In-kind financing during a pandemic: Trade credit and COVID-19*

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Abstract

Using a cross-country quarterly firm-level dataset, we empirically examine the impact of the COVID-19 pandemic on trade credit channel of firms. In contrast to the impact on trade credit documented during earlier crisis episodes, we find that firms with poor credit quality obtain lower amounts of trade credit from their supplier firms during the quarters following the COVID-19 outbreak. Furthermore, we document that firms with better growth prospects and firms with better stakeholder relationships are able to obtain trade credit in the COVID-19 shock period, despite their poor creditworthiness. Our empirical analysis supports the view that supplier financing is conditional on the product market conditions and is not always a generous substitute for bank credit.

Keywords: Trade credit; COVID-19; Financial constraints; Credit default; ESG

JEL classification: G21; G28; G32; H12

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1. Introduction

The spread of COVID-19 proved to be a macroeconomic shock to the economies worldwide (Altig et al., 2020). Most of the countries imposed strict lockdowns, encouraged remote working, and enforced social distancing norms to curtail the transmission of infectious coronavirus (Hale, Petherick, Phillips, & Webster, 2020; Moosa, 2020). The lockdown period proved to be the worst downturn in the global economy after the great depression (Gopinath, 2020). On one hand, the abrupt pandemic-induced uncertainty affected the demand for products and services, especially for discretionary items. On the other hand, the containment measures adversely affected the global supply chains (Boissay, Patel, & Shin, 2020). Taken together, the impact of the reduced demand and the disrupted supply chains significantly affected the firms around the world.

Based on early capital market reaction during the onset of the pandemic, several studies documented that inflexible firms, which are financially constrained and operationally vulnerable, are more likely to be impacted adversely during the COVID-19 shock period (Ding, Levine, Lin, & Xie, 2021; Ramelli & Wagner, 2020). One of the prominent factors that determine the flexibility of a firm is its ability to optimally manage its working capital. In our study, we explore the impact of the COVID-19 pandemic on trade financing obtained by firms from their suppliers. Specifically, we ask whether firms with higher creditworthiness, better stakeholder relationships, and growth options disproportionately obtained valuable alternative financing resources from their suppliers during the pandemic.[1]

The COVID-19 pandemic offers a unique setting to examine how the supply of trade credit is impacted during a crisis that emanates from the real sector, which is radically different from a crisis that emanates from financing difficulties such as the global financial crisis (GFC) of 2008-09 (Didier, Huneeus, Larrain, & Schmukler, 2021). The rapid monetary and fiscal support measures taken by most of the major developed and developing economies ensured to mount a credible response to channel credit during the

[1]As per BIS estimates, non-financial corporations provide 70% of the overall trade credit supply (in-kind financing or alternative financing) in the economy (Boissay et al., 2020).

pandemic (Hofmann, Shim, Shin, et al., 2020).[2] In such a context, relying on the exogenous COVID-19 pandemic-induced real sector shock and the associated disruptions to economic activity, we test the arguments put forth by Petersen and Rajan (1997) on trade credit supply. We posit that *ex-ante* riskier firms obtain lesser support from their suppliers during the COVID-19 crisis period. Furthermore, we posit that, despite the suspect credit quality, firms with better growth opportunities and stakeholder relationships are able to obtain trade credit.

Given the rapidity of the pandemic-induced disruptions and the consequent responses by most of the countries, we examine the impact on trade credit—defined as the accounts payable of a firm scaled by its assets in our study—with cross-country firm-level quarterly data.[3] As we attempt to explain the characteristics of firms that are able to obtain trade credit from their suppliers during the pandemic, it is imperative to disentangle the supply and demand-side factors that contribute to the trade credit channel. For instance, given the sudden decline in economic activity, it is likely that the average working capital requirement comes down for firms. As COVID-19 disrupted the global supply chains, it is likely that supplies to a particular industry are affected disproportionately. Hence, in our study, we control for the demand-side and supply-side factors using dummies that capture unobserved heterogeneity at various levels of aggregation. We incorporate country-industry-year-quarter dummies that control for trade credit demand due to industry-specific quarterly shocks at the country level. The highly saturated model also controls for other unobserved heterogeneity, which does not vary with time and is specific to a country, industry, or a firm. In addition, we control for other observable demand-side factors such as sales, which contribute to demand-driven fluctuations in obtaining trade credit, and for supply-side factors such as the level of leverage, which captures the debt capacity and the potential substitution between trade credit and bank credit.

[2]For instance, Demir and Javorcik (2020) show that trade credit obtained from banks was much more resilient than other sources of trade financing during the onset of the COVID-19 pandemic.

[3]In alternative estimations, we define payables as the accounts payables of a firm scaled by the cost of goods sold.

The key findings of our empirical analysis that employs a difference-in-differences model are as follows. First, conforming to the arguments that supplier firms extend trade credit to creditworthy firms, we find evidence that firms with lower default probability obtain substantially higher trade credit during the COVID-19 shock period; riskier firms obtain about 0.3 percentage points lower trade credit, which is about 5% of the accounts payable for the median firm in our sample, during the pandemic period compared to the pre-pandemic period. Furthermore, we find that less creditworthy firms have obtained lower net payables in the COVID-19 shock period, or conversely, the creditworthy firms have increased their net payables during the crisis period. This suggests that creditworthy firms are relying on higher payables from their upstream suppliers but not providing credit to the downstream firms. Unlike earlier studies that document an increase in trade credit for riskier firms during crisis episodes, we find that less risky firms have managed to obtain alternative financing during the COVID-19 shock period.

Interestingly, and in contrast to our baseline findings, the estimations for the same sample of firms during the GFC period yield the opposite result. The findings for the GFC period corroborate the evidence supporting the financial constraints view of trade credit (Biais & Gollier, 1997; Carbo-Valverde, Rodriguez-Fernandez, & Udell, 2016; Casey & O'Toole, 2014). We find that riskier firms obtained 0.43 percentage points higher trade credit during the GFC period. Given that the pandemic-induced crisis was a real sector shock rather than a shock to the credit markets—for instance, ted spread, a measure of global liquidity risk and confidence in credit markets was several times higher during the peak of the GFC relative to the COVID-19 shock period—we are able to demonstrate that the trade credit channel is not similar across crisis episodes.[4]

What could potentially explain the contrasting results that we document? It is likely explained by bridging the arguments put forth by Cunat (2007), Schwartz (1974), and Petersen and Rajan (1997). Trade credit supply is conditional on a forward-looking future value of relationships between the borrowing firm and its supplier. The advantage that

[4]A comparison of the GDP growth and ted spread across the two crisis episodes are shown in Figure A2.

supplier draws from extending credit includes the threat of cutting off future supplies, reliable information on the order book of the borrowing firms, and higher salvage of goods that are supplied in the event of a default. During a real sector crisis that affects the demand for products, the above advantages enjoyed by the supplier are adversely affected. For instance, the threat of cutting of supplies when the demand is down is less effective for supplier firms. However, in the event of a credit crisis, which may only have a spillover impact on the demand side, the supplier could still finance the customer firm on the expectation of future prospects.

Our primary findings corroborate the findings of Klapper, Laeven, and Rajan (2012). In contrast to the overwhelming evidence that firms with poor credit profile obtain trade credit, especially during crisis episodes, Klapper et al. (2012) document that firms with better credit profile and higher market share eke out better trade credit terms from their suppliers. Moreover, smaller suppliers with a higher cost of obtaining bank credit provide such generous terms to the borrowers with better credit quality. It is likely that the motives of the supplier to extend generous trade credit to less risky customers further their interest to partake in future profits. It is also likely that the suppliers provide the riskier borrower firms with higher price discounts in lieu of favourable credit terms to maintain the relationships, while mitigating the risk of default.

Second, we find that riskier firms with higher contemporaneous growth are able to obtain greater trade credit from their suppliers. Firms with higher sales growth during the COVID-19 shock period obtain 0.38 percentage points higher net accounts payable, even when their credit standing is suspect. Moreover, firms in industries that are less capital-intensive obtain higher trade credit (about 0.36 percentage points) compared to those in capital-intensive industries. Alfaro, Chari, Greenland, and Schott (2020) argue that capital-intensive firms are more prone to the COVID-19 induced disruptions compared to labour-intensive sectors, given the amenability of labour to remote working and mobility. The findings, which support the view of Petersen and Rajan (1997), suggest that suppliers do value the promise of current as well as future prospects while evaluating firms with higher default probability.

Third, we find that riskier firms with better stakeholder relationships are able to obtain greater amounts of trade credit. A one unit increase in ESG score for riskier firms is associated with a 0.04 percentage points higher trade financing from their suppliers. This finding supports the argument that maintaining good relationships with the stakeholders prove to be helpful during crisis periods. The findings are further strengthened by our analysis involving the social score of firms. We find that riskier firms with higher social scores obtain higher trade credit in the COVID-19 shock period compared to the riskier firms with lower social scores. In lieu of a bilateral relationship data of borrowers and suppliers, we employ a relationship measure that captures the engagement of a firm with its stakeholders at large. Our findings on the impact of stakeholder relationship on trade credit corroborate the findings by Zhang, Lara, and Tribó (2020) on the importance of social responsibility and trade credit supply. While the results are based on an aggregate relationship score given the paucity of data at a micro-level, the findings with the broader relationship measure support the view that relationships matter during periods of distress.

The credit rationing faced by firms with suspect credit quality is moderated if the product market conditions are favourable or if the firms have maintained good relationships with their stakeholders. Taken together, the moderating effect of growth opportunities and stakeholder relationship on trade credit supply to riskier firms suggest that trade credit is conditional on the product market conditions and is *'not'* a generous substitute for bank credit.

A counterfactual explanation for the trade credit rationing observed in our study could be the generous amount of credit available from banks and credit markets for firms with suspect credit quality, which is a potential reverse substitution. However, we find that firms with poor creditworthiness also faced rationing from the lenders in the COVID-19 shock period. Both the parallel trends and the regression estimation results support this view. Therefore, we are able to strengthen our inference that trade credit is potentially not a generous substitute for bank credit during product market disruptions, especially for firms with poor credit quality.

The findings documented in the study are robust to alternative estimations. First,

we test the results with an alternative dependent variable. We scale the payables and net payables with the cost of goods sold that controls for potential demand-side changes. All our baseline results are largely consistent with the alternative dependent variable. Second, we test the results with an alternative proxy for firm risk and find that our baseline results are largely unaffected. We complement this test with an alternative estimation that categorizes firms based on their financial constraints and find consistent results. Third, we do a placebo test with an artificially induced crisis in a normal period. We find that there is no significant difference in the trade credit reliance of firms grouped by their creditworthiness. Finally, we find that our results are largely unchanged when we try various saturation levels for the fixed effects captured in our estimations. Overall, the results of the robustness tests strengthen the baseline results.

The study deepens the understanding of the impact of real sector shocks on trade credit in the following ways. First, we are able to unearth some of the pandemic-specific channels that affect trade credit financing obtained by firms in a cross-country setting. Unlike earlier studies that document the impact on trade credit channels during crisis episodes, our study presents alternative evidence in view of a crisis that largely affected the demand-side and operations of firms across countries. Second, the cross-country data allows us to provide external validity—empirical analysis that provides generalizable results—compared to the internal validity of single-country studies. However, the cross-country setting also limits our identification of supply-side factors such as the characteristics of supplier firms given the paucity of data at a cross-country level.

Third, while Petersen and Rajan (1997) find empirical support using cross-sectional data from the US, we document the impact of product market shocks on trade credit using cross-country panel data. While the majority of the studies have found support in favour of the substitution view of trade credit (see, for instance, Adelino, Ferreira, Giannetti, & Pires, 2020), to our knowledge, ours is the first study that lends support to the importance of the product market in the trade credit transmission channel in a cross-country setting. Finally, our study contributes to the alternative view that less risky firms obtain higher amounts of valuable and cheaper trade credit from the supplier

firms compared to riskier firms (Klapper et al., 2012; Murfin & Njoroge, 2015).

Our study can be situated in the following strands of literature. First, our analysis complements the studies on the impact of crisis episodes on the supply of trade credit. For example, Casey and O'Toole (2014), Bastos and Pindado (2013), and Lin and Chou (2015) find that credit-constrained and less creditworthy firms obtain higher trade credit during a global financial crisis period. Trade credit from suppliers lends a 'helping hand' to the credit-constrained firms to mitigate the negative shocks of financial crises (Nilsen, 2002; Wilner, 2000). A similar finding is documented for small firms and credit-constrained firms during the financial crisis of 2008-09 (Carbo-Valverde et al., 2016; McGuinness & Hogan, 2016). In another set of studies, Love and Zaidi (2010) and Love, Preve, and Sarria-Allende (2007) find support for the substitution hypothesis of trade credit only in the early phase of the crisis period. They show that financially weaker firms receive and extend less trade credit in the period following financial crises, supporting the re-distributional view of trade credit.

Second, we contribute to the emerging literature on the effect of COVID-19-induced disruptions on firm performance. Ding et al. (2021) study the impact of firm characteristics on returns during the COVID-19 shock period. They show that firms with better *ex-ante* financial conditions experience higher returns. Additionally, firms involved in corporate social responsibility (CSR) activities are more resilient to the COVID-19 shocks (Albuquerque, Koskinen, Yang, & Zhang, 2020; Didier et al., 2021; Ding et al., 2021). Firms with greater financial and operational flexibility, for instance, with higher cash holdings, had higher market capitalization during the pandemic period (Ramelli & Wagner, 2020). Didier et al. (2021) show that firms with lower insolvency and lower default risk outperform inefficient firms in the pandemic period.

