dependent on trade credit than firms that fall into the other groups of our financing constraints scheme.

Table 3: Summary statistics for firm characteristics by yearly financing constraint status

	μ/σ/p10/p25/p50/p75/p90 (NFC)	μ/σ/p10/p25/p50/p75/p90 (PFC)	μ/σ/p10/p25/p50/p75/p90 (FC)	μ/σ/p10/p25/p50/p75/p90 (All)
TOBIN'S_Q	0.6418	0.6204	0.5692	0.5881
	0.1490	0.3599	0.6380	0.5331
	0.4826	0.2277	0.0866	0.1913
	0.5835	0.4738	0.4427	0.4583
	0.5961	0.6990	0.7346	0.6673
	0.7349	0.8530	0.9100	0.8497
	0.8705	0.9408	0.9490	0.9434
INV/COGS	0.0963	0.0360	−0.3033	−0.0057
	0.5534	1.4917	2.2059	1.4413
	−0.2725	−0.6251	−1.1540	−0.6129
	−0.0991	−0.3079	−0.5201	−0.2917
	0.0223	−0.0735	−0.2232	−0.0587
	0.2212	0.2379	0.0000	0.1935
	0.5474	0.9483	0.6451	0.7939
DEBT/TA	0.6242	0.7888	1.2313	0.8781
	0.2009	0.5934	1.9462	1.0249
	0.3179	0.2478	0.4383	0.2694
	0.5412	0.4568	0.5332	0.4918
	0.6721	0.7414	0.8650	0.7357
	0.6857	0.9915	1.3198	0.9990
	0.8259	1.2527	2.3143	1.3941
ΔSALES	0.1051	0.0779	0.0195	0.0810
	0.3300	0.3232	0.2946	0.3675
	−0.1497	−0.2126	−0.2788	−0.2225
	−0.0111	−0.0489	−0.1001	−0.0494

	0.0868	0.0664	0.0288	0.0695
	0.1947	0.1898	0.1570	0.1954
	0.3644	0.3761	0.3170	0.3924
PROFITABILITY	14.8959	12.3550	10.7034	12.794
	0.9509	1.3371	1.37767	1.7524
	13.6646	10.6804	8.9145	10.5960
	14.6127	11.6499	10.0705	11.6729
	15.3567	12.5598	10.9635	12.8480
	15.4681	13.2443	11.5919	14.0823
	15.5380	13.8287	12.1592	15.2577
CASH/K	0.1454	0.1134	0.1291	0.1230
	0.3124	0.1593	0.1698	0.1867
	0.0002	0.0000	0.0000	0.0000
	0.0047	0.0045	0.0053	0.0050
	0.0475	0.0464	0.0637	0.0495
	0.1712	0.1562	0.1852	0.1672
	0.3852	0.3284	0.3579	0.3558
CASHFLOW	0.0959	0.1313	0.0546	0.1212
	0.0808	0.2673	0.3872	0.2937
	0.0044	−0.0910	−0.3255	−0.0866
	0.0370	0.0218	−0.0774	0.0162
	0.1050	0.1029	0.0735	0.1008
	0.1337	0.2139	0.2172	0.2038
	0.1761	0.3718	0.3900	0.3650
APA/TA	0.4270	0.2800	0.2935	0.3108
	0.4931	0.2964	0.4745	0.4019
	0.0578	0.0283	0.0090	0.0240
	0.1323	0.0888	0.0433	0.0836
	0.2852	0.2120	0.1585	0.2166

	0.5400	0.3954	0.3928	0.4255
	0.9188	0.6061	0.6904	0.6785
EMPLOYMENT	4.6814	2.2878	0.3789	2.5417
	0.7914	0.2723	0.3255	1.2519
	3.7468	1.9242	0.0000	1.0413
	4.0525	2.0722	0.0000	1.6742
	4.5667	2.2949	0.5103	2.4727
	5.1648	2.5199	0.6932	3.3384
	5.7679	2.6604	0.6959	4.1946
N	21,078	40,509	5,628	67,215

Note: this table shows variations in financial variables by annual financing constraint status for a sample of South African firms from 2010 to 2017. We follow Kaplan and Zingales (1997) in assigning overall financial status, based on whether firm financing constraint status for each year falls into the category of NFC, PFC, or FC. Each entry reports the mean, standard deviation, 10th percentile, 25th percentile, median, 75th percentile, and 90th percentile. The variables are defined in Table I.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020) .

3.3 Robustness of the financing constraints classification

As a robustness check, we estimate a multilevel logit model of the probability that a firm falls into its ascribed category, with NFC being the lowest class and FC the highest. Accordingly, we estimate the likelihood of being classified as financially constrained based on a set of firm-level indicators, including LEVERAGE, TOBIN'S Q RATIO, and cash flow investor, industry, and year effects. We derive TOBIN'S Q as the book value of total assets minus the book value of equity plus the market value of equity weighted by the book value of total assets. Although imperfect, this classification scheme captures the major and conventional aspects of firms' financial constraints in a novel way. While not all-encompassing, consistent with theory, these data on the distribution of financial constraint characteristics shed light on which group of firms benefits from greater access to trade credit.

We estimate several ordered logit models of the probability that a firm falls into one of the three financial constraint classes: with NFC = 1, PFC = 2, and FC = 3. Table 4 displays the results of the logit estimations. The likelihood of being classified as financially constrained decreases significantly in firms with higher LEVERAGE and CASHFLOW/K. *A priori*, the more a firm has access to external finance and the more cash it disposes of, the less likely it is to be classified as financially constrained. We include industry dummies in all of the specifications. All of the coefficients are statistically significant at the 1 per cent level. As in Kaplan and Zingales (1997), Tobin's Q has a positive impact on the probability of being financially constrained. Table 4 provides strong support for a correct and consistent distribution of firms among the respective financial groups.

Table 4: Predictability of financing constraint status

Dep. variable	[1]	[2]	[3]	[4]
TOBIN'S_Q	0.3128***	0.3125***		
	[0.0441]	[0.0474]		
DEBT/TA	−0.0281	−0.0271	−0.1042***	−0.1033***
	[0.0341]	[0.0341]	[0.0330]	[0.0329]
$CASHFLOW_t / K_{t-1}$	−0.1625***	−0.1632***	−0.1636***	−0.1643***
	[0.0642]	[0.0644]	[0.0635]	[0.0637]
CUT_1	1.2784	1.1037	1.0953	0.9144
	[0.0442]	[0.0514]	[0.0295]	[0.0509]
CUT_2	1.8024	1.6277	1.6186	1.4378
	[0.0606]	[0.0896]	[0.0547]	[0.0811]
CUT_3	4.3696	4.1951	4.1843	4.0035
	[0.1066]	[0.1328]	[0.1008]	[0.1321]
Year dummies	No	Yes	No	Yes
Industry dummies	Yes	Yes	Yes	Yes
Log-likelihood	−169715.27	−169645.94	−169581.95	−169513.44
Pseudo R^2	0.0164	0.0168	0.0170	0.0174

Note: ordered logits determining annual financing constraint status for our sampled firms. All variables are as defined in Table 1. Robust standard errors are in square brackets. Regressions control for year and industry effects.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020) .

