



# The evolution of trade credit: new evidence from developed versus developing countries

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## Abstract

Using a large sample of listed firms from 72 countries over the period 1990–2019, we document a marked decrease in trade credit that is more pronounced for firms in developed economies relative to those in emerging economies. We find little evidence that firm characteristics drive this trend, as their relation with trade credit remains relatively stable throughout the sample period. We test several competing propositions and find that the listing decade, institutional factors, and financial development explain the downward trajectory in trade credit. We also report diminishing returns to trade credit that are higher in the US and other developed economies than in emerging economies. These results are robust to alternative definitions of trade credit and to controlling for several firm-specific and macroeconomic factors.

**Keywords** Trade credit · Time series · Emerging economies · Firm age · Employment

**JEL classification** D22 · G15 · G32 · G39

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## 1 Introduction

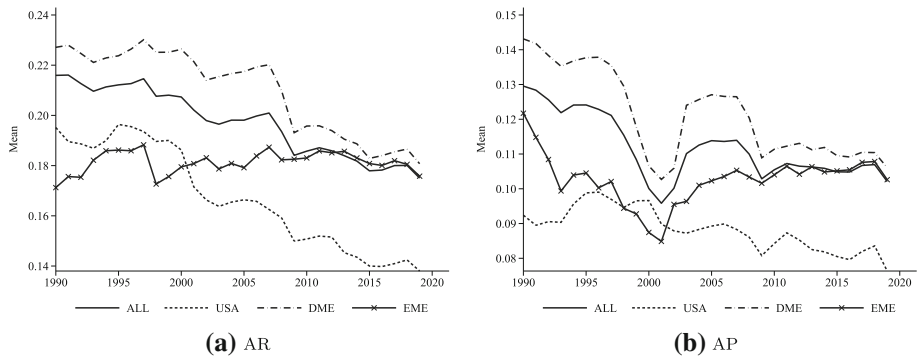
The central role of trade credit in providing an alternative form of finance for firms that face difficulties in accessing capital markets is well documented in the literature. In their study of small businesses in the US Petersen and Rajan (1997) report that trade credit, which accounts for 17% of current assets, is the single most important component of short-term financing. Hill et al. (2012) find that the average US firm invested USD360 million (or 18% of assets) in receivables over the period 1973–2006. Others report figures of similar magnitude.<sup>1</sup> The importance of trade credit as a financing source is even more pronounced in emerging economies where access to external finance is limited. For example, Kwenda and Holden (2014) report that trade credit in South Africa amounted to 32% of total assets from 2001 to 2010, and Ge and Qiu (2007) highlight that Chinese firms rely heavily on trade credit due to limited access to bank credit.

However, the use of trade credit has changed over time. The time series plot in Fig. 1 shows that average trade credit across the 72 countries in our sample has followed a clear downtrend from 1990 to 2019, and this is the case whether trade credit is measured by accounts payable or accounts receivable. The time trend also varies across countries. With an initial conjecture that experiences vary across developed and developing countries, the figure shows that the decline in the use of trade credit has been more pronounced for firms in developed market economies (DMEs) than for those in emerging market economies (EMEs) (as classified by the MSCI World Index). Further, this decline has been more pronounced for US firms than for other DMEs.

There are also discernible intermittent trends during shorter periods that have been mentioned in the literature. For example, accounts receivable of EMEs trended upwards during the decade that preceded the financial crisis (1998–2007), but this trend seems to have subsequently reversed and converged with the downtrend of the average trade credit across all countries. Average accounts payable initially trended downwards till 2001 for DMEs, EMEs and the average firm, but the pattern reversed during the run-up to the financial crisis and plateaued thereafter resulting in a mild overall upward trend. The US experience is different in that the general trend was downwards almost throughout the plotted period. The upward trend in average accounts payable around the financial crisis is consistent with Ferrando and Mulier (2013), who find that firms in emerging markets used accounts payable for financing after the financial crisis. The reversals in accounts payable around 2001 and 2007 are also consistent with the idea that firms in emerging markets adjust trade credit in response to monetary expansions and contractions (see Nilsen 2002; Biais and Gollier 1997). It is clear from Fig. 1, therefore, that the ratio of trade credit to total assets varies over time, its average has been declining over the past three decades, and that there is heterogeneity across countries with similarities within groups of countries in the time trend, particularly within DMEs and EMEs.