The rest of the paper is organized as follows. In the following section, we describe the conceptual background of the study. Data and methodology employed in our study is detailed in the succeeding section. Next, we discuss the key findings of our study. The subsequent section provides an analysis of the robustness tests. The final section concludes with some potential insights for policymakers.

2. Conceptual background

2.1. Trade credit and creditworthiness

There are two separate, yet complementary, views on trade credit financing obtained by firms. One view argues that trade credit substitutes for bank credit for firms facing financing trouble; *ex-ante* riskier firms would obtain trade credit in the absence of bank credit as the suppliers prefer to increase their sales by offering products on credit (Fisman & Love, 2003; Love et al., 2007; Meltzer, 1960). Schwartz (1974) argues that suppliers enjoy a financing advantage given their better monitoring ability and information advantage over institutional creditors.

According to the second view, however, trade credit financing is obtained by creditworthy firms (Klapper et al., 2012; Petersen & Rajan, 1997). Even when the suppliers choose to extend trade credit to firms with poor credit quality, it is provided to the borrower firms with growth options and firms that maintain better relationships with their suppliers (Petersen & Rajan, 1997). Despite the suspect credit quality of the borrower firms, suppliers tend to finance firms with better prospects given the implicit stake in the present value of future profits from maintaining supply.

It is also likely that the objective of firms during a product market crisis such as COVID-19 is to improve the liquidity available to survive the crisis period. As suggested by Didier et al. (2021), firms may hibernate during a pervasive shock that affects the product demand and disrupt the operations. Therefore, creditworthy firms, which are more likely to repay their dues, are likely to be preferred by the suppliers to extend the credit terms. In addition, if the creditworthy firms, which are likely to obtain valuable liquid resources from their suppliers, do not pass on the credit to downstream firms that are credit constrained, then the trade credit rationing is further exacerbated. Hence, we hypothesize that:

Hypothesis 1 (H1) *More (less) creditworthy firms obtain higher (lower) trade credit during the COVID-19 shock period compared to the pre-COVID-19 period.*

While we expect the less creditworthy firms to obtain lower trade credit during the

COVID-19 period, there could be heterogeneity in the impact of the crisis on such firms. For instance, despite the poor credit quality, some of the firms will have a higher demand for their products and services given the pandemic-specific shocks such as remote working amenability. Hence, in the following hypotheses, we posit that conditional on some moderating factors, the less creditworthy firms also obtain higher trade credit during the COVID-19 period.

2.2. Trade credit, creditworthiness, and growth opportunities

One of the conditions in which the suppliers are ready to overlook the creditworthiness of the borrower firms is the presence of growth opportunities for the borrower firms (Petersen & Rajan, 1997). It is likely that the firm that is currently risky and unprofitable may have growth opportunities. In such cases, the suppliers are willing to finance the supplies to partake in the future business opportunities. They lend to less creditworthy firms only if it is expected that future growth opportunities in business will make up for the risks undertaken. Based on the arguments of Petersen and Rajan (1997) that suppliers are willing to overlook the credit quality of the borrower firms with substantial product market opportunities, we posit that:

Hypothesis 2 (H2) *Less creditworthy firms with higher growth opportunities obtain higher trade credit compared to less creditworthy firms with lower growth opportunities during the COVID-19 shock period.*

2.3. Trade credit, creditworthiness, and stakeholder relationship

As argued by Petersen and Rajan (1997) and formalized by Cunat (2007), a firm with better supplier relationship obtains higher trade credit as the bonds are reinforced by the mutual dependence and the consequent future value of the relationship. Better stakeholder relationships can improve the trade credit relationship between a supplier and a borrower firm through the following channels. First, firms that are socially responsible tend to have better financial performance, which includes honouring debt repayments and other financial contacts (Waddock & Graves, 1997). Second, firms that are socially

responsible are likely to have a loyal customer base that is price inelastic, which would result in sustainable sale of products at higher margins (Albuquerque, Koskinen, & Zhang, 2019; Servaes & Tamayo, 2013). Finally, socially responsible firms are likely to diffuse the value chain shocks by not passing on or transferring the risks emanating from the value chain (Zhang et al., 2020). Therefore, we hypothesize that:

Hypothesis 3 (H3) *Less creditworthy firms with higher stakeholder engagement obtain higher trade credit compared to less creditworthy firms with lower stakeholder engagement during the COVID-19 shock period.*

3. Data and Methodology

3.1. Data

We obtain data for our study from the Refinitiv Eikon database and the Credit Research Initiative (CRI) database. The financial variables, as well as the variables used in determining stakeholder relationship (ESG score and Social score), are obtained from Refinitiv Eikon database. The PD of firms, which captures the creditworthiness of firms, is obtained from the CRI database maintained by the National University of Singapore. The CRI database provides one-year default probability at a monthly level. Several recent studies in the finance literature have employed this data (Beber, Fabbri, Pagano, & Simonelli, 2021; Gallagher, Schmidt, Timmermann, & Wermers, 2020; Li, Lu, & Srinivasan, 2019). As the financial variables vary at a quarterly frequency, we estimate the average PD at the quarterly level. We exclude all financial firms (SIC 60 to 67) from our study. The final estimation sample after accounting for the availability of key estimation variables contains 87,986 firm-quarter observations, which comprise 7,406 unique firms from a total of 58 countries.

In our study, we utilize a panel data of firm-level quarterly financial information, which spans from 2017 to 2020, to estimate the impact of COVID-19 on the relationship between creditworthiness and trade credit channel of firms. The treated variable in our estimations is the *ex-ante* creditworthiness of firms, which is proxied by the PD of firms

(Duan, Sun, & Wang, 2012; Duan, Wang, et al., 2012). PD is defined as the likelihood that a debtor firm is unable to honor its financial obligations in the coming year. In our study, we take the median value of the probability of default of firms to identify firms with high default rates and low default rates. *High default* equals 1 for the above-median probability of default of firms and 0 otherwise.

The dependent variables employed in our study are *Payables* and *Net Payables*. *Payables* equals accounts payable scaled by total assets and *Net Payables* equals the difference between accounts payable and accounts receivable scaled by the total assets of the firm. Accounts payable is defined as the amounts owed to the suppliers for goods purchased or services obtained to carry out the normal operations of the business. Accounts receivable is defined as the total value of dues against customers for goods sold or services accomplished during the normal course of business.

The control variables employed in our study are liquidity, profitability, leverage, and the size of firms. Here, *Liquidity* is defined as cash and cash equivalents of a firm scaled by total assets of the firm. *Profitability* equals the earnings before interest, tax, depreciation and amortization (EBITDA) scaled by total assets of the firm. *Leverage* equals the debt-to-equity ratio of the firm. We employ total revenues of the firm as a proxy for firm size. A detailed description of the variables is shown in Table 1.

Furthermore, to estimate the role of stakeholder relationships on the trade credit obtained by firms during the COVID-19 shock period, we employ *ESG score* and *Social score* of firms as a proxy for stakeholder relationship. *ESG score* is defined as the company's overall score based on environmental score (firm's impact on the natural systems), social score (firm's capacity of generating trust among stakeholders across the value chain) and governance score (firm's systems and processes to act in the best interests of its shareholders). It is an indicator of management competence and non-financial performance of firms. *Social score* reflects the capacity of a firm to generate trust and loyalty among its stakeholders by implying the best management practices. It is considered as the firm's ability to increase shareholders' value and build a reputation among its stakeholders.

Table 2 shows the summary statistics of key variables used in the study. The average

firm in our sample has accounts payable of 8.85%. The average value of net payables is −3.69%, which shows that the average firm in our sample has a net credit outstanding from its customers. A summary of the within-country variation in both payables and net payables is shown in Figure A1. The one-year probability of default of the average firm in our sample is 0.32%, which is the default probability of firms categorized as BBB- or investment grade by major rating agencies. The average Altman Z score of firms in our sample is 3.28, which indicates that the chances of insolvency in the next year for the average firm is minimal. The average value of the KZ index is −18.60 indicating that the average firm is not financially constrained.

The average value of the ESG score for the firms in our sample is 41.38 and the social score is 42.98. The average firm in our sample has 16% of cash and marketable securities as a proportion of its assets. The average firm is profitable (2%) and has a leverage ratio of 0.74. The average sales growth of firms is 5% and more than half of our sample (54%) comprise of firms in the manufacturing sector. The correlation table of all the variables is shown in Table A2.

3.2. Methodology

3.2.1. Trade credit during COVID-19

This section describes the methodology employed in our study to estimate the impact of COVID-19 on the trade credit obtained by firms. We employ a difference-in-differences (DiD) method to test the impact of the product market shock on trade credit obtained by firms classified based on their creditworthiness. We use a cross-country quarterly firm-level panel data that helps in improving the external validity of the estimation results. The estimation equation employed in our baseline model is as follows:

$$Y_{i,t} = \beta_0 + \beta_1 \, X_{i,t-4} \times COVID - 19_t + + \beta_2 \, X_{i,t-4} + \beta_3 \, Z_{i,t-1} + \delta_i + \alpha_{cjt} + \epsilon_{it} \qquad (1)$$

In Equation 1, Y represents the dependent variable that captures the trade credit obtained by firms in our study. We employ *Payables* and *Net Payables* as our dependent

variables. Here, *Payables* is defined as the accounts payable scaled by total assets of the firm (Cunat, 2007; Petersen & Rajan, 1997). *Net Payables* equals the difference between accounts payable and accounts receivable of a firm scaled by total assets of the firm ((Accounts payable- Accounts receivable)/Total assets). To control for potential demand changes for products and services of a firm, we employ an alternative scaling variable, cost of goods sold (COGS) instead of assets, as a robustness to estimate the impact on the payables and net payables (Zhang et al., 2020).

The main explanatory variable in the estimation equation is $X_i \times COVID - 19$ where X is a dummy variable (*High default*) that takes the value of 1 for firms with a probability of default (PD) above the median PD and 0 otherwise. The PD measure is the *ex-ante* default probability, which is lagged by a year (4 quarters), to avoid potential reverse causality concerns. The default probability of a firm is sensitive to the changes in short-term liabilities such as trade credit during COVID-19 (Bureau, Duquerroy, & Vinas, 2021). *COVID-19* is a dummy variable that takes the value of 1 for the pandemic period and 0 otherwise. Z represents a vector of quarterly firm-level control variables that are commonly employed in the literature on trade credit. Z includes *Liquidity*, *Profitability*, *Leverage* and *Size* of the firms. All control variables are lagged by one quarter to reduce potential endogeneity concerns. Table 1 describes all variables employed in the study. The event window for the DiD estimation as shown in Equation 1 spans 16 quarters starting from Q1'2017 until Q4'2020. The pre-COVID-19 event window is from Q1'2017 to Q1'2020 and the COVID-19 shock period is from Q2'2020 to Q4'2020[5].

δ_i represents the firm-fixed effects for the firm i to control for firm-specific unobserved heterogeneity. We also control for any industry-specific effects varying over time at the country-industry-year-quarter level by α_{cjt} where c, j, and t represent country, industry and year-quarter respectively. The interaction term captures the unobserved time-varying effects at the country and industry levels in isolation as well as at the country-industry level. Moreover, the year-quarter effects, which are any common shocks at a quarterly

[5]The authors acknowledge that a few countries were impacted by COVID-19 earlier (Q1'2020), but according to the Oxford COVID-19 Government Response Tracker, the stringency was higher in Q2'2020 relative to Q1'2020. For details, see Hale et al. (2020)

frequency, are also subsumed in the α_{cjt} term. The highly saturated interaction term helps us reduce potential biases caused by omitted variables (for details, see Gormley and Matsa (2014)).

It is likely that the interventions and response measures taken by various governments encourage the supplier firms to provide generous credit to the borrower firms. Such policy interventions—taken during the COVID-19 shock period—may confound the effects that we examine in the study. Therefore, the interactive fixed effects (country-industry-year-quarter) employed in our study, which are similar to those employed in recent empirical studies in corporate finance (see for instance, Degryse, De Jonghe, Jakovljević, Mulier, & Schepens, 2019, and Gopalakrishnan, Jacob, and Mohapatra (2021)) , help us control for such unobserved time-invariant and variant heterogeneity at the country and the industry level. Overall, we believe that the saturated fixed effects help in better identification of the impact of COVID-19 shocks on the trade credit channel of firms.