3.4 Trade credit intensity

Our primary purpose is to employ an industry-specific measure of trade credit intensiveness. Rajan and Zingales (1998) pioneered a technique that allows subsequent research to use US COMPUSTAT data to derive an industry-level 'propensity for trade credit'. They provide the theoretical underpinnings and show that using domestic data to benchmark industry dependence on trade credit would be problematic due to endogeneity issues, and that relying on US data resolves the endogeneity issue. Appealing to US data, incumbent research argues that using exogenous US data as the industry benchmark for the actual use of trade credit in other countries is appropriate, as such data originates from a well-developed market where trade credit choices are, arguably, optimal (see Fisman and Love 2003; Levine et al. 2018).

Particularly, Fisman and Love (2003) highlight that US firms are likely to represent the desired (optimal) level of trade credit used by firms in a given industry and that using the US trade credit data implicitly assumes that trade credit usage by industries in the United States is representative of trade credit usage worldwide. Fisman and Love (2003) and Rajan and Zingales (1998), among others, maintain that US capital markets—namely, listed firms—are relatively frictionless. Fisman and Love (2003) contend that even the most constrained of US firms face far less scarcity of funding from formal institutions than companies in other countries, thus explaining why firms with financing needs in other countries might rely more heavily on supplier financing in the form of trade credit as a means of funding growth.[5]

We identify industries' need for trade credit, measured as the ratio of account payable to total assets using US firm-level data, using the entire COMPUSTAT database (S&P n.d.). The argument is that a highly financially constrained firm operating in an industry sector that is highly dependent

[5] Nanivazo et al. (2021) employ a similar technique to examine whether foreign bank entry helps to alleviate poverty in Africa.

on external finance is likely to fall back on trade credit to finance its operations and sustain its resilience. We then analyse the ratio of industries' growth rates to trade credit financing to bypass external finance roadblocks from the financial markets.

4 Empirical approach

In this section, we discuss our approach to testing the presence of financial constraints across different groups of firms; then, we elaborate on the methodological approach implemented to measure the effect of trade credit on financially constrained firms.

4.1 Testing the presence of financing constraints: the Euler equation

We implement a multipronged strategy to structurally test the presence of financing constraints, rank firms based on financing constraint status, and test the likelihood that a firm falls into its designated class according to its financing status. We start by examining the presence of financing constraints employing the Euler equation. Conventionally, the Q-based methodology and the Euler equation compete when estimating a firm's financing constraints. Because it does not rely on stock market information, the Euler equation circumvents noisy signals, often difficult for stakeholders to follow, and sets itself up as appealing for countries with underdeveloped asset markets.

Several studies elect to directly estimate firms' Euler equation to test for the presence of firm financing constraints (Forbes 2007). Bond and Meghir (1994), Gilchrist and Himmelberg (1999), Haramillo et al. (1996), Harrison et al. (2004), Hubbard (1998), Love (2003), and Whited (1992) provide theoretical justifications and empirical support for employing the Euler equation in testing financing constraints. Derived from the value-maximization problem as the Q model, the Euler equation framework mitigates problems associated with measuring marginal Q, and can be extended to specify an alternative model with borrowing constraints by allowing the shadow cost of external financing to depend on the firm's debt-to-assets ratio (Hubbard 1998; Whited 1992). In the Euler equation, the financially constrained firm behaves as if it had a higher discount rate for a given level of today's adjustment costs (Forbes 2007). Adding overidentifying restrictions to the Euler equation and testing for model misspecification, we estimate the presence of credit constraints employing the following set-up:

$$\left(\frac{\mathrm{I}}{\mathrm{K}}\right)_{\mathrm{it}} = \theta + \delta\left(\frac{\mathrm{I}}{\mathrm{K}}\right)_{\mathrm{i,t-1}} + \gamma\left(\frac{\mathrm{SALES}}{\mathrm{K}}\right)_{\mathrm{it}} + \varphi\left(\frac{\mathrm{CASH}}{\mathrm{K}}\right)_{\mathrm{it}} + \zeta\left(\frac{\mathrm{CASH}}{\mathrm{K}} * \mathrm{CONST}\right)_{\mathrm{it}} + \tau_i + \vartheta_{\mathrm{t}} + \varepsilon_{\mathrm{it}} \quad (1)$$

where τ_i are the firm fixed effects for each firm i; ϑ_{t} are period-specific effects; and $\varepsilon_{\mathrm{it}}$ is the idiosyncratic error term. K is capital stock, i.e. property, plant, and equipment, and other fixed assets. I refers to capital expenditures or funds used to acquire fixed assets, the current year's capital expenditures minus the previous year's capital expenditures, deflated by lagged capital expenditures. $SALES$ represents K-weighted gross sales or revenues. $CASH$ represents the firm's K-weighted cash holdings, including cash, cash equivalent, and near-cash items.

Employing this structural framework, we test the prevalence of financing constraints across the different groups of firms. $CONST$ is a dichotomy variable capturing the firm's financing constraint status, equal to 1 for firms in the NFC and PFC groups and 0 for firms in the PC group. In the presence of credit constraints, $\zeta < \varphi$, i.e. barriers to accessing external finance, are lower in larger and less opaque firms than in smaller firms plagued with information asymmetry problems.

Alternatively, we repeat the test on $SIZE = LN(TOTALASSETS)$: if smaller firms face higher financial constraints owing to information asymmetry problems, then we can test whether financial constraints exist for small firms and decrease with firm size using the null hypothesis that $\varphi = 0$ and $\zeta = 0$ against the alternative hypothesis ($\varphi > 0$ and $\zeta < 0$). Forbes (2007) posits that this strategy based on the Euler equation has several significant advantages over the Q-based methodology, including circumventing the numerous problems related to measuring marginal Q and allowing the explicit modelling of the shadow cost of financing as a function of a firm's cash stock (or other proxies for financial constraints). However, the author raises several issues with the Euler methodology, including that it imposes a high degree of structure on the estimating equation and poor small sample properties.