It is not immediately clear what drives this general downtrend given the central role of trade credit in corporate finance, especially for EMEs who face limited access to capital

<sup>1</sup> Rajan and Zingales (1995) report that in 1991 trade credit represented 17.8% of total assets in US firms, 22% in UK firms, and over 25% in firms of other countries. Further, Aktas et al. (2012) report that trade credit averaged between 10 and 15% of total assets in the US. Demirguc-Kunt and Maksimovic (2001) report that trade credit accounts for 25% of the total assets of firms in France, Germany, and Italy, and Wu et al. (2012) report 11% to 15% in China.



**Fig. 1** Time series plots of trade credit. This figure plots the mean trade credit (accounts receivable and payable, AR and AP) over time. The sample consists of listed non-utility and non-financial firms from the US (US), twenty two developed countries other than the US (DME) and forty nine emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The downward dip in AP just prior to 2001 is driven by Japan. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

markets.<sup>2</sup> The financial development proposition emphasises the central role of trade credit for less established firms. For example, McMillan and Woodruff (1999) and Fisman and Love (2003) highlight the importance of this form of financing for firms in emerging economies that have significant underdeveloped capital markets and institutional frameworks. With limited and costly alternatives, such as bank loans and lines of credit, due to institutional voids, trade credit becomes the default source of financing for many firms (McMillan and Woodruff 1999). Figure 1 points to a convergence of the trend of EMEs, who experienced significant growth in recent years, towards the trend of the average firm. This convergence by EMEs could be a reflection of change in their use of trade credit as a buffer that compensates for the decline in bank credit following the financial crisis, as discussed by Ferrando and Mulier (2013).<sup>3</sup> In line with the substitution hypothesis, financial development eases financial market imperfections, which enhances access to bank credit and enables firms to reduce their reliance on trade credit (Demirguc-Kunt and Maksimovic 2001; Fisman and Love 2003). One ought, therefore, to expect trade credit provision to decline with the growth in the financial sector.

Using multivariate regressions with several firm-specific and country-specific determinants of trade credit, we first confirm the statistical significance of the decrease in average trade credit, and show that this decline is significantly more pronounced in the US than in other developed and emerging market economies. We then investigate the trend by decade and find firms extend less trade credit in the 2000s and 2010s than in the 1990s, which confirms a consistent decrease on average in the reliance on trade credit, as depicted in Fig. 1, even after controlling for firm-specific and macroeconomic factors. A further analysis based on the decade of listing (vintage effect) shows that the decline in older firms (those listed before 2000) and the influx of new and younger firms drive the decrease in trade credit. We further examine the impact of institutional factors and financial development and

<sup>2</sup> Gwatidzo and Ojah (2014) find that less developed institutional frameworks in Africa limit corporate financing choices as firms have limited access to capital markets.

<sup>3</sup> Arena et al. (2015) document a boom in bank credit across 135 developing countries over the period 1960–2011. For example, Machokoto et al. (2020) document an 89% increase in corporate debt over the period 1991–2015 in South Africa.