3.2.2. Role of growth opportunities and stakeholder relationships on trade credit

In this section, we describe the methodology employed to estimate whether factors such as growth opportunities and stakeholder relationships affect the differential impact of COVID-19 on trade credit obtained by firms.

$$\begin{aligned} Y_{i,t} = \beta_0 + \beta_1\ X_{i,t-4} \times COVID-19_t \times M_{i,t-1} + \beta_2\ X_{i,t-4} \times M_{i,t-1} \\ + \beta_3\ COVID-19_t \times M_{i,t-1} + \beta_4\ COVID-19_t \times X_{i,t-4} \\ + \beta_5\ Z_{i,t-1} + \delta_i + \alpha_{cjt} + \epsilon_{it} \end{aligned} \tag{2}$$

In Equation 2, the dependent variable Y, the explanatory variable X, *COVID-19*, and Z are same as defined earlier. M refers to the variables that could moderate the impact of the COVID-19 shock on trade credit supply obtained to firms classified based on their creditworthiness. We explore two sets of moderator variables that affect the supply of trade credit to firms (Petersen & Rajan, 1997), the product market growth opportunities of firms and the stakeholder relationships maintained by the firms. For the growth opportunities, we employ two variables: *High sales growth*, which is a dummy variable that

takes the value of 1 for firms with a sales growth that is above the median sales growth in the estimation sample in a quarter; and *Manufacturing*, which is a dummy variable that takes the value of 1 if the firm belongs to SIC industrial classification for the manufacturing sector and 0 otherwise. To estimate the moderating impact of stakeholder relationships on the trade credit channel, we employ *ESG score* and *Social score*.

3.3. Univariate trends

Figure 1 shows the trend of average payables and average net payables in the pre-COVID-19 period and COVID-19 shock period for the last two years. The top panel shows that there is a sharp decline in average payables after the declaration of COVID-19 as a pandemic. It is likely that, on average, firms obtained lower amounts of trade credit due to muted demand—which was induced by the government restriction to contain the virus—and, consequently, muted supply requirements. The bottom panel shows that despite decrease in average payables during the pandemic, average net payables increased in the COVID-19 shock period.

The parallel trends of average payables and average net payables during the COVID-19 shock period and the GFC period is shown in Figure 2. The top panel, which shows the trend during the COVID-19 shock period, suggests that the average payables for firms in the high default category declined during the COVID-19 shock period. However, despite an initial decline, the average payables for the firms in the low default category rose to the pre-COVID-19 levels. The bottom panel, which shows the trend during the GFC period, suggests that, while there is an overall decline, the riskier firms obtained higher payables relative to less risky firms. Similarly, the net payables are considerably higher for the riskier firms compared to the less risky firms in the post-GFC period. This is consistent with the findings of Love et al. (2007) who show that trade credit increases for riskier firms during crisis periods.

Figure 3 shows the parallel trend of average payables for firms classified based on high and low creditworthiness and high and low contemporaneous growth. As indicated in the top panel, the riskier firms in the manufacturing sector have lower payables in the

COVID-19 shock period compared to the riskier firms in the services sector. It is likely that the manufacturing firms become even riskier during the pandemic because of the operational disruptions caused by COVID-19 (Alfaro et al., 2020). The trends in the bottom panel indicate that riskier firms with high sales growth continue to obtain higher payables relative to riskier firms with low sales growth. Suppliers prefer to overlook the suspect credit quality when firms have growth opportunities and, consequently, such firms obtain a higher trade credit (Petersen & Rajan, 1997). For a similar classification of firms based on their creditworthiness and growth opportunities, Figure 4 shows the parallel trends for average net payables. The pattern is similar to that of average payables of growth firms.

Figure 5 shows the parallel trend of average payables for firms classified based on high and low creditworthiness and high and low stakeholder relationships. Stakeholder relationships of firms are captured using the ESG score (top panel) and social score (bottom panel). The top panel of Figure 5 shows that riskier firms with high ESG scores, relative to firms with low ESG scores, continue to obtain trade credit during COVID-19. The second panel also shows the same pattern. Riskier firms with a high social score show a stable pattern in average payables obtained in the COVID-19 shock period compared to firms with a low social score, which shows a declining trend. Similarly, Figure 6 shows the parallel trend of net payables for the same set of firm classification. The parallel trends in Figure 6 strongly indicate that, despite poor credit quality, firms with better relationship scores are able to obtain considerably higher trade credit in the pandemic period relative to similar firms with lower relationship scores.

Overall, the univariate trends support our key hypothesis that riskier firms have been rationed of valuable supplier credit during the COVID-19 shock period. Only firms with better growth opportunities and firms with better stakeholder relationships obtain higher supplier financing despite weaker credit profiles. However, the results from the univariate trends are at best indicative and do not help us draw any inference about the causes of the change in trade credit supply in the COVID-19 shock period. In the next section, we analyze whether the indicative trends hold up in a regression framework that controls for

other factors that could affect the trade credit supply to firms.

4. Results and Discussion

In this section, we estimate Equation 1 and Equation 2 and discuss the key findings of the regressions results. First, we discuss the estimation results of the impact of COVID-19 on trade credit obtained by firms. Next, we discuss the results of the estimations that analyze the moderating impact of growth opportunities and stakeholder relationships.

4.1. Impact of COVID-19 on trade credit

Table 3 shows the results for the baseline estimation as described in Equation 1. Columns (1) to (4) present the estimation results for the COVID-19 shock period. The first two columns present the estimation results with accounts payable scaled by total assets as the dependent variable and columns (3) and (4) present the results with net payables scaled by total assets as the dependent variable. Columns (1) and (3) show the estimations without the control variables and columns (2) and (4) show the estimation results with firm-level control variables. The coefficient of *High default* $\times$ *COVID-19* is consistently negative across all estimations. The results suggest that riskier firms—categorized as high default—obtained lower supplier financing (by about 0.27%) in the COVID-19 shock period relative to the pre-COVID-19 period. Even after controlling for the firm-level variables, our results show that payables obtained by high default firms declined by 0.24% in the pandemic period. Columns (3) and (4) of Table 3 show that net payables of high default firms reduced by 0.29% and 0.31% respectively. The COVID-19 shock reduction observed for firms with poor creditworthiness is about 5% of the accounts payable of the average firm in our sample.

While the results of accounts payable support the view that riskier firms are rationed during a product market crisis, it is the results on net payable that strengthens it. The results on net payables suggest that creditworthy firms were drawing on more credit from the upstream firms rather than providing credit to the downstream firms in the form

of receivables. If a creditworthy firm, which is more likely to obtain formal sources of credit, is rationing the downstream firms, then it strengthens the view that constrained borrower firms find it tough to obtain credit during a product market crisis.

Next, we re-estimate Equation 1 for the same set of firms during the GFC. The GFC sample period starts from Q1'2005 to Q1'2009. The crisis period starts from the third quarter of 2008 to the first quarter of 2009. This period was considered in earlier studies to study the effect of GFC on trade credit (Coulibaly, Sapriza, & Zlate, 2013). We employ a dummy variable, *GFC_dum*, which takes the value of 1 for the crisis period and 0 otherwise. The results of the re-estimations are shown in columns (5)-(8). In contrast to the results observed during the COVID-19 shock period, columns (5) and (6) show that trade credit obtained by high-default firms increased by 0.43% and 0.57% respectively during the GFC period. The results for net payables as the dependent variable during GFC period are also significant.

Taken together, the results suggest that trade credit is not always a generous substitute to bank credit. Our results support Hypothesis 1. Unlike the credit substitution observed during GFC period, less creditworthy firms faced credit rationing from their suppliers in the pandemic period. This finding is consistent with the argument of Petersen and Rajan (1997) that the creditworthiness of the borrower firms is one of the key determinants of trade credit supply. Moreover, the higher trade credit obtained by firms with better credit quality demonstrates the market power of such firms to obtain payables from their suppliers even during risky times such as a pandemic (Giannetti, Serrano-Velarde, & Tarantino, 2021; Klapper et al., 2012).

Our findings, which are in contrast to the impact of previous crisis episodes on the supply of trade credit, buttress the view that trade credit supply is conditional on the product market conditions. During a real sector shock that affects the entire value chain, suppliers are likely to be cautious and selective in their choice of firms to extend credit to. The financing advantage enjoyed by suppliers over formal institutions as a result of transaction frequency, salvage value of assets and potential market power of the suppliers (Schwartz, 1974) is negatively impacted during a real sector shock. As a consequence,

suppliers are reluctant to extend trade credit to riskier firms. This finding contrasts the results of Love et al. (2007) who find that trade credit acts as a substitute for firms facing financial constraints during crisis periods. However, our findings regarding the GFC period are consistent with the findings of Love et al. (2007). Our results show that trade credit does not act as a substitute for firms across all types of crises.

4.2. Impact of growth opportunities on trade credit during COVID-19

In this section, we analyze whether growth opportunities moderate the impact of COVID-19 on less creditworthy firms. If supplier financing is conditional on the product market opportunities of firms, then firms, despite their poor credit quality, would obtain financing from their suppliers.

Table 4 shows the estimation results for Equation 2 with growth opportunities as the moderating variable. We employ two proxies for growth opportunities: (a) the sales growth of the firms (estimation results shown in columns (1) and (3)) and (b) firms amenable to continuing operations during COVID-19 shock (estimation results shown in columns (2) and (4)). Both columns (1) and (2) employ accounts payable scaled by total assets as the dependent variable, whereas, columns (3) and (4) employ net payables scaled by total assets as the dependent variable. The results suggest that net payables increased by 0.37% for riskier firms with higher sales growth. However, we do not observe a statistically significant impact on the payables of such firms in the COVID-19 shock period.

Next, we find that riskier firms in the services sector, which are less capital-intensive and more amenable to flexible operational requirements (Alfaro et al., 2020), have obtained 0.35% higher trade credit in the COVID-19 shock period compared to riskier firms operating in the manufacturing sector. However, the results for riskier firms in the services sector with net payables as the dependent variable are not statistically significant.

Overall, our findings find support for Hypothesis 2 and are in line with the results of Petersen and Rajan (1997) who show that suppliers are willing to extend trade credit to firms with higher sales growth. By participating in the growth opportunities of such

firms, suppliers have an implicit stake in its future growth options (Cunat, 2007; Petersen & Rajan, 1997; Wilson & Summers, 2002).

4.3. Impact of stakeholder relationships on trade credit during COVID-19

Table 5 shows the estimation results for how stakeholder relationship mitigates the relationship between trade credit and high default firms during the COVID-19 shock period. We use *ESG score* and *Social score* of firms as the proxies for stakeholder relationships of firms. The dependent variable of the estimation results shown in columns (1)-(2) and columns (3)-(4) is accounts payable scaled by total assets and net payables scaled by total assets respectively. Our results show that maintaining good relationships with stakeholders positively affects the relationship between high default firms and the trade credit obtained by such firms in the pandemic period.

The results suggest that a one standard deviation increase in the ESG score results in obtaining 0.03% higher payables by riskier firms during the COVID-19 shock period. Moreover, it also results in an increment of 0.06% in the net payables of riskier firms in the COVID-19 shock period. Furthermore, the estimation results also show that a one standard deviation increase in the firm's social score results in obtaining 0.03% higher trade credit by riskier firms during the COVID-19 shock period. Our results also show that it increases the net payables of riskier firms by 0.02% during the pandemic.

We find evidence in support of Hypothesis 3. Altogether, the riskier firms with good stakeholder relationships are able to obtain more trade credit during COVID-19 shock. The higher ESG score of firms acts as a signal for the firms' stakeholders and reduces information asymmetry. The stronger relationships maintained by a firm with its stakeholders signal that the firm is socially responsible and, consequently, builds a reputation among the suppliers (Fombrun & Shanley, 1990; Zerbini, 2017; Zhang, Ma, Su, & Zhang, 2014). Previous studies show that trust and reputation are the two mechanisms that ensure that trade credit contracts are sustainable (Hilary & Huang, 2015; Karlan, 2005; Levine, Lin, & Xie, 2018).[6] Specifically, Zerbini (2017) and Zhang et al. (2020) find that

[6]A high ESG score and social score of firms also increases the trust between firms and stakeholders

better stakeholder relationships help firms in obtaining trade credit from suppliers. It is likely that the adverse impact of higher riskiness of firms is positively mitigated by their socially responsible behaviour, which, in turn, helps in obtaining higher trade credit in the COVID-19 shock period. Hence, our results on the moderating effect of better relationships on trade credit obtained by riskier firms during COVID-19 complement the findings in the literature.

4.4. Alternative specifications of the dependent variable

We repeat our baseline estimations using alternative specifications of our dependent variables. Following Chen, Ma, and Wu (2019) & Xu, Wu, and Dao (2020), we define *Payables* as accounts payable scaled by the cost of goods sold (COGS) and *Net Payables* as the difference of accounts payable and accounts receivable scaled by COGS. The benefit of using this measure is that it focuses more on the operating perspective rather than a firm-wide financing perspective. In this way, this measure avoids the noise in the estimations caused by the firm-specific financial management policies. Moreover, in our study, COGS captures the changes in economic activity induced by the pandemic. For instance, a firm that stops its operation would reduce its purchases of inputs and hence, its COGS would reduce. Furthermore, scaling by COGS captures the effect if trade credit falls more or less rapidly than the decrease in economic activity of the firm.

Table 6 presents the results related to the alternative specifications of dependent variables. Columns (1)-(4) show the results with payables as the dependent variable and columns (5)-(8) show the results with net payables as the dependent variable. The results suggest that our results are robust to the alternative specifications. Table 6 shows that payables obtained by riskier firms declined by 0.02% in the COVID-19 shock period. The results related to growth opportunities and stakeholder relationships are also consistent with our baseline findings. The net payables obtained by riskier firms in manufacturing sector has declined by 0.04% in the pandemic period. However, the result with payables as the dependent variable is not statistically significant. Furthermore, a one standard

(Cheung & Pok, 2019; Lins, Servaes, & Tamayo, 2017).

deviation increase in ESG score and social score of firms results in 0.01% and 0.01% increase in payables of riskier firms in the COVID-19 shock period, respectively. Overall, our results with alternative specifications of the dependent variable are consistent with the baseline findings of Table 3, Table 4 and Table 5.