4.2 Measuring the effect of trade credit on financially constrained firms

Assume that trade credit serves as a substitute for bank credit for a particular class of firms, assets, and product mix. If this holds for firms in labour-intensive and manufacturing industries, this type of informal lending eases access to finance, allowing firms to bypass costly bank loans and further increase free cash flows, sustaining growth and employment. To assess whether firms in industries reliant on trade credit perform optimally, we follow a well-established empirical strategy in the incumbent literature (see Claessens and Leaven 2003; Fisman and Love 2003; Petersen and Rajan 1997; Rajan and Zingales 1998). We test the central hypothesis that financially constrained firms in industries dependent on trade credit will be relatively more resilient to the extent that they can tap into trade credit to finance their operations.[6] This conjecture implies a regression model that takes the following form:

$$\mathrm{Y_{it}} = \alpha_i + \delta\left(\mathrm{DEBT_{it}}/\mathrm{TA_{i,t-1}}\right) * (\mathrm{TRADECREDIT})_{jt} + \beta \mathrm{X_{it}} + \varepsilon_{it} \qquad (2)$$

where i denotes firm, denotes industry, and t represents the year. While we sort the firms according to financial constraint status, we interact proxies of financial constraints and external finance needs with an exogenously constructed trade credit dependence measure. Next, we dissect the financing constraints by level using the retained proxies. A positive sign on the interaction term of credit constraint and trade credit dependence, $DEBT\ /\ TA * TRADECREDIT$, would denote a constraint-relaxing effect induced on the leveraged firm through higher trade credit. As increasing leverage amplifies the firm's risk profile, increasing its financial risks and interest burdens and thus limiting its debt capacity, trade credit fills in the financing shortfall created by the inability to generate free cash flow and to take on extra debt. We employ firm fixed effects to account for unobserved sources of fluctuations in each industry's dependent variable. We adjust errors for heteroscedasticity. Claessens and Laeven (2003) and Fisman and Love (2003), among others, rule out the need for the interaction term's constructs to enter the regression independently. The outcome variables consist of employment, profitability, and sales growth in output across the tables.

Our stock measure of financing constraints captures and seeks to quantify the firm's capital shortfall—its financing gap, or the proportion that the firm cannot fund out of retained earnings of free cash flows, for which it falls back on major outside creditors. More specifically, we measure a firm's short-run liquidity needs, following Raddatz (2006) in employing the proportion of

[6] To test our hypothesis that trade credit improves firm-level outcomes at financially constrained firms in trade-credit-intensive industries, we run separate tests for each class of financial constraints.

working capital financed by ongoing sales, with higher values indicating greater dependence on short-run liquidity.

To obtain industry-level measures of trade credit dependence, we follow a practice established in the incumbent literature, employing the ratio of accounts payable to total assets ($APAY/TA$) using data from the COMPUSTAT database (see Fisman and Love 2003 and Petersen and Rajan 1997, among others). We obtain the median value for each industry using the ratios over all firm-years over the sample period. This ratio represents the share of total assets financed by trade credit. By extension, it indicates an industry's ability to draw on informal lending facilities instead of bank financing.

The analysis differentiates between firms in industries with substantial liquidity needs to the extent that they rely on external liquidity in trade credit ($APAY/TA$), possibly to finance short-term operations. Perhaps these firms operate in industries with high liquidity needs, which may result from product-market specificities, high inventory levels, input mix, and supply chain, among other factors, requiring the smoothing out of both investment and capital to streamline operations. This study follows Claessens and Laeven (2003), Fisman and Love (2003), Levine et al. (2018), and Rajan and Zingales (1998), among others, to derive industry levels of liquidity needs, the trade credit intensity from US data at the two-digit Standard Industrial Classification (SIC) code level, and use it as a proxy for industry reliance on trade credit in South Africa.

The assumption is that cross-industry external liquidity financing needs in the US, a well-developed financial market, reflect the level of external liquidity reliance in similar industries worldwide. Rajan and Zingales (1998) provide the rationale for using US data as 'industry representative' of the actual use of trade credit across industries worldwide. There is a strong consensus that US firms exhibit the desired (optimal) level of trade credit used by firms in a given industry (e.g. Claessens and Laeven 2003, Fisman and Love 2003, Levine et al. 2018, and Rajan and Zingales 1998, among others): a strong assumption, borne out of necessity, because within a country actual data on industry dependence on trade credit would be problematic, owing to endogeneity issues. Therefore, it is more appropriate to turn to a country with well-developed markets, where trade credit choices are, in some sense, optimal (Fisman and Love 2003). The United States supplies an exogenous measure of trade credit.

We follow the technique in Fisman and Love (2003), Levine et al. (2018), and Rajan and Zingales (1998), among others, to construct measures of trade credit using US data. We employ accounts payable, representing the level of goods and services a buying firm receives from its vendors on credit. Accounts payable are unsupported by formal promissory notes, enforceable in courts. In the regressions, we employ our indicator of trade credit, derived from US benchmark data, as representative of industry liquidity needs and measured as the ratio $APAY/TA$, the share of accounts payable in total assets. This indicator is constructed among US firms in each industry at the two-digit SIC code level and employed as a benchmark for South African firms' trade credit intensity.

5 Results

After classifying firms into the three financial constraint classes, we test for the presence of financing constraints across firms. Then, we implement direct tests of the effect of trade credit dependence on financially constrained firms. This section conducts a systematic analysis of the data using regression analysis to better understand the nexus between trade credit, employment, profitability, and sales growth.

5.1 Tests of financing constraints

We estimate the Euler-based Equation 1, employing the GMM-type estimation technique on the grounds that the variables may be jointly endogenous, causing reverse causality issues and biasing the coefficient estimates. Employing first differences on each of the variables, the GMM-type estimator removes the firm-specific effects. It also utilizes lagged levels of the variables as instruments. The GMM-type estimator is consistent and efficient, with standard tests of instruments' validity and the absence of second-order serial correlation in the differenced equation (Arellano and Bond 1991; Arellano and Bover 1995). First, as in Table 9, we use the Sargan test of overidentifying restrictions. For all models discussed in Tables 5 and 9, the Sargan statistic for overidentifying restrictions and the Arellano–Bond AR(2) tests, respectively, show that, at least at the 10 per cent significance level, our instruments are appropriately orthogonal to the error and no second-order serial correlation is detected.