**Table 1** Variable definitions

| Variable   | Source            | Definition  |
|--|-------------------|---|
| <i>Firm-specific variables</i>                             |                   |   |
| AR   | <i>DataStream</i> | Accounts receivable to total assets   |
| AP   | <i>DataStream</i> | Accounts payable to total assets  |
| NTC  | <i>DataStream</i> | Accounts receivable <i>less</i> accounts payable to total assets  |
| $\Delta$ AR  | <i>DataStream</i> | The change in accounts receivable to lagged total assets  |
| $\Delta$ AP  | <i>DataStream</i> | The change in accounts payable to lagged total assets   |
| $\Delta$ NTC   | <i>DataStream</i> | The change in net trade credit to lagged total assets   |
| Trend  |                   | Time trend variable   |
| L1990s   | <i>DataStream</i> | Dummy=1 for firms listed over the period 1990–1999, and zero otherwise  |
| L2000s   | <i>DataStream</i> | Dummy=1 for firms listed over the period 2000–2009, and zero otherwise  |
| L2010s   | <i>DataStream</i> | Dummy=1 for firms listed over the period 2010–2015, and zero otherwise  |
| Crisis   |                   | Dummy=1 for the period 2008–2009, and zero otherwise  |
| Post-Crisis  |                   | Dummy=1 for the period 2010–2012, and zero otherwise  |
| Cash   | <i>DataStream</i> | Cash and cash equivalents to total assets   |
| LTDA   | <i>DataStream</i> | Long-term debt to total assets  |
| STDA   | <i>DataStream</i> | Short-term debt to total assets   |
| SGrowth  | <i>DataStream</i> | Sales growth  |
| ROA  | <i>DataStream</i> | Operating income to total assets  |
| R&D  | <i>DataStream</i> | Research and development to total assets  |
| Capex  | <i>DataStream</i> | Capital expenditure to total assets   |
| Age  | <i>DataStream</i> | The difference between the year when a firm first appears in the database and the current year (Firm age)                             |
| LogAge   | <i>DataStream</i> | Logarithm of the firm age   |
| Tobin's $q$  | <i>DataStream</i> | Market value of equity plus total debt to total assets ( $Q$ )  |
| $\Delta$ Emp   | <i>DataStream</i> | The change in the number of employees   |
| Size   | <i>DataStream</i> | Logarithm of total assets   |
| PPE  | <i>DataStream</i> | Property, plant and equipment to total assets   |
| Industrial Median  | <i>DataStream</i> | The industrial median based on the ICB Industrial Classification  |
| <i>Macroeconomic control variables</i>                     |                   |   |
| Inflation  | <i>World Bank</i> | Inflation based on consumer prices (annual %)   |
| GDPGrowth  | <i>World Bank</i> | The growth in gross domestic product (GDP)  |
| <i>Institutional variables—national governance quality</i> |                   |   |
| VAE  | <i>WGI</i>        | Voice and accountability  |
| PVE  | <i>WGI</i>        | Political stability and absence of violence/terrorism   |
| GEE  | <i>WGI</i>        | Government effectiveness  |
| RQE  | <i>WGI</i>        | Regulatory quality  |
| RLE  | <i>WGI</i>        | Rule of law   |
| CCE  | <i>WGI</i>        | Control of corruption   |
| Governance Quality   | <i>WGI</i>        | Governance quality is the first principal component of the six measures of national governance quality (VAE, PVE, GEE, RQE, RLE, CCE) |

**Table 1** continued

| Variable  | Source | Definition  |
|---|--------|---|
| <i>Institutional variables—financial and economic development</i> |        |   |
| Financial development   | IMF    | Financial Development Index (FDI) is a comparative ranking of economies based on access, depth, and efficiency of the financial institutions and markets (see Svirydenka 2016)  |
| Financial institutions  | IMF    | Financial Institutions Index (FII) is a comparative ranking of economies based on the depth, efficiency and access of financial institutions (see Svirydenka 2016)  |
| Financial markets   | IMF    | Financial Markets Index (FMI) is a comparative ranking of economies based on the depth, efficiency and access of financial markets (see Svirydenka 2016)  |
| Financial Institutions—Depth                                      | IMF    | Financial institutions depth is proxied by a combination of private-sector credit to GDP, pension fund assets to GDP, mutual fund assets to GDP, and insurance premiums, life and non-life to GDP (see Svirydenka 2016)   |
| Financial Institutions—Access                                     | IMF    | Financial institutions access is proxied by a combination of bank branches per 100,000 adults and ATMs per 100,000 adults (see Svirydenka 2016)   |
| Financial Institutions—Efficiency                                 | IMF    | Financial institutions efficiency is proxied by a combination of net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets, return on equity (see Svirydenka 2016)  |
| Financial Markets—Depth   | IMF    | Financial markets depth is proxied by a combination of stock market capitalisation to GDP, stocks traded to GDP, international debt securities of government to GDP, total debt securities of financial corporations to GDP and total debt securities of non-financial corporations to GDP) (see Svirydenka 2016) |
| Financial Markets—Access  | IMF    | Financial markets access is proxied by a combination of the percent of market capitalisation outside of top 10 largest companies and total number of issuers of debt (domestic and external, non-financial and financial corporations) (see Svirydenka 2016)  |
| Financial Markets—Efficiency                                      | IMF    | Financial markets efficiency is proxied by stock market turnover ratio (stocks traded to capitalisation) (see Svirydenka 2016)  |
| MSCI classification   | MSCI   | The country classification based on the Morgan Stanley Capital International Market Framework   |
| DME   | MSCI   | Dummy=1 for developed countries, and zero otherwise   |
| EME   | MSCI   | Dummy=1 for developing countries, and zero otherwise  |

This table lists the variables used and their definitions. Firm specific variables are from *DataStream