5. Alternative estimations and robustness tests

In this section, we re-estimate the results based on Equation 1 and Equation 2 with various additional tests. First, we repeat our baseline estimation with the debt growth of firms as the dependent variable to check whether our results are driven by reverse substitution effect between bank credit and trade credit. Second, we re-estimate our results using alternative measures (Z score and KZ index) for the creditworthiness of firms. Third, we repeat our baseline estimation using stable unit treatment value assumption (SUTVA) DiD with no interference and variation in the treatment and control group (Rubin, 1980). Fourth, we test whether there is a significant effect of COVID-19 on trade credit for the firms located in emerging markets. Next, we repeat our estimation using a subsample (excluding the US and Japan) to check if our results hold without including observations from the US and Japan. Lastly, we conduct a falsification test by introducing an artificially induced crisis prior to our sample period.

5.1. Impact of COVID-19 on debt growth of firms

One of the counterfactual explanations to our results is the potential substitution of bank credit for trade credit. If riskier firms are able to obtain generous bank credit in a pandemic period, then the firms might prefer to opt for a cheaper form of bank financing rather than the expensive trade credit from suppliers. Hence, we conduct a robustness test using debt growth as the dependent variable to check whether there is a positive impact on debt growth of riskier firms during the COVID-19 shock period.

Table 7 shows the results of our estimation with debt growth as the dependent variable. The results suggest that there is no significant impact on the debt growth of riskier

firms during the COVID-19 shock period relative to the pre-COVID-19 period. This further strengthens our baseline results as the impact of COVID-19 on trade credit is not driven by a potential reverse substitution between bank credit and trade credit. Such a relationship is also seen in the parallel trends shown in Figure A3. The debt growth declines for both low-default firms and high-default firms after the declaration of COVID-19.

5.2. Alternative default propensity and trade credit during COVID-19

In this section, we employ an alternative proxy for the default of firms. It is likely that the choice of treatment and control groups based on the PD measure drives the results rather than the hypothesized role of creditworthiness. Hence, we use Altman Z score as a proxy of the creditworthiness of firms. We use the median value of the Altman Z score for identifying firms with a higher and lower chance of bankruptcy. We use *EBITDA*, *Working Capital*, *Retained earnings*, *Market capitalisation* and *Revenue* for calculating the Altman Z score.[7]. Here, the *Low Z score* is defined as 1 for the firms with below-median Altman Z score and 0 otherwise.

Table 8 shows the estimation results with *Low Z score*. Columns (1)-(5) show the results with accounts payable scaled by total assets as the dependent variable and columns (6)-(10) show the results with net payables scaled by total assets as the dependent variable. The results show that firms with lower Altman Z scores (firms with poor creditworthiness) obtained 0.23% and 0.31% lower payables and net payables respectively in the COVID-19 shock period. Our findings that firms with a higher risk of bankruptcy obtain lower trade credit during the COVID-19 shock period is consistent with our baseline findings.

Again, our results support the results of Petersen and Rajan (1997) & Cunat (2007) that suppliers are willing to extend credit to creditworthy buyers and they value the

[7]Based on Altman (1968), Altman Z score is measured as follows: 1.2 $\times$ *Working capital/Total assets* + 1.4 $\times$ *Retained earnings/Total assets* + 3.3 $\times$ *EBITDA/Total assets* +0.6 $\times$ *Market capitalisation/(Total assets- Book value of equity)* + 0.999 $\times$ *Revenue/ Total assets*

promise of future prospects. These findings are consistent with our findings with *High default* as a measure of the riskiness of firms. The firms with lower *Altman Z scores* receive lower trade credit during the COVID-19 shock period as these firms are in a financially weak position.

5.3. Financial constraints and trade credit during COVID-19

It is argued in the literature that financially constrained firms are more prone to trade credit usage. Given the credit rationing faced by such firms from formal financial institutions, they seek more credit from their suppliers to manage their working capital requirements (Biais & Gollier, 1997). To test, whether financially constrained firms are credit rationed by their suppliers during COVID-19 shock, we re-estimate Equation 1 with KZ index as the measure of firms quality rather than PD.[8]. We use the *High KZ* as a proxy for firms' ability to obtain financing. *High KZ* is defined as 1 for firms with above-median KZ index and 0 otherwise. In the estimations, we employ the *High KZ* for firms with high financial constraints.

Table 9 shows the estimation results with the KZ index as a proxy for financial constraints. Our results shown in columns (1)-(4) are consistent with previous findings. Firms with a higher KZ index (lower financial constraints) obtain 0.24% and 0.29% lower payables and net payables in the COVID-19 shock period. The results suggest that even after controlling for other firm-level variables, the firms facing higher financial constraints receive lower payables during COVID-19 shock, which is in contrast to the findings documented during earlier crisis periods.

[8]Following Kaplan and Zingales (1997), we calculate KZ index as: -1.002 $\times$ *Funds from operations/lagged net PPE* -39.368 $\times$ *Cash dividends/lagged net PPE* -1.315 $\times$ *Cash and short term investments/lagged net PPE*+3.139 $\times$ *Leverage* + 0.283 $\times$ *(Market capitalisation +Total assets-Equity)/ Total assets*

5.4. Parallel trend tests

One of the key assumptions made in the DiD specification is parallel trends of the treatment and control group in the pre-treatment window. In this section, we test whether this assumption holds in our multi-country setting. To conclude that the treatment and control groups demonstrate a parallel trend in the pre-COVID-19 window, we estimate the following regression for the 12 quarters preceding Q2'20.

$$Y_{it} = \alpha + \beta High\ default_{it-13} + \sum_{k=t-12}^{t-1} \gamma_k \times Quarter_k \times High\ default_{ik} + \mu_i + \nu_{cjt} + \epsilon_{it} \tag{3}$$

In the regression, the dependent variables are regressed on the $High\ default$ dummy and its interactions with the quarters in the pre-event window. If the parallel trends assumptions hold, then the wedge between the treated and the control groups should not diverge during the pre-event window. Therefore, γ_k, the coefficients of the interaction term has to be insignificant. In other words, the incremental wedge between the two groups should be zero.

The results of the parallel trend test are shown in Figure 7. In both panels, we find that the coefficients of the interaction terms are statistically insignificant. The results indicate that the wedge has not substantially changed during the pre-event window of our estimation sample. The tests of parallel trends support the causal inference of the baseline results documented in the study.

5.5. Control for stable unit treatment of the treated group

In our estimation shown in Equation 1, we allow the treated and control groups, which are classified into two groups based on a *High default* dummy, to vary with time. However, a time-variant dummy might violate the assumption that the treated group is stable over the estimation window, which is indicated as the stable unit treatment value assumption (SUTVA). A model that claims no violation implies that potential outcomes for firm i are unrelated to the treatment status of other firms in the sample (Angrist, Imbens, &

Rubin, 1996). In other words, it outlines that there is only one level of treatment, and the treatment of one firm has no impact on other treated or control firms (Atanasov & Black, 2016; Imbens & Rubin, 2015).

Hence, we re-estimate Equation 1 by ensuring that the treated group do not vary with time. We classify firms into two groups based on the PD measure as of Q4'2019 for the entire estimation window. However, we do not claim no violation based on the choice of groups. It is likely that there are spillover effects in the post-treatment window, which is a limitation in our study.

The estimation results are shown in columns (5) to (8) of Table 9. These results are also consistent with the results presented in Table 3 without SUTVA. The results show that firms with high default probability obtain 0.27% and 0.20% lower payables and net payables respectively in the pandemic period. We assess whether COVID-19, rather than some other shock associated with COVID-19, can explain the reduced trade credit in the riskier firms. Our estimation results with SUTVA show that an external shock like COVID-19 helps in explaining reduced trade credit in risky firms.

5.6. Impact of COVID-19 on trade credit for emerging markets

The smaller firms in the emerging markets are more likely to depend on trade credit during the COVID-19 shock period. It is plausible that the impact of COVID-19 on trade credit is more prominent for firms in the emerging markets compared to firms in advanced economies. Hence, we test whether there is a significant difference in the trade credit obtained by high default firms in the COVID-19 shock period in the emerging economies and advanced economies.

We define *Emerging economy dummy* as firms located in emerging markets. These firms are labelled as *Emerging economy dummy* based on the classification provided by International Monetary Fund (IMF). *Emerging economy dummy* equals 1 for firms located in emerging economy and 0 otherwise. Table A3 presents the estimation results related to emerging economies. The results suggest that there is no significant impact on trade credit obtained by riskier firms in emerging markets. However, our results are consistent

with the baseline findings that riskier firms obtain lesser trade credit during the pandemic period.

5.7. Placebo estimations

Finally, we conduct a placebo test to study the impact of the riskiness of firms on obtaining trade credit from suppliers during an artificially induced crisis period. This method has been used in previous studies (Acharya & Xu, 2017; Atanasov & Black, 2016; Duchin, Ozbas, & Sensoy, 2010). The sample period of placebo estimation starts from 2013 to 2016, with the first quarter of 2016 as the artificially induced crisis period. The last three quarters of 2016 are considered as the post-crisis period. The selection of post-crisis period is based on the crisis period for our baseline estimation results.

Table A4 shows the results for the placebo estimation of our study. We do not find any significant difference in the trade credit obtained by riskier firms and creditworthy firms during the placebo crisis except for the firms with high ESG scores and social scores. The estimation results indicate that a one standard deviation increase in the ESG score and social score of riskier firms helps in obtaining 0.01% and 0.02% higher trade credit respectively during the placebo crisis period. We confirm that our results do not follow the artificially induced crisis.

5.8. Robustness test results without firm-level controls

Finally, we conduct a robustness test based on our baseline estimation equation without including firm-level control variables. In these estimations, we include firm-year fixed effects as we do not include firm-level controls. These fixed effects control for firm-level variations at the yearly level.

Table A5 shows the results related to estimations without firm-level control variables. Our results are largely consistent with the baseline findings presented in Table 3. The results suggest that payables and net payables obtained by riskier firms declined by 0.11% and 0.14%, respectively, during the COVID-19 shock period. The results related to growth opportunities and stakeholder relationships are also consistent with the findings

of Table 4 and Table 5. The riskier firms with higher growth opportunities and better stakeholder relationships obtained higher trade credit during the COVID-19 shock period.

6. Conclusion

In this study, we examine the impact of COVID-19-induced real sector crisis on the trade credit supply obtained by firms across countries. Several studies have documented that trade credit is a generous substitute to bank credit for financially constrained firms, especially during earlier crisis episodes. However, we find that less creditworthy and financially constrained firms obtained lower trade credit than creditworthy firms during the COVID-19 shock period. The contrasting result in our study supports the view that the supply of trade credit is conditional on the product market conditions, and is not always a substitute for bank credit.

Furthermore, we find that firms with better growth opportunities—firms in industries that are more amenable to work from home and firms with higher sales growth —obtain higher trade credit despite the suspect credit quality. We also find that riskier firms that maintain better stakeholder relationships obtain higher trade credit during the COVID-19 shock period. The findings of the study suggest that trade credit acts as a substitute for bank credit only during favourable product market conditions. During the COVID-19 pandemic, which was characterized both by operational disruptions and reduced demand for products and services, borrower firms with better growth prospects obtained valuable trade credit. Moreover, the results are robust to several alternative estimations.

Given the rapidity of the crisis, we employ high-frequency quarterly firm-level financial information to examine the impact on trade credit supply. Availability of such high-quality data is limited to larger firms that are publicly listed in the markets. Hence, it is imperative to extend the study to include the smaller businesses to document the extent of COVID-19 impact across the value chain. Future studies can explore the trade credit channel with a focus on smaller firms, either in a cross-country or a single-country setting with richer identification of the suppliers and customers of firms.

While governments in both advanced and developing economies have made several policy interventions, it is important to note the disproportionate trade credit obtained by better quality firms during the COVID-19 shock period. Relying on credit transmission for weaker firms through the banking channel or the redistribution through stronger suppliers might turn out to be less beneficial compared to direct grants and support for such firms. Given the exogenous nature of the shock, several firms might face existential challenges due to the real sector disruptions and find it tough to survive until the pandemic recovery phase.