Table 5: Testing the presence of financing constraints—Euler equation

		CONST = 1 if NFC = 1, PFC = 1, and 0 if FC = 0	SIZE = LN(TOTALASSETS)
Dependent variable (I/K)	*Parameters*	[1]	[2]
SALES/K	γ	−0.00008	−0.0003***
		[0.0004]	[0.0001]
CASH/K	**φ**	**0.0565****	**0.0683*****
		[0.0275]	**[0.0137]**
CASH/K*CONST	ζ	**−0.0591****	
		[0.0283]	
CASH/K*SIZE	ζ		**−0.0043*****
			[0.0009]
LAG(I/K)	δ	0.0864	0.0801
		[0.0652]	[0.0491]
CONSTANT	θ	0.337***	0.355***
		[0.0998]	[0.0853]
N		2,151	5,936
Industry fixed effects		Yes	Yes
Time fixed effects		Yes	Yes
Sargan test p-value		0.5486	0.4185
AR(2) p-value		0.5651	0.3427
Test of linear combination of coefficients			
CASH/K − CASH/K*CONST		**0.1155**	NA
z-statistics		**2.09**	NA

Note: GMM estimates of the Euler equation of Equation 1. In both specifications, the dependent variable is $\left(\frac{I}{K}\right)_{it}$. SALES is firm sales weighted by capital. CASH refers to cash and equivalent and near-cash items normalized by K. In specification 1, the interaction term involves a dummy variable, CONST = 1 for larger firms classified as NFC and PFC, and 0 for firms classified as FC. In specification 2, the interaction term involves SIZE, modelled as LN(TOTALASSETS), testing whether financial constraint status is inversely related to SIZE. Robust standard errors are in square brackets. ***, **, and * refer to 1%, 5%, and 10% levels of statistical significance, respectively.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020) .

In both specifications in Table 5, the coefficient estimates for the variables of the financial constraints continue to be statistically significant at least at the 5 per cent level, suggesting that, on average, smaller firms in our sample are relatively more financially constrained. Notably, the point estimates satisfy the hypotheses that $\zeta < \varphi$ for specification 1, and $\varphi > 0$ and $\zeta < 0$ for specification 2. Remarkably, the null hypothesis test that $\zeta < \varphi$ in specification 1 reveals that financing constraints are lower for NFC and PFC, i.e. for larger firms than for smaller (FC) firms, and we reject the null hypothesis that $\varphi = 0$ and $\zeta = 0$ for the alternative hypothesis ($\varphi > 0$ and $\zeta < 0$) for specification 2. We perform a test of a linear combination of the regression coefficients on the CASH/K*CONST and CASH/K variables reported in Table 5. We test the null hypothesis that the difference between the coefficients on CASH/K*CONST and CASH/K is less than zero. The final two rows of Table 5 report the difference between those coefficients and the corresponding z-statistic for the null hypothesis that the difference is negative. We reject the null hypothesis of no financing constraints as the magnitude of ζ is statistically significantly smaller than that of φ, suggesting that smaller firms are financially constrained as classified.

We obtain coefficients on the control variables that are qualitatively similar both in signs and significance in both specifications to those of Forbes (2007). The models allow financial constraints to vary by firm size. Column 1 of Table 5 includes an interaction term between CASH and a financial constraint, defined by constraint groups, a dummy variable, with $CONST = 1$ for larger NFC firms and PFC firms. Column 2 of the table includes an interaction term between CASH and a continuous measure of firm size, modelled as $LN(TOTALASSETS)$. CONST captures differences in financial constraints between FC and NFC firms. Specification 2, the SIZE regression, tests for any linear relationship between firm size and financial constraints. The results in Column 1 of the table suggest that firms classified as financially constrained face significant hurdles to accessing credit markets. Column 2 estimates imply that smaller firms are highly financially constrained while suggesting an inverse relationship between financial constraints and firm size. With a p > 10 per cent for both the Sargan test of overidentifying restriction and the AR(2) test of autocorrelation, the post-estimation tests satisfy the requirements of a correctly specified model and no second-order serial correlation in the errors and that the Euler equation estimates correctly identify the presence of financing constraints as classified.

5.2 Financial constraints and employment

We follow the methodology proposed in Rajan and Zingales (1997) augmented by Claessens and Laeven (2003) and Fisman and Love (2003). We control for firm fixed and year effects. Statistically, the estimated coefficient on the interaction term, $DEBT\ /TA * TRADECREDIT$, should be 0 as long as the firm characteristics adequately capture its ability to promote employment, generate profits, and secure growth opportunities. A significantly positive coefficient on the interaction term rejects the hypothesis that trade credit fails to relax financing constraints on the financially constrained firm.[7] Table 6 presents the results for the effect of access to trade credit on a firm's employment sensitivity. The table first reports ordinary least squares (OLS) results that serve as a benchmark followed by fixed-effects regressions. Although robust with standard errors clustered at the industry level, the OLS estimator, unlike the fixed effects, does not account for unobserved heterogeneity across sampled firms and only exploits natural variations available across firms, which may result in bias estimates.

[7] It is worth recalling that Claessens and Laeven (2003) and Fisman and Love (2003) concur that there is no need for DEBT/TA and TRADECREDIT to independently enter the regression.

Firms classified as NFC and PFC exhibit the least or insignificant employment trade credit sensitivity. Small, opaque, informationally challenged, and financially constrained firms exhibit the highest employment trade credit sensitivity (0.174), significant at the 1 per cent level, exceeding the statistically and economically insignificant effect for rival groups. The coefficient estimate associated with the interaction between credit constraint and our stock measure of trade credit dependence is economically and statistically significant, revealing the critical economic role played by trade credit by allowing small firms plagued with information asymmetry to tap into alternative sources of financing as they face constraints to traditional credit channels. *Ceteris paribus*, the estimate on the interaction term $DEBT\ /TA * TRADECREDIT$, suggests that a one-standard-deviation increase in our TRADECREDIT measure (0.4745) corresponds to an 8.26-percentage-point ($= 0.174 * 0.4745$) increase in employment. The coefficient estimate in Table 6 implies that at the financially constrained firms, this amounts to a 21.79 per cent ($\approx 0.0826/0.3789$) increase in the mean of employment (0.3789, shown in Table 3). The economic magnitude of the impact of TRADECREDIT on employment at financially constrained firms is rather substantial.

To see this, consider the hypothetical 'average' financially constrained firm with the average group value of EMPLOYMENT (1.47): a one-standard-deviation increase in TRADECREDIT leads to an increase of $0.36 \approx 0.0826 * e(1.47)$ jobs. In other words, the number of new workers in the financially constrained group of firms grows by $0.36 * 5{,}628 \approx 2{,}022$ for a one-standard-deviation increase in TRADECREDIT. The values of EMPLOYMENT for the financially constrained firms range from 0 to 10.26 with a standard deviation of 1.76. They suggest that the number of workers in our sample of firms ranges from 465 to over 4,770, associated with a one-standard-deviation increase in TRADECREDIT. Our classification scheme allows us to pinpoint the effect of trade credit among the most financially constrained firms.