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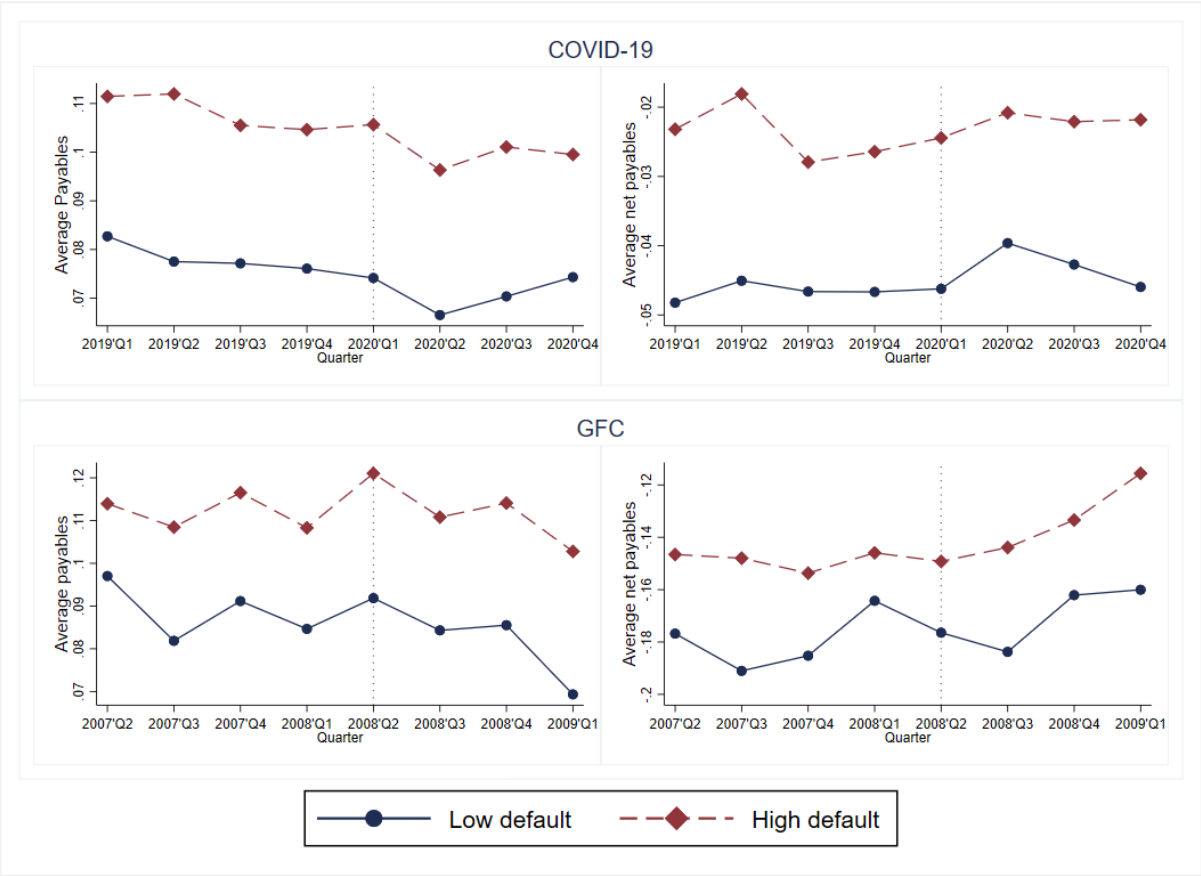
Figure 1: Trend of average payables and average net payables in pre-COVID-19 and post-COVID-19 period

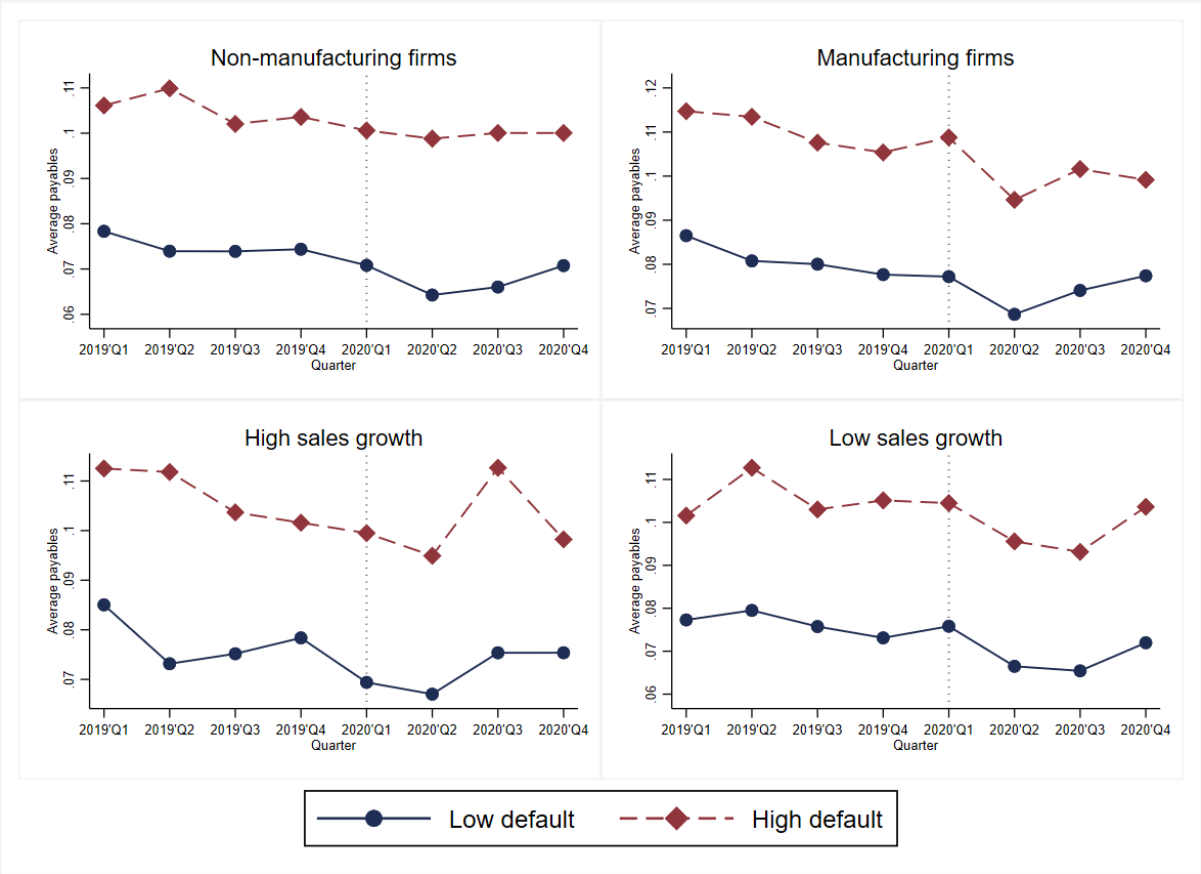
The figure displays the trend of average payables and average net payables for last two years. *Payables* is defined as accounts payable scaled by total assets of the firm. *Net payables* is defined as the difference between accounts payables and accounts receivable scaled by total assets of a firm. The description of all variables is presented in Table 1.

Figure 2: Parallel trend of average payables and average net payables during COVID-19 and GFC period



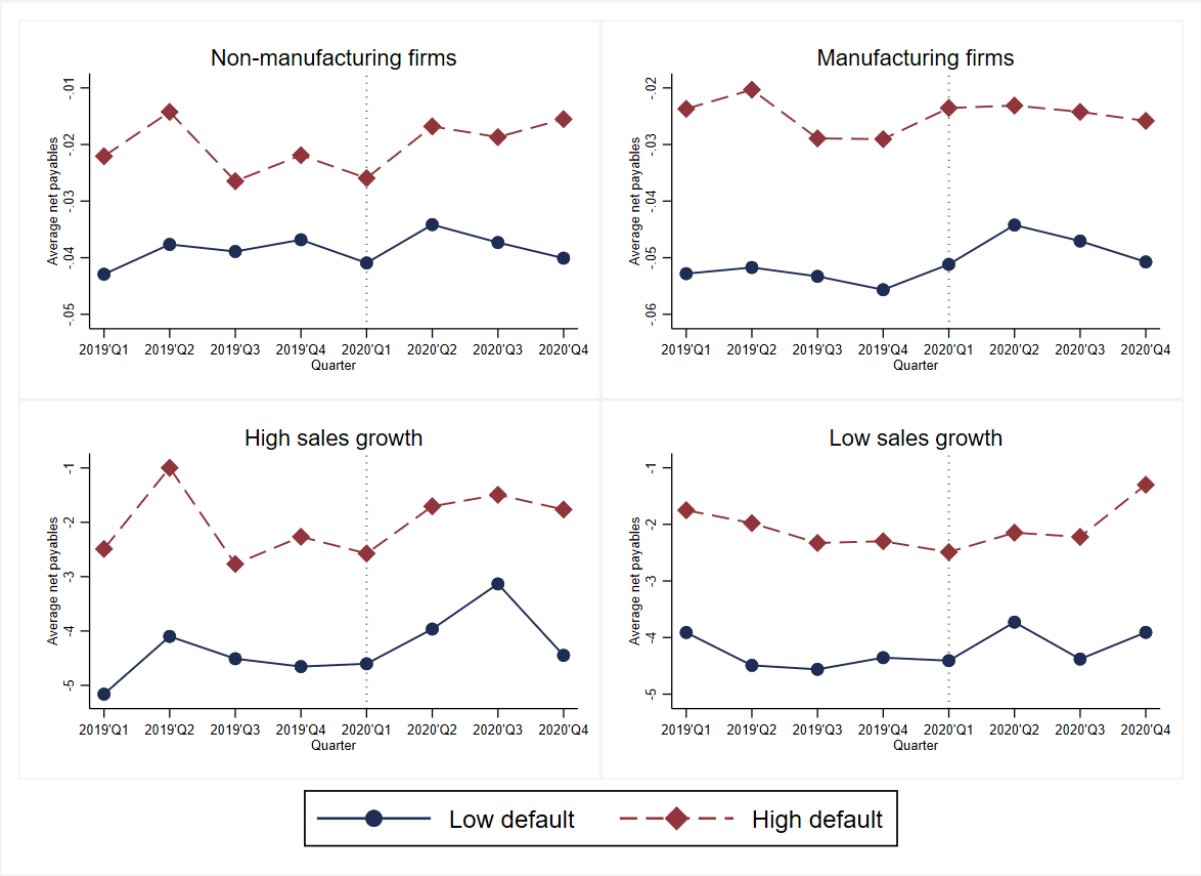
The figure displays the parallel trend of average payables and average net payables during COVID-19 and GFC period based on probability of default of firms. *COVID-19* is defined as 1 for April 2020- December 2020 and 0 otherwise. *GFC* is defined as 1 for July 2008- March 2009 and 0 otherwise. *High default* is defined as 1 for the firms with above median probability of default. The description of all variables is presented in Table 1.

Figure 3: Parallel trend of average payables for growth firms



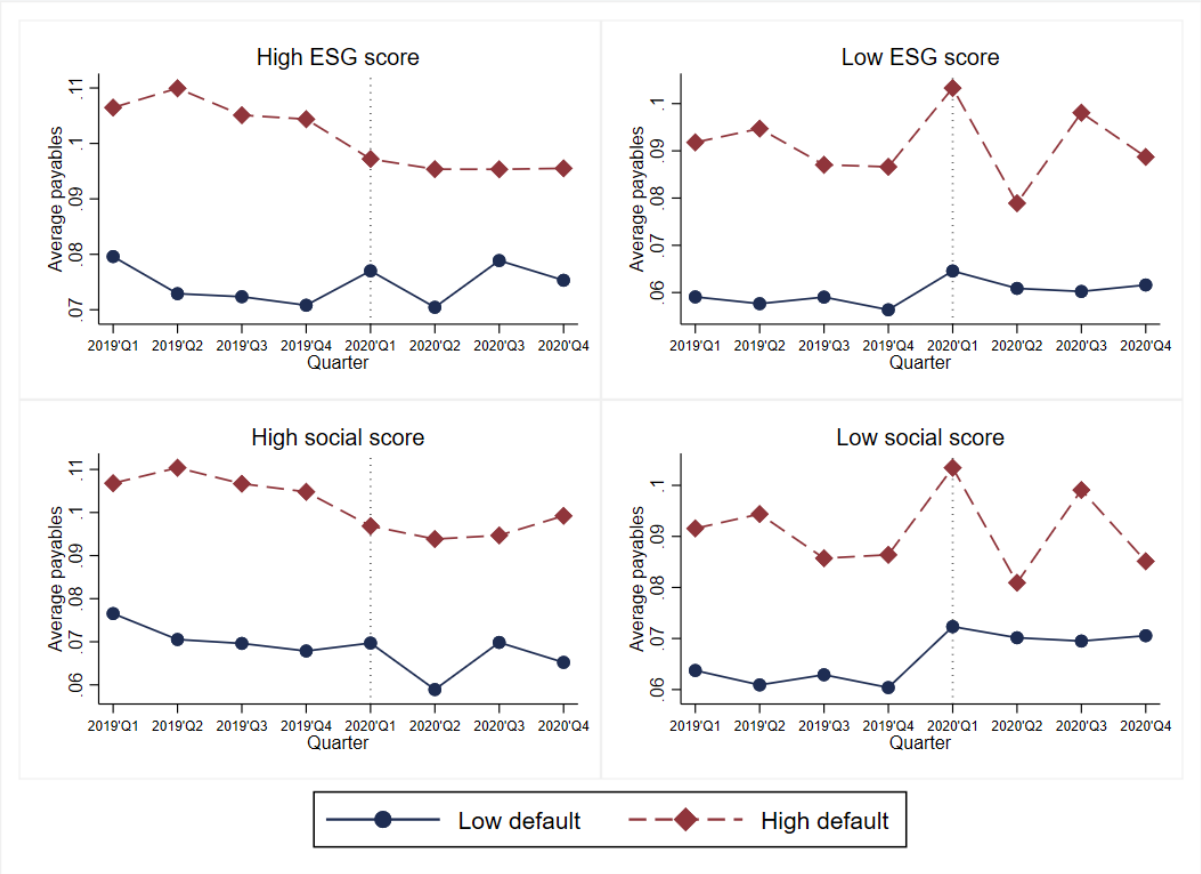
The figure displays the parallel trend of average payables for last two years for the growth firms. The firms are classified as high default and low default based on probability of default of firms. High sales growth and non-manufacturing firms are referred as growth firms. *Manufacturing firms* represents a dummy variable that is defined as 1 for firms in the manufacturing industry and 0 otherwise. *High sales growth* is defined as 1 for firms with above median sales growth and 0 otherwise. *High default* is defined as 1 for the firms with above median probability of default. The description of all variables is presented in Table 1.