Table: 6 Regression of effect of trade credit dependence on employment by financial constraint status

	NFC	NFC	PFC	PFC	FC	FC	All firms	All firms
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
DEBT/TA*APAY/TA	−0.161	0.0084	−0.0016	−0.0090	**0.104*** **	**0.174*** **	0.0032	0.0091
	[0.380]	[0.0238]	[0.0320]	[0.0077]	**[0.0228]**	**[0.0218]**	[0.0631]	[0.0100]
CAPEX	0.161***	0.0575*	0.0102***	0.0041	0.0127**	0.0163	0.0975***	0.0131***
	[0.0245]	[0.0303]	[0.0025]	[0.0028]	[0.0060]	[0.0108]	[0.0054]	[0.0023]
∆SALES	−0.119***	−0.0409	−0.0189	−0.0575**	−0.0213	−0.0867	−0.227***	−0.102***
	[0.0406]	[0.0297]	[0.0134]	[0.0213]	[0.0510]	[0.0671]	[0.0272]	[0.0139]
DEBT/TA	0.0298	−0.0037	0.0099	−0.0019	−0.0864***	−0.102	0.0911***	−0.0255**
	[0.0508]	[0.0109]	[0.0095]	[0.0148]	[0.0294]	[0.0990]	[0.0255]	[0.0122]
GDP_PER_CAPITA	0.398		1.775**		-3.228		3.755***	
	[1.393]		[0.663]		[3.321]		[0.861]	
INFLATION	0.0283		−0.0536**		0.0859		0.0335**	
	[0.0315]		[0.0222]		[0.0853]		[0.0150]	
COGS	0.267***	0.183***	0.0482***	0.119***	−0.0238	0.112	0.453***	0.227***
	[0.0777]	[0.0425]	[0.0082]	[0.0235]	[0.0303]	[0.0818]	[0.0482]	[0.0187]
CONSTANT	−6.399	0.350	−14.31**	0.430	29.26	−1.351	−39.32***	−1.064***
	[12.13]	[0.825]	[5.978]	[0.362]	[29.76]	[1.202]	[7.690]	[0.296]
Firm effects	OLS	Yes	OLS	Yes	OLS	Yes	No	Yes
Year effects	No	Yes	No	Yes	No	Yes	No	Yes
N	2,676	2,340	4,396	3,411	352	211	27,662	24,971
R-squared	0.225	0.958	0.0358	0.819	0.0523	0.810	0.494	0.964

Note: $DEBT/K * APAY/TA$ is the firm's total debt multiplied by the industry median of accounts payable ratio, our proxy for trade credit. All other variables are defined in Table 1. Regressions are estimated for the three financial constraint classes and the overall sample. OLS estimations are followed by fixed-effects regressions for each financial constraint grouping. Fixed-effects regressions control for year and firm effects. Robust standard errors are in squared brackets. ***, **, and * represent 0.01, 0.05, and 0.1 levels of significance, respectively.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020) .

Not surprisingly, trade credit is more impactful at financially weaker firms that are highly reliant on trade credit. The effect is statistically insignificant for firms classified as NFC or PFC. Although NFC and PFC firms in our sample do not benefit from employment growth stemming from trade credit, we cannot rule out ripple effects throughout the value chain since these firms are the likely trade credit suppliers, allowing them to sustain employment levels, maintaining market power through guaranteed sales or customer base. The result is consistent with our expectation that trade creditors may have a relative advantage in developing countries with less-developed financial markets. In other words, the results on a financially constrained firm's ability to access external finance in the form of trade credit have ramifications for emerging and developing economies with a diversity of institutions in which this form of informal credit occurs. The result is consequential for several reasons. Ayyagari et al. (2014) report that in developing economies, small firms have the most significant shares of job creation and the highest sales growth and employment growth, even after controlling for firm age. The financially constrained firm's ability to access credit in the form of creditor's supply may provide a lifeline to the economy, mainly where the financial intermediary sector is relatively small.

It is noteworthy that La Porta and Shleifer (2008) show that even if informal firms account for a large portion of economic activity in developing countries, growth and development stem from creating highly productive formal firms. Klapper and Love (2011) also document a significant positive relationship between new firms (likely or possibly financially constrained) and income per capita. These findings suggest that emerging economies, characterized by a large number of SMEs, lack of adequate credit bureaus, and shallow financial markets may benefit from promoting an environment conducive to informal lending in the form of supplier finance to sustain employment and to support industry, demand, and forward leakages in the informal sector to push back poverty rates. The extant literature suggests that small firms devoid of collateral (Mathur and Marcelin 2014), highly intertwined with the informal sector, which empowers women (Minniti and Naudé 2010) and alleviates poverty (Tamvada 2010), may serve as a bridge into the formal sector (Bennett 2010).

5.3 Financial constraints and profits

In Table 7, we test the effect of trade credit on a firm's profitability. As in Table 6, we expect a positive sign on the interaction term $DEBT\ /TA * TRADECREDIT$. The findings in Table 7 confirm that access to trade credit boosts financially constrained firms' profitability. The interaction term's coefficient (0.921) is positive and significant at the 1 per cent level for FC firms and the overall sample. Meanwhile, it is insignificant for firms in the NFC and PFC groups. In comparison, benchmark OLS regressions report estimates with robust standard errors clustered at the industry level; the regressions of interest control for firm fixed and year effects to account for factors affecting a firm's profits through time.