Figure 4: Parallel trend of average net payables for growth firms



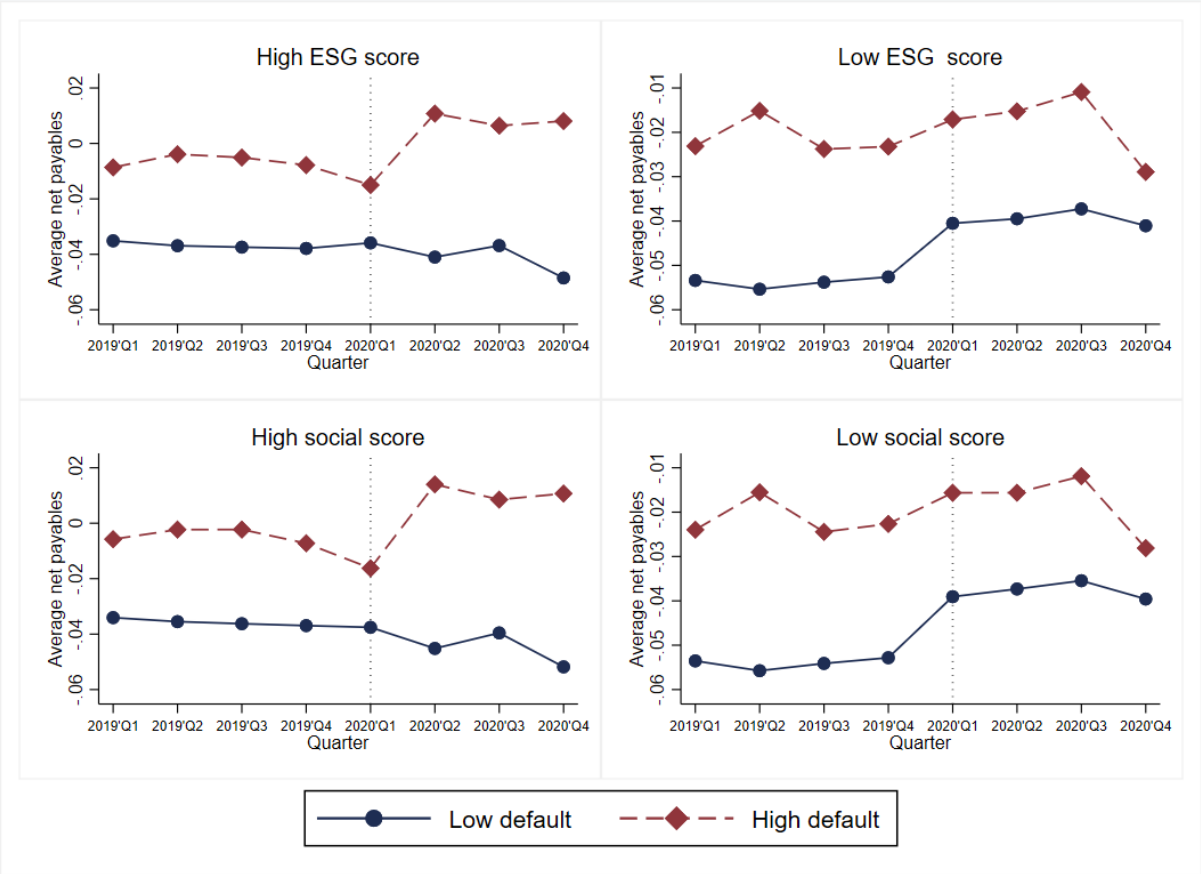
The figure displays the parallel trend of average net payables for last two years for the growth firms. The firms are classified as high default and low default based on probability of default of firms. High sales growth and non-manufacturing firms are referred as growth firms. *Manufacturing firms* represents a dummy variable that is defined as 1 for firms in the manufacturing industry and 0 otherwise. *High sales growth* is defined as 1 for firms with above median sales growth and 0 otherwise. *High default* is defined as 1 for the firms with above median probability of default. The description of all variables is presented in Table 1.

Figure 5: Parallel trend of average payables according to stakeholder relationship



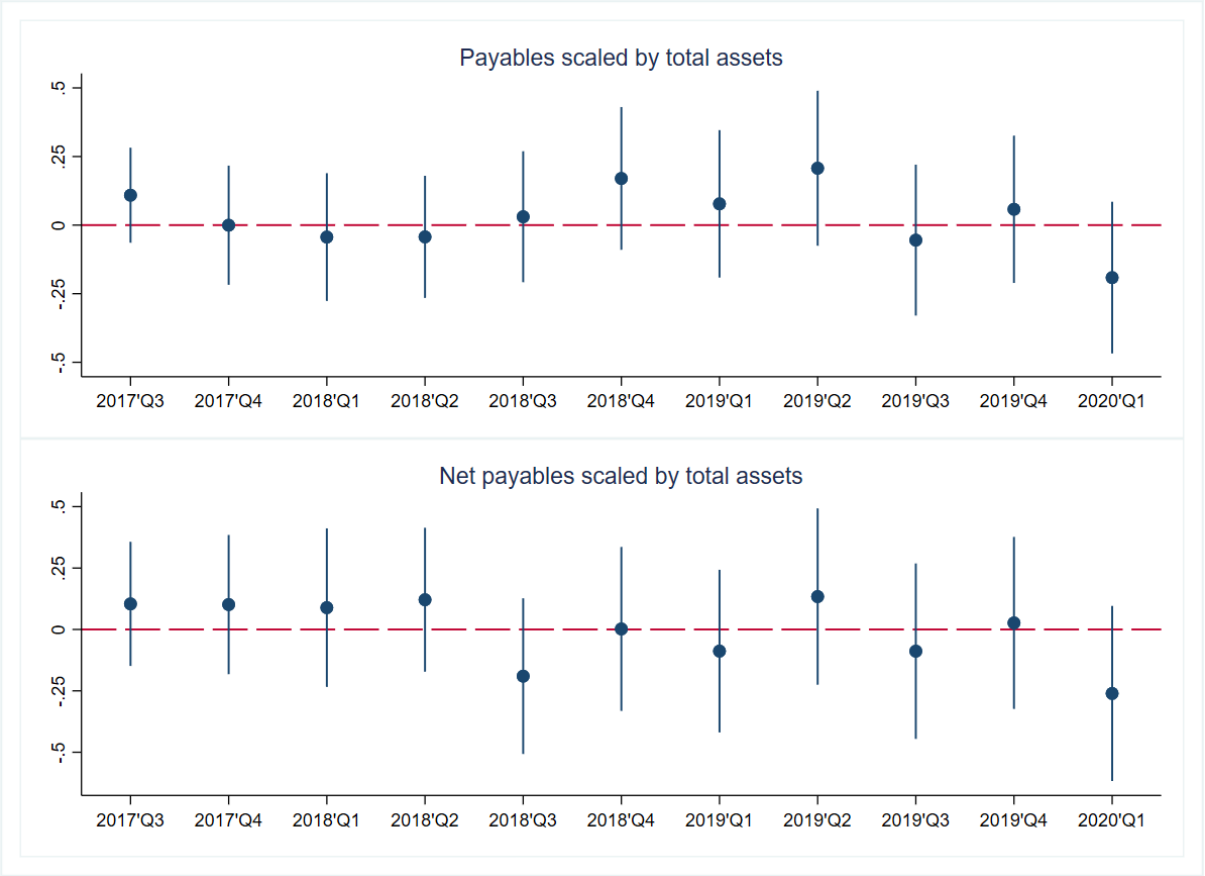
The figure displays the parallel trend of average payables for last two years according to stakeholder relationship. The firms are classified as high default and low default based on probability of default of firms. *High default* is defined as 1 for the firms with above median probability of default. *High ESG score* represents a dummy variable that is defined as 1 for firms with above median ESG score and 0 otherwise. *High social score* represents a dummy variable that is defined as 1 for firms with above median social score and 0 otherwise. The description of all variables is presented in Table 1.

Figure 6: Parallel trend of average net payables according to stakeholder relationship



The figure displays the parallel trend of average net payables for last two years according to stakeholder relationship. The firms are classified as high default and low default based on probability of default of firms. *High default* is defined as 1 for the firms with above median probability of default. *High ESG score* represents a dummy variable that is defined as 1 for firms with above median ESG score and 0 otherwise. *High social score* represents a dummy variable that is defined as 1 for firms with above median social score and 0 otherwise. The description of all variables is presented in Table 1.

Figure 7: Results of Parallel trends test



The figure shows the results of parallel trends test between high default and low default firms. The dependent variable in the first panel is payables scaled by total assets. The dependent variable in the second panel is net payables scaled by total assets. The estimations shown in figure are for pre-COVID-19 period starting from 2017'Q3 to 2020'Q1. The vertical lines in the figure show the coefficients of *High default* × *Year-Quarter* for each quarter. These estimations include firm, country-industry-year quarter fixed effects. The robust standard errors are clustered at the firm level.

Table 1: Variable definitions and data sources

Variable	Definition and construction	Data source
Payables	Accounts payable scaled by total assets of the firm	Refinitiv Eikon
Net Payables	Difference between accounts payables and accounts receivables scaled by total assets of the firm	Refinitiv Eikon
Probability of default	Likelihood that a debtor is unable to honor its financial obligations in the coming year	Credit Research Initiative
High default	A dummy variable that is defined as 1 for firms with above median probability of default and 0 otherwise	Credit Research Initiative
Altman Z score	A measure based on financial ratios for calculating the probability of a firm becoming insolvent	Refinitiv Eikon
KZ index	An index based on the estimation of the determinants of financial constraints	Refinitiv Eikon
Liquidity	Cash & equivalents scaled by total assets of the firm	Refinitiv Eikon
Profitability	Earnings before interest, tax, depreciation and amortization (EBITDA) scaled by total assets of the firm	Refinitiv Eikon
Leverage	Debt-to-equity ratio of the firm	Refinitiv Eikon
Size	Total revenue of the firm	Refinitiv Eikon
Sales growth	Change in revenue of the firm relative to previous quarter	Refinitiv Eikon
Manufacturing dummy	A dummy variable that is defined as 1 for firms in manufacturing industry and 0 otherwise	Refinitiv Eikon
High sales growth	A dummy variable that is defined as 1 for firms with above median sales growth and 0 otherwise	Refinitiv Eikon
ESG score	Overall score based on environmental, social and corporate governance scores	Refinitiv Eikon
Social score	Capacity of a firm to generate trust and loyalty among its stakeholders by implying the best management practices	Refinitiv Eikon
Debt growth	Logarithm of debt of current quarter scaled by debt of previous quarter	Refinitiv Eikon
Placebo	A dummy variable that is defined as 1 for the artificially induced crisis period and 0 otherwise	Refinitiv Eikon
Emerging economy dummy	A dummy variable that is defined as 1 for the emerging economies and 0 otherwise	International Monetary Fund

Table 2: Summary statistics of key variables

Variable	N	Mean	SD	Min	P10	P25	P50	P75	P90	Max
Payables (%)	87986	8.85	8.53	0.11	1.12	2.79	6.29	12.06	19.80	45.05
Net payables (%)	87986	-3.69	9.21	-77.05	-13.80	-8.05	-3.11	0.50	5.42	81.91
Probability of default (%)	87986	0.32	0.75	0.00	0.00	0.01	0.04	0.24	0.92	4.85
Altman Z score	77851	3.28	8.80	-105.71	0.56	1.02	1.76	3.31	6.62	698.38
KZ index	45117	-18.60	80.95	-627.19	-27.43	-6.92	-0.69	1.72	3.45	22.71
Manufacturing dummy	87986	0.54	0.50	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Sales growth	76294	0.05	0.46	-0.96	-0.24	-0.08	0.01	0.11	0.29	3.33
ESG score	18671	41.38	19.03	5.23	17.81	26.35	39.20	55.63	68.88	84.91
Social score	18671	42.98	22.71	2.04	14.46	24.79	40.59	59.94	75.58	93.52
COVID-19	87986	0.18	0.38	0.00	0.00	0.00	0.00	0.00	1.00	1.00
Liquidity	74234	0.16	0.15	0.00	0.01	0.05	0.12	0.23	0.38	0.67
Profitability	80997	0.02	0.03	-0.09	0.00	0.01	0.02	0.03	0.05	0.11
Leverage	80998	0.74	1.33	-3.15	0.00	0.06	0.40	0.96	1.90	8.24
Size	79111	13.04	1.95	8.39	10.56	11.68	12.95	14.43	15.67	17.66
Debt growth	63982	0.02	0.48	-10.81	-0.18	-0.06	0.00	0.06	0.23	14.53

Notes: Table 1 presents the description of all the variables. N stands for the number of observations. Min. & Max. show the minimum and maximum value of each variable respectively. SD and P represent the standard deviation and percentile respectively.

Table 3: Impact of COVID-19 on trade credit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High default × *COVID-19*	-0.278***	-0.245***	-0.290***	-0.316*				
	(0.041)	(0.057)	(0.091)	(0.151)				
High default × *GFC_dum*					0.430**	0.571***	0.733**	1.055***
					(0.192)	(0.186)	(0.315)	(0.238)
High default	-0.021	-0.079	-0.014	-0.003	-0.042	-0.130	-0.049	-0.211**
	(0.041)	(0.048)	(0.061)	(0.068)	(0.079)	(0.088)	(0.081)	(0.081)
Liquidity		-2.231***		2.649**		-3.224***		-4.462***
		(0.449)		(1.150)		(0.508)		(0.736)
Profitability		-4.960***		-2.210		-12.039***		-23.273***
		(0.762)		(5.205)		(2.232)		(6.866)
Leverage		-0.051***		0.016		-0.110*		-0.134**
		(0.017)		(0.018)		(0.062)		(0.061)
Size		1.294***		-0.176		0.586***		0.686***
		(0.427)		(0.333)		(0.141)		(0.134)
Constant	8.880***	-7.815	-3.659***	-1.876	9.665***	2.192	9.655***	1.333
	(0.020)	(5.664)	(0.026)	(4.251)	(0.049)	(1.780)	(0.058)	(1.637)
Observations	87,986	69,963	87,986	69,963	40,747	27,291	40,389	27,098
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.928	0.94	0.892	0.904	0.896	0.892	0.824	0.803

Notes: The dependent variable in model (1), (2), (5) & (6) is payables scaled by total assets and (3), (4), (7) & (8) is net payables scaled by total assets. *High default* is defined as 1 for firms with above median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *GFC* is defined as 1 for July 2008- March 2009 and 0 otherwise. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table 4: Impact of growth opportunities on trade credit during COVID-19

	(1)	(2)	(3)	(4)
High default × *COVID-19* × *High sales growth*	0.041		0.376**	
	(0.169)		(0.148)	
COVID-19 × *High sales growth*	0.143		-0.192***	
	(0.108)		(0.051)	
High default × *High sales growth*	0.017		-0.086***	
	(0.050)		(0.029)	
High sales growth	0.070		0.042	
	(0.047)		(0.032)	
High default × *COVID-19* × *Manufacturing dummy*		-0.356**		-0.535
		(0.129)		(0.516)
High default × *Manufacturing dummy*		0.050		0.038
		(0.095)		(0.233)
High default × *COVID-19*	-0.276***	-0.069	-0.475***	-0.053
	(0.093)	(0.073)	(0.119)	(0.426)
High default	-0.108	-0.105	0.073	-0.022
	(0.075)	(0.076)	(0.068)	(0.159)
Liquidity	-2.013***	-2.226***	2.861**	2.655**
	(0.369)	(0.452)	(1.155)	(1.143)
Profitability	-5.287***	-4.973***	-0.882	-2.230
	(0.685)	(0.765)	(4.705)	(5.234)
Leverage	-0.036	-0.051***	0.011	0.015
	(0.021)	(0.017)	(0.022)	(0.019)
Size	1.304***	1.293***	-0.415	-0.178
	(0.411)	(0.427)	(0.326)	(0.332)
Constant	-8.057	-7.797	1.295	-1.844
	(5.468)	(5.658)	(4.165)	(4.238)
Observations	60,163	69,963	60,163	69,963
Firm fixed effects	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.944	0.940	0.910	0.905

Notes: The dependent variable in model (1) & (2) is payables scaled by total assets and (3) & (4) is net payables scaled by total assets. *High default* is defined as 1 for firms with above median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *High sales growth* is defined as 1 for the firms with above median sales growth and 0 otherwise. *Manufacturing dummy* is defined as 1 for firms in the manufacturing industry and 0 otherwise. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table 5: Impact of stakeholder relationships on trade credit during COVID-19

	(1)	(2)	(3)	(4)
High default × *COVID-19* × *ESG score*	0.038***		0.060***	
	(0.006)		(0.008)	
COVID-19 × *ESG score*	0.008**		-0.022***	
	(0.003)		(0.007)	
High default × *ESG score*	0.004***		-0.006	
	(0.001)		(0.004)	
ESG score	-0.002		0.006	
	(0.004)		(0.004)	
High default × *COVID-19* × *Social score*		0.031***		0.027***
		(0.003)		(0.003)
COVID-19 × *Social score*		0.007***		-0.015*
		(0.002)		(0.009)
High default × *Social score*		0.003		-0.005
		(0.002)		(0.004)
Social score		0.001		0.009*
		(0.005)		(0.005)
High default × *COVID-19*	-1.504***	-1.237***	-2.367***	-1.004***
	(0.277)	(0.253)	(0.394)	(0.107)
High default	-0.299***	-0.262***	0.116	0.072
	(0.069)	(0.087)	(0.173)	(0.175)
Liquidity	-1.457***	-1.446***	1.450	1.459*
	(0.373)	(0.388)	(0.870)	(0.777)
Profitability	-1.907	-1.851	-0.980	-1.023
	(1.106)	(1.202)	(1.496)	(1.167)
Leverage	-0.025**	-0.025**	0.087***	0.088***
	(0.009)	(0.009)	(0.015)	(0.014)
Size	0.056	0.045	-0.456***	-0.458***
	(0.206)	(0.212)	(0.010)	(0.014)
Constant	6.805**	6.818*	2.469***	2.362***
	(3.183)	(3.308)	(0.020)	(0.011)
Observations	14,726	14,726	14,726	14,726
Firm fixed effects	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.967	0.967	0.941	0.941

Notes: The dependent variable in model (1) & (2) is payables scaled by total assets and (3) & (4) is net payables scaled by total assets. *High default* is defined as 1 for firms with above median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *ESG score* refers to the overall score of a firm based on environmental, social and corporate governance scores. *Social score* refers to a firm's capacity to generate trust and loyalty with its workforce, customers and society. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table 6: Robustness test results with Payables scaled by COGS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High default × *COVID-19*	-0.023*	-0.005	-0.242***	-0.188***	-0.004**	0.016	-0.116***	-0.123***
	(0.012)	(0.009)	(0.021)	(0.007)	(0.001)	(0.010)	(0.016)	(0.023)
High default × *COVID-19* × *Manufacturing dummy*		-0.036				-0.041**		
		(0.021)				(0.015)		
High default × *COVID-19* × *ESG score*			0.006***				0.003***	
			(0.001)				(0.000)	
High default × *COVID-19* × *Social score*				0.005***				0.003***
				(0.000)				(0.001)
Firm-level control variables	No	No	No	No	No	No	No	No
Observations	66,960	66,960	12,835	12,835	66,960	66,960	12,835	12,835
Firm-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.889	0.889	0.922	0.922	0.932	0.932	0.942	0.942

Notes: The dependent variable in column (1)-(4) is payables scaled by cost of goods sold and column (5)-(8) is net payables scaled by cost of goods sold. *High default* refers to firms with above-median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *High sales growth* is defined as 1 for the firms with above median sales growth and 0 otherwise. *Manufacturing dummy* is defined as 1 for firms in the manufacturing industry and 0 otherwise. *ESG score* refers to the overall score of a firm based on environmental, social and corporate governance scores. *Social score* refers to a firm's capacity to generate trust and loyalty with its workforce, customers and society. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table 7: Impact of COVID-19 on debt growth of firms

	(1)	(2)
High default × *COVID-19*	-0.005	-0.012
	(0.008)	(0.014)
High default	-0.021**	-0.021**
	(0.008)	(0.009)
Liquidity		-0.314***
		(0.059)
Profitability		-0.454*
		(0.226)
Leverage		-0.021
		(0.012)
Size		-0.033
		(0.032)
Constant	0.026***	0.541
	(0.003)	(0.425)
Observations	61,298	53,632
Firm fixed effects	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes
Adjusted R^2	0.020	0.018

Notes: The dependent variable is debt growth. *High default* refers to firms with above median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table 8: Alternative default propensity and trade credit during COVID-19

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Low Z score × *COVID-19*	-0.231**	-0.175*	-0.051	-1.358***	-1.473***	-0.315***	-0.332**	-0.111	-1.104	-1.449
	(0.096)	(0.090)	(0.064)	(0.309)	(0.297)	(0.092)	(0.115)	(0.147)	(1.043)	(0.880)
Low Z score × *COVID-19* × *High sales growth*		-0.182					-0.015			
		(0.149)					(0.044)			
Low Z score × *COVID-19* × *Manufacturing dummy*			-0.335					-0.386		
			(0.212)					(0.305)		
Low Z score × *COVID-19* × *ESG score*				0.029**					0.014	
				(0.012)					(0.019)	
Low Z score × *COVID-19* × *Social score*					0.030***					0.022*
					(0.008)					(0.013)
Firm-level control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	63,432	54,772	63,432	13,042	13,042	63,432	54,772	63,432	13,042	13,042
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.942	0.945	0.942	0.968	0.968	0.907	0.913	0.913	0.943	0.943

Notes: The dependent variable in column (1)-(5) is payables scaled by total assets and column (6)-(10) is net payables scaled by total assets. *Low Z score* refers to firms with below median Altman Z score. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *High sales growth* is defined as 1 for the firms with above median sales growth and 0 otherwise. *Manufacturing dummy* is defined as 1 for firms in the manufacturing industry and 0 otherwise. *ESG score* refers to the overall score of a firm based on environmental, social and corporate governance scores. *Social score* refers to a firm's capacity to generate trust and loyalty with its workforce, customers and society. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table 9: Impact of financial constraints on trade credit during COVID-19 and SUTVA DiD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
KZ index median × *COVID-19*	-0.242*	-0.278**	-0.292*	-0.249				
	(0.116)	(0.108)	(0.146)	(0.154)				
High default × *COVID-19*					-0.271***	-0.294***	-0.208***	-0.236*
					(0.069)	(0.030)	(0.068)	(0.130)
KZ index median	0.262***	0.187***	0.117	0.059				
	(0.049)	(0.051)	(0.068)	(0.063)				
Liquidity		-2.306***		1.738*		-2.011***		2.832**
		(0.534)		(0.905)		(0.405)		(1.134)
Profitability		-5.031***		-4.227		-4.846***		-2.286
		(1.306)		(4.201)		(0.733)		(5.721)
Leverage		1.336***		-0.413		1.364***		-0.130
		(0.410)		(0.441)		(0.420)		(0.316)
Size						-0.058***		-0.001
						(0.018)		(0.022)
Constant	8.408***	-9.026	-3.467***	1.857	8.720***	-8.824	-3.665***	-2.458
	(0.024)	(5.587)	(0.031)	(5.881)	(0.006)	(5.593)	(0.006)	(4.048)
Observations	41,332	35,272	41,332	35,272	76,776	65,317	76,776	65,317
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.935	0.941	0.903	0.909	0.938	0.942	0.899	0.907

Notes: The dependent variable in model (1), (2), (5) & (6) is payables scaled by total assets and (3), (4), (7) & (8) is net payables scaled by total assets. *High KZ* is defined as 1 for the firms with above median KZ index and 0 otherwise. *High default* refers to firms with above median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

A. Appendix

Figure A1: Payables and net payables distribution

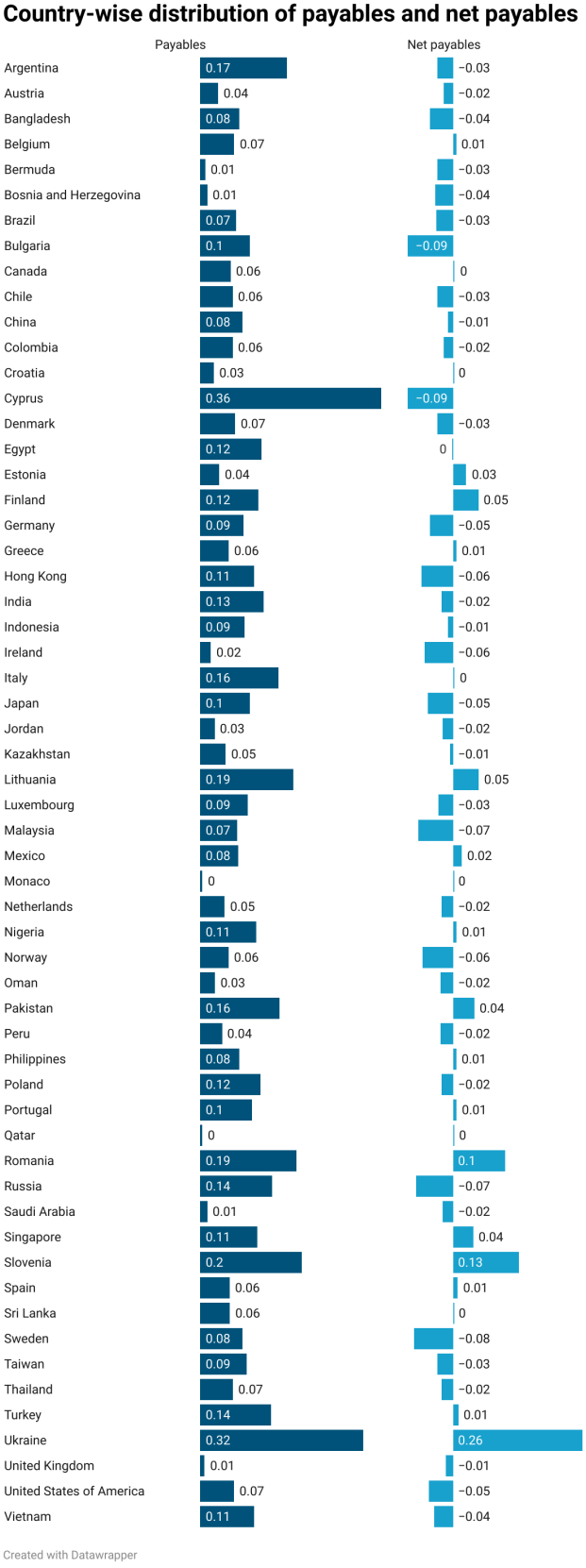
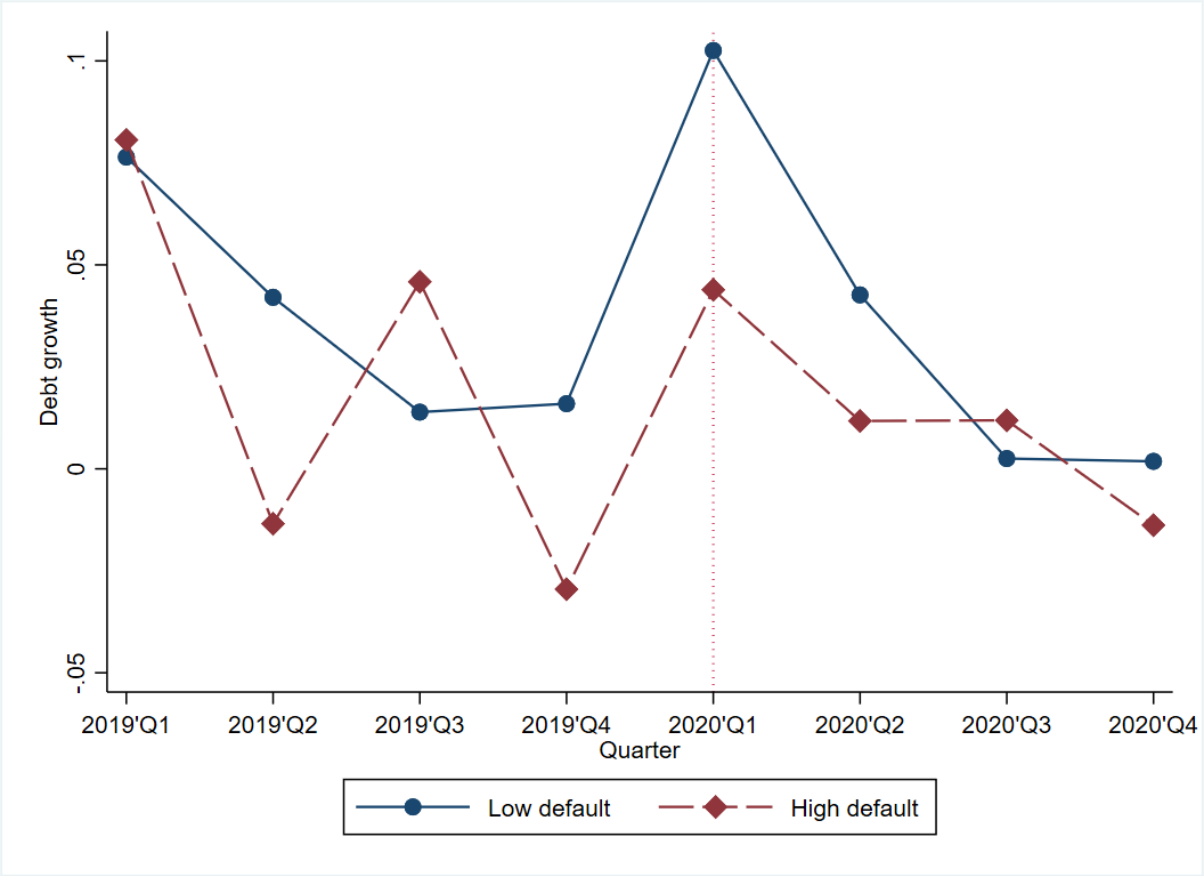


Figure A2: Trend of GDP growth rate and TED spread rate

The figure shows the trend of GDP growth rate and TED spread rate for last two decades. *COVID-19* refers to infectious coronavirus disease of 2019 and *GFC* refers to the Global Financial Crisis.

Figure A3: Parallel trend of debt growth of firms during COVID-19 period



The figure shows the parallel trend of average debt growth of firms for last two years. The firms are classified as high default and low default based on probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *Debt growth* is defined as the logarithm of debt of current quarter scaled by debt of previous quarter. The description of all variables is presented in Table 1.

Table A1: Country-wise distribution of sample

Country	Observations	Unique firms	Country	Observations	Unique firms
Argentina	86	12	Luxembourg	6	2
Austria	20	2	Malaysia	782	85
Bangladesh	82	7	Mexico	346	31
Belgium	46	4	Monaco	26	3
Bermuda	142	14	Netherlands	10	4
Bosnia & Herzegovina	8	3	Nigeria	116	14
Brazil	480	40	Norway	153	24
Bulgaria	44	3	Oman	40	5
Canada	662	64	Pakistan	175	20
Chile	234	25	Peru	117	15
China	11,522	1127	Philippines	218	21
Colombia	58	4	Poland	713	69
Croatia	154	14	Portugal	60	6
Cyprus	30	2	Qatar	10	2
Denmark	150	13	Romania	22	4
Egypt	185	19	Russia	542	49
Estonia	14	2	Saudi Arabia	179	18
Finland	32	2	Singapore	151	21
Germany	1,199	114	Slovenia	14	2
Greece	48	7	Spain	25	5
Hong Kong	4	2	Sri Lanka	384	32
India	3,142	566	Sweden	339	46
Indonesia	2,505	205	Taiwan	6,773	515
Ireland	62	5	Thailand	2,150	172
Italy	40	6	Turkey	827	91
Japan	30,303	2162	Ukraine	8	2
Jordan	118	12	United Kingdom	48	3
Kazakhstan	22	2	United States of America	20,076	1485
Lithuania	16	2	Vietnam	2,268	220
			Total	87,986	7406

Table A2: Correlation table

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1)*Payables*	1														
(2)*Net payables*	0.323	1													
(3)*High default*	0.174	0.176	1												
(4)*Low Z score*	0.038	0.237	0.308	1											
(5)*High KZ*	0.027	0.191	0.195	0.365	1										
(6)*Manufacturing dummy*	0.106	-0.073	0.003	-0.143	-0.138	1									
(7)*High sales growth*	-0.045	-0.032	-0.020	-0.069	-0.018	0.008	1								
(8)*ESG score*	0.052	0.056	-0.148	0.056	-0.014	0.094	-0.028	1							
(9)*Social score*	0.042	0.049	-0.156	0.050	-0.038	0.079	-0.039	0.866	1						
(10)*COVID-19*	0.002	0.044	-0.013	-0.002	-0.001	-0.024	-0.016	-0.034	-0.017	1					
(11)*Liquidity*	0.025	-0.059	-0.056	-0.295	-0.288	0.131	0.035	-0.098	-0.072	0.060	1				
(12)*Profitability*	-0.021	-0.092	-0.223	-0.255	-0.113	-0.002	0.113	0.121	0.132	-0.061	-0.053	1			
(13)*Leverage*	-0.013	0.101	0.134	0.233	0.145	-0.093	0.009	0.046	0.056	0.004	-0.163	-0.094	1		
(14)*Size*	0.296	0.169	-0.001	0.223	0.060	-0.054	-0.077	0.448	0.437	-0.022	-0.182	0.198	0.140	1	
(15)*Debt growth*	0.005	0.001	-0.016	0.020	-0.019	-0.008	-0.022	0.007	0.009	-0.034	-0.007	0.010	-0.015	0.002	1

Table A3: Impact of COVID-19 on trade credit for emerging markets

	(1)	(2)	(3)	(4)
High default × *COVID-19* × *Emerging economy dummy*	0.053	0.151	0.256	0.058
	(0.224)	(0.177)	(0.230)	(0.261)
High default × *COVID-19*	-0.291***	-0.255***	-0.341***	-0.325*
	(0.043)	(0.060)	(0.083)	(0.165)
High default × *Emerging economy dummy*	0.030	-0.035	-0.065	-0.169
	(0.084)	(0.128)	(0.212)	(0.197)
High default	-0.017	-0.075	-0.010	0.006
	(0.046)	(0.050)	(0.064)	(0.074)
Liquidity		-2.351***		2.508**
		(0.443)		(1.163)
Profitability		-4.782***		-2.228
		(0.841)		(5.281)
Leverage		-0.046**		0.019
		(0.017)		(0.021)
Size		1.259**		-0.180
		(0.428)		(0.337)
Constant	8.831***	-7.411	-3.659***	-1.797
	(0.021)	(5.699)	(0.050)	(4.325)
Observations	85,352	68,666	85,352	68,666
Firm fixed effects	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.931	0.943	0.895	0.905

Notes: The dependent variable in column (1)-(2) is payables scaled by total assets and column (3)-(4) is net payables scaled by total assets. *High default* refers to firms with above median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *Emerging economy dummy* is defined as 1 for the firms in emerging economies and 0 otherwise. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table A4: Placebo estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
High default × *Placebo*	0.118	0.157**	-0.088	-0.451***	-0.985***	0.587	0.747	-0.098	-0.462***	-1.059***
	(0.105)	(0.071)	(0.099)	(0.097)	(0.174)	(0.589)	(0.596)	(0.091)	(0.119)	(0.144)
High default × *Placebo* × *High sales growth*		-0.091					-0.160			
		(0.129)					(0.247)			
High default × *Placebo* × *Manufacturing dummy*			0.348*					1.161		
			(0.191)					(1.046)		
High default × *Placebo* × *ESG score*				0.015***					0.015**	
				(0.005)					(0.005)	
High default × *Placebo* × *Social score*					0.027***					0.028***
					(0.007)					(0.006)
Firm-level control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	101,962	100,689	101,962	13,758	13,758	101,628	100,414	101,628	13,710	13,710
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.926	0.929	0.927	0.978	0.978	0.806	0.817	0.806	0.975	0.975

Notes: The dependent variable in column (1)-(5) is payables scaled by total assets and column (6)-(10) is net payables scaled by total assets. *High default* is defined as 1 for firms with above median probability of default. *Placebo* refers to an artificially induced crisis period and is defined as 1 for the period April 2016-December 2016 and 0 otherwise. *High sales growth* is defined as 1 for the firms with above median sales growth and 0 otherwise. *Manufacturing dummy* is defined as 1 for firms in the manufacturing industry and 0 otherwise. *ESG score* refers to the overall score of a firm based on environmental, social and corporate governance scores. *Social score* refers to a firm's capacity to generate trust and loyalty with its workforce, customers and society. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.

Table A5: Robustness test results without firm-level controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
High default × *COVID-19*	-0.114***	-0.075	0.039*	-1.315***	-1.607***	-0.143***	-0.181***	0.051	-1.565***	-2.056***
	(0.026)	(0.045)	(0.022)	(0.207)	(0.163)	(0.022)	(0.023)	(0.061)	(0.290)	(0.220)
High default × *COVID-19* × *High sales growth*		0.126					0.268**			
		(0.128)					(0.106)			
High default × *COVID-19* × *Manufacturing dummy*			-0.302***					-0.381**		
			(0.042)					(0.144)		
High default × *COVID-19* × *ESG score*				0.016***					0.024***	
				(0.003)					(0.008)	
High default × *COVID-19* × *Social score*					0.022***					0.034***
					(0.002)					(0.005)
Firm-level control variables	No	No	No	No	No	No	No	No	No	No
Observations	63,432	54,772	63,432	13,042	13,042	63,432	54,772	63,432	13,042	13,042
Firm-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry-Year Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.952	0.956	0.952	0.972	0.972	0.923	0.929	0.923	0.955	0.955

Notes: The dependent variable in column (1)-(5) is payables scaled by total assets and column (6)-(10) is net payables scaled by total assets. *High default* refers to firms with above-median probability of default. *COVID-19* is defined as 1 for the period April 2020-December 2020 and 0 otherwise. *High sales growth* is defined as 1 for the firms with above median sales growth and 0 otherwise. *Manufacturing dummy* is defined as 1 for firms in the manufacturing industry and 0 otherwise. *ESG score* refers to the overall score of a firm based on environmental, social and corporate governance scores. *Social score* refers to a firm's capacity to generate trust and loyalty with its workforce, customers and society. Table 1 presents the description of all the variables. The robust standard errors are displayed in brackets which are clustered at the firm, year-quarter and country level. The significance level at 1%, 5% and 10% is denoted by ***,**,* respectively.