Table 7: Regression of effect of trade credit dependence on firms' profitability by financial constraint status

	NFC	NFC	PFC	PFC	FC	FC	All firms	All firms	All firms
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
DEBT/TA*APAY/TA	−0.0442	−0.0768	0.0827	0.0642	**0.354*** **	**0.921*** **	0.208***	0.144	0.0393**
	[0.192]	[0.131]	[0.132]	[0.0749]	**[0.0694]**	**[0.188]**	[0.0736]	[0.122]	[0.0148]
CAPEX	0.0316	0.0448	0.0709***	0.0373	−0.0214	−0.199*	0.246***	0.139***	0.0142
	[0.0288]	[0.0691]	[0.0159]	[0.0357]	[0.0169]	[0.107]	[0.0191]	[0.0171]	[0.0146]
∆SALES	0.198	0.109	0.472***	0.465***	0.931***	1.079*	0.462***	0.391***	0.391***
	[0.141]	[0.134]	[0.0917]	[0.116]	[0.269]	[0.605]	[0.0668]	[0.0462]	[0.0921]
DEBT/TA	−0.557***	0.0108	−0.552***	−0.384***	−0.243	−0.454	−0.716***	−0.752***	−0.326***
	[0.0748]	[0.121]	[0.0416]	[0.129]	[0.153]	[0.512]	[0.0405]	[0.0396]	[0.0488]
FIXED_ASSETS/TA_{t-1}	−0.00778	0.0263	−0.0590***	−0.00203	0.0176	0.184*		−0.0933***	0.0179
	[0.0402]	[0.0902]	[0.0195]	[0.0378]	[0.0264]	[0.0881]		[0.0168]	[0.0210]
GDP_PER_CAPITA	−0.0614		−0.977		−8.902				
	[2.599]		[3.911]		[10.96]				
COSG	0.306***	0.385***	0.272***	0.448***	−0.158	−0.926		0.555***	0.360***
	[0.0280]	[0.136]	[0.0511]	[0.153]	[0.101]	[0.832]		[0.0230]	[0.0718]
CONSTANT	8.978	7.208**	15.51	4.717**	92.61	26.00**	9.359***	20.59*	6.830***
	[23.10]	[2.847]	[34.74]	[2.222]	[98.09]	[11.68]	[0.224]	[12.20]	[1.075]
Firm effects	OLS	Yes	OLS	Yes	OLS	Yes	OLS	OLS	Yes
Year effects	No	Yes	No	Yes	No	Yes	No	No	Yes
N	2,124	1,813	2,991	2,150	204	111	20,227	19,311	16,616
R-squared	0.0994	0.615	0.120	0.749	0.0815	0.725	0.222	0.448	0.838

Note: $\mathrm{DEBT/K} * \mathrm{APAY/TA}$ is firm's total debt multiplied by the industry median of accounts payable ratio, our proxy for trade credit. All other variables are defined in Table 1. Regressions are estimated for the three financial constraints classes and the overall sample. OLS estimations are followed by fixed-effects regressions for each financial constraint grouping. Fixed-effects regressions control for year and firm effects. Robust standard errors are in square brackets. ***, **, and * represent 0.01, 0.05, and 0.1 levels of significance, respectively.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020).

Access to trade credit might shape corporate performance for highly financially constrained firms through several mechanisms, including lower interest payments or trade credit discount policies. Unfortunately, Beck et al. (2008) observe that small firms do not use trade finance disproportionately more than larger firms; thus, these financing sources hardly compensate for small firms' lower level of access to bank financing. Loaded up and rolled over, trade credit eases financing constraints, thus enhancing corporate profits. Levine et al. (2018) report that firms in industries with high liquidity needs in high-trust economies enjoy a smaller drop in profits (earnings before interest and taxes, EBIT) than similar firms in low-trust countries.

The results in Table 7 indicate that trade credit enhances a firm's profits significantly for FC firms and the overall sample, implying that trade credit benefits in relation to a firm's performance reach firms beyond those in the most financially constrained class. The economic magnitude of the estimated impact of trade credit on firm profitability is substantial. For example, take the coefficient estimates on FC firms in Column 6 of Table 7. The estimate on the interaction term $DEBT\ /TA * TRADECREDIT$ suggests that a one-standard-deviation increase in the trade credit treated measure (0.4745) leads to a 0.44-percentage-point ($= 0.4745 * 0.921$) increase in profitability, the equivalent of a 4.07 per cent ($\approx 0.44/10.7396$) surge in the financially constrained firms' mean of profits (10.7396 per cent, shown in Table 3). The effect is statistically and economically significant but weaker in the overall sample. It is statistically indistinguishable from 0 for firms in the NFC and PFC groups. Levine et al. (2018) identify trust as the primary mechanism through which trade credit affects a firm's outcomes in crisis years when bank financing dries up.

5.4 Financial constraints and sales growth

Table 8 presents the results for the effect of trade credit on sales growth. Consistent with our anticipations, we observe higher sales growth rates associated with increased trade credit financing for the firms least dependent on liquid funds compared with firms facing substantial working capital needs. The sales growth regressions in Column 1 of Table 8 show that NFC firms have higher sales growth than their PFC and FC rivals, controlling for TOBIN'S Q, CAPEX, COGS, and macroeconomic indicators. The magnitude of the effect is economically and statistically significant. The estimates in Column 1 of Table 8 suggest an increase in sales of 7.99 per cent ($= 0.162 * 0.4931$), which amounts to 76 per cent ($\approx 0.0799/0.1051$) expansion in the mean sales growth of NFC firms. The results contrast with those reported in Ayyagari et al. (2014), who document that small firms have higher sales growth than large firms in middle-income countries but find no significant difference in low- and high-income countries. The full-sample results imply that the benefits of trade credit for sales expansion are not confined to NFC firms.

Our results imply that in the context of trade credit, suppliers of trade finance benefit significantly by expanding sales while their employment and profitability levels remain static. FC firms may face steep financing costs to raise additional funds from formal financial intermediaries. Garcia-Appendini and Montoriol-Garriga (2013) observe that suppliers extend substantial trade credit to their customers when bank credit is scarce. High financing costs overburden the firm, weakens its working capital, and exacerbate its liquidity needs. A profitable trade finance recipient may expand its business through higher retained earnings. Taking up trade finance under favourable terms may be less costly for the FC firm's operations. We notice a weak employment and profitability response to trade finance at NFC, possibly larger, firms. To improve profitability, these firms may shorten the collection period to reduce write-offs and collection costs since, as finance suppliers, they will need to finance receivables through debts or hold precarious liquidity positions.

Table 8: Regression of effect of trade credit dependence on firm's sales growth by financial constraint status

	NFC	NFC	PFC	PFC	FC	FC	All firms	All firms	All firms
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
DEBT/TA*APAY/TA	**0.162****	**0.211**	0.0383	0.00794	0.0169	-0.0251	0.0360*	0.0376	0.0010
	[0.0628]	**[0.153]**	[0.0328]	[0.0130]	[0.0422]	[0.0404]	[0.0201]	[0.0251]	[0.0064]
CAPEX	0.0047	−0.0171	0.0062***	−0.0012	0.0028	−0.0035	−0.0114	0.00106	−0.00699***
	[0.0038]	[0.0179]	[0.0018]	[0.0065]	[0.00345]	[0.0090]	[0.0079]	[0.0015]	[0.0020]
TOBIN'S_Q_{t-1}	−0.0244	0.0233	−0.0134	−0.0512	0.0750*	−0.137		−0.0048	−0.0239
	[0.0574]	[0.128]	[0.0129]	[0.0500]	[0.0402]	[0.111]		[0.0095]	[0.0148]
GDP_GROWTH	0.0067		0.0073		0.0556**			0.0288***	
	[0.0142]		[0.0139]		[0.0263]			[0.0083]	
INFLATION	0.0507		-0.0148		0.297***			0.0484*	
	[0.0777]		[0.0497]		[0.101]			[0.0249]	
COGS	0.0248***	0.480***	0.0647***	0.439***	0.0534**	0.726***		0.0255***	0.443***
	[0.0074]	[0.0707]	[0.0072]	[0.0621]	[0.0205]	[0.188]		[0.0038]	[0.0303]
CONSTANT	−0.500**	−8.463***	−0.959***	−6.631***	−1.329***	−9.963***	0.0841***	−0.430***	−6.983***
	[0.186]	[1.230]	[0.145]	[0.938]	[0.410]	[2.586]	[0.0038]	[0.0664]	[0.483]
Firm effects	OLS	Yes	OLS	Yes	OLS	Yes	OLS	OLS	Yes
Year effects	No	Yes	No	Yes	No	Yes	No	No	Yes
N	2,606	2,276	4,162	3,231	349	208	28,245	26,463	23,979
R-squared	0.0145	0.436	0.0375	0.502	0.0431	0.553	0.0009	0.0183	0.453

Note: $\mathrm{DEBT/K} * \mathrm{APAY/TA}$ is the firm's total debt multiplied by the industry median of accounts payable ratio, our proxy for trade credit. All other variables are defined in Table 1. Regressions are estimated for the three financial constraints classes and the overall sample. OLS estimations are followed by fixed-effects regression for each financial constraint grouping. OLS regressions control for GDP growth and rate of inflation. Fixed-effects regressions control for year and firm effects. Robust standard errors are in square brackets. ***, **, and * represent 0.01, 0.05, and 0.1 levels of significance, respectively.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020).

FC firms' higher levels of employment and profits hint at a resilience-induced trade finance effect. With implications for employment and the enhancement of the firm, access to alternative, informal financing sources may boost economic performance. The overarching implication is that in countries with weak legal systems and shallow financial market development, firms may obtain external financing through trade finance, thus sustaining business activities—the economy. Distinctly, the findings fit expectations that firms with potentially weak banking relationships substitute bank finance with informal external finance sources. These findings differ sharply from those of Beck et al. (2008), who posit that the use of informal financing does little to relax the financial constraints faced by small firms in developing economies. To bridge the financing gap, developing countries with underdeveloped financial markets should strive to create an environment that fosters trade credit among firms to achieve higher growth.

5.5 Financing constraints and outcomes: GMM estimator

The fixed-effects technique constitutes the usual remedy for many confounding factors. Nonetheless, combining the first-difference equations with the level equations, and using the first difference as instruments, the GMM-type estimator provides reliable and robust estimates against which we can gauge those obtained from the fixed-effects estimator. Using lagged levels as instruments for differenced equations and lagged differences as instruments for level equations, we re-estimate the regressions employing the GMM-type technique. We estimate all of the models using a first-difference transformation that removes the individual firm effect. The instrument set includes up to two lags of levels of firm-specific variables for difference equations and the second lag of differences of firm-specific variables for level equations (Aggarwal et al. 2011; Baum et al. 2010). As in Table 5, employing the lagged values of the regressors significantly alleviates reverse causality problems; nonetheless, by design, it cannot address biases stemming from measurement error, thus justifying, in a cross-country setting, Fisman and Love's (2003) appeal to a country's legal origin as an instrumental variable. We consider macroeconomic indicators such as GDP growth and inflation as exogenous. As in Table 5, the GMM estimates are reliable only with valid instruments, assessed using Sargan's test of overidentifying restrictions, asymptotically distributed as in the number of restrictions (Baum et al. 2010). As with the estimation of the Euler equation, a rejection of the null hypothesis that instruments are orthogonal to errors would indicate that the estimates are not consistent. We also present test statistics for second-order serial correlation in the error process.

Table 9 exhibits the GMM estimates of Equation 2 where, throughout regressions—at least at the 10 per cent level of significance—the Sargan's test and the AR(2) fail to reject the null, implying that the instruments are orthogonal to the errors and the absence of second-order serial correlation. The coefficient estimates are qualitatively and quantitatively similar to those obtained from the fixed-effects estimator for EMPLOYMENT and PROFITABILITY but weaker for SALES. We obtain comparable estimates on EMPLOYMENT employing the fixed effects (0.174, $p<0.01$) and the GMM estimator (0.173, $p<0.01$). There are no discernible differences in the standard errors. Note that the GMM estimate on the interaction term $DEBT/TA * TRADECREDIT$ for firms in the FC group in the PROFITABILITY regression (1.048, $p<0.01$) is comparable to that obtained using the fixed-effect estimator (0.921, $p<0.01$). Unlike previous regressions, the GMM coefficient estimate on the interaction term is statistically insignificant across financial constraint groups for sales regressions.

Table 9: GMM regressions of effect of trade credit dependence on firm's outcomes by financial constraint status

			Employment			Profitability			Sales
	NFC	PFC	FC	NFC	PFC	FC	NFC	PFC	FC
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
DEBT/TA*APAY/TA	0.0752	0.0127	**0.173*** **	0.0360	0.0464	**1.048*** **	0.0301	0.0179	0.0069
	[0.0613]	[0.0125]	**[0.0252]**	[0.0809]	[0.0778]	**[0.0725]**	[0.0416]	[0.0288]	[0.0421]
CAPEX	0.0250	−0.0045	0.0024	−0.00501	−0.00952	−0.171	0.0107	0.0034	0.0061
	[0.0156]	[0.0042]	[0.0097]	[0.0489]	[0.0265]	[0.143]	[0.0085]	[0.0029]	[0.0059]
TOBIN'S_Q_{t-1}							−0.158***	−0.128***	−0.0280
							[0.0520]	[0.0378]	[0.102]
ΔSALES	0.207***	0.0540	−0.0560	0.704***	0.959***	1.724***			
	[0.0571]	[0.0347]	[0.0453]	[0.171]	[0.134]	[0.333]			
DEBT/EQUITY	0.0351	−0.00992	−0.192***	0.00636	−0.326***	−0.289			
	[0.0256]	[0.0250]	[0.0746]	[0.0889]	[0.0962]	[0.247]			
GDP_GROWTH							0.0092	0.0346**	−0.0393
							[0.0088]	[0.0135]	[0.0421]
COGS	−0.0809	0.0541*	0.0757	−0.0563	0.0802	−1.367***	0.707***	0.593***	0.590***
	[0.0558]	[0.0287]	[0.0656]	[0.130]	[0.110]	[0.294]	[0.0465]	[0.0314]	[0.0995]
FIXED_ASSETS/TA_{t-1}				0.0266	−0.0100	0.174			
				[0.0534]	[0.0288]	[0.154]			
$EMPLOYMENT_{t-1}$	1.075***	0.830***	0.606***						
	[0.133]	[0.105]	[0.0984]						
$PROFITABILITY_{t-1}$				0.381***	0.210***	0.200**			
				[0.0937]	[0.0462]	[0.0867]			
$\Delta SALES_{t-1}$							−0.0064	0.0185	−0.0049
							[0.0134]	[0.0222]	[0.0527]

CONSTANT	0.865	−0.389	−0.742	8.832***	8.540***	26.79***	−0.400	−0.793	−1.741
	[0.750]	[0.391]	[0.937]	[2.410]	[1.706]	[6.583]	[0.438]	[0.596]	[1.358]
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,886	2,769	323	1,310	2,462	149	1934	2,906	207
Sargan's p-value	0.3117	0.1218	0.6501	0.4811	0.4708	0.8348	0.5366	0.5192	0.4424
AR (2) p-value	0.9707	0.5494	0.7090	0.6792	0.3209	0.5859	0.2318	0.6531	0.4988

Note: regression of trade credit dependence on employment, profitability, and sales from 2010 to 2017. $\mathrm{DEBT/K} * \mathrm{APAY/TA}$ is the firm's total debt multiplied by the industry median of accounts payable ratio, our proxy for trade credit. All other variables are defined in Table 1. Regressions are estimated for the three financial constraints classes and the overall sample. All regressions control for year effects. Robust standard errors are in square brackets. ***, **, and * represent 0.01, 0.05, and 0.1 levels of significance, respectively.

Source: authors' construction based on COMPUSTAT (S&P n.d.) and CIT-IRP5 data (National Treasury and UNU-WIDER 2020).

Overall, this paper's differing findings on the role of trade credit in boosting the resilience of small firms—those that are the most financially constrained—in developing economies have substantial implications for job creation, poverty reduction, and economic growth. The results fit previous results on access to and reliance on external sources of financing and the economics of trade finance, including Allen et al. (2005), Ayyagari et al. (2010), Beck et al. (2008), Bennett (2010), Fisman and Love (2003), Klapper and Love (2011), Levine et al. (2018), and Rajan and Zingales (1997), among others. One significant highlight of our paper is our observation of the most potent effects of trade credit; this calls for policy-makers to pursue a trade finance policy that recognises the critical role played by trade credit in fostering employment and job creation.

The legal rights of creditors may be a significant driver of trade finance. It is highly informal and relies disproportionately on social trust (Allen et al. 2005; Ayyagari et al. 2010; Levine et al. 2018), implying that out-of-court enforcement mechanisms may be just as important. Acemoglu and Johnson (2005), Ayyagari et al. (2008), Fernandes and Kraay (2007), and Mathur and Marcelin (2015) conduct a body of inquiries on the relationship between property rights and contracting institutions. Others examine issues related to investment environment and obstacles to growth (Ayyagari et al. 2008; Beck et al. 2005) and firm financing patterns (Ayyagari et al. 2010; Beck et al. 2008). Policy-makers must create a legal environment enabling the enforcement of informal contracts so that financially constrained firms can leap over barriers to formal finance in order to fund operations and maintain a certain employment level.

The results in Tables 6 to 9 on employment and profitability hold to the inclusion of year and industry dummies. They also hold to controlling for firms' characteristics. We consistently find that the $DEBT\ /TA * TRADECREDIT$ interaction term enters the three regressions for the financially constrained group of firms positively and significantly, indicating that corporate employment is more resilient to financing constraints in economies that promote trade finance. The point estimates for the firms with high financing constraints are greater than for those with low financing constraints. Although the point estimates for firms with low liquidity needs in the employment and profitability regressions, when controlling for fixed effects and year and industry effects, remain statistically insignificant, they convey some relevant policy information insofar as they do not evidence the existence of job loss and decline in corporate profits as a result of trade finance. The results on the relationship between trade credit and corporate resilience to financing constraints, with this caveat, are quite robust to controlling for relevant factors and employing various estimation techniques.

6 Conclusion

We examine whether trade credit improves the financially constrained firm's resilience. We are not aware of previous inquiries into the economics of trade finance in financially constrained firms. We partition our sample into three classes of financial constraints: never financially constrained (NFC), possibly financially constrained (PFC), and financially constrained (FC). Euler equation estimates confirm the presence of financing constraints for smaller firms in our sample. The results show that access to trade credit enhances corporate employment, profits, and sales growth. Supplier finance has a stronger effect on firm performance among financially constrained firms with short-term liquidity shortages.

Using a single country setting, we cannot rule out that other country characteristics, including institutional quality, contract enforcement mechanisms, religious and cultural practices, out-of-court settlements, and economic development, might be significant drivers of the role of trade finance in relaxing financial constraints when traditional credit channels are closed. Nevertheless,

our external trade credit dependence benchmark compensates considerably for the levels of development of financial institutions, stock market developments, and other impediments to trade credit. Notably, our policy variable, the interaction term between trade credit and debt capacity, enters the regressions for the FC group of firms positively and significantly for employment and profitability, with the same effect observed for sales in the NFC group.

The study provides strong evidence that the corporate workforce can be more resilient to financing constraints in economies that promote trade finance. The point estimates for firms with high financing constraints are greater than for those with low financing constraints. The results hold across regressions and estimation techniques. In lower financing constraints groups, controlling for fixed effects, years, and industries, the estimates for employment and profits remain statistically insignificant but convey some relevant policy information considering that they do not evidence job losses and decline in corporate profits due to trade finance. The results on the relationship between trade credit and corporate resilience to financing constraints, with this caution, remain robust to controlling for relevant firm-level and macroeconomic factors.

Our finding that, at least partially, supplier finance substitutes external financing sources for financially constrained firms is in line with Ayyagari et al. (2014), who report that small firms use less external finance, especially bank finance. However, contrary to Ayyagari et al. (2014), we document that supplier finance fills in small firms' financing gap, suggesting that policies seeking to improve small firms' access to external finance need to consider practices and institutional arrangements that enable trade credit flows in conjunction with broader financial development initiatives. By showing that non-bank financing fosters the resilience of financially constrained firms through higher profits and employment, and hence improved performance, these results have important policy implications for developing countries with shallow credit markets.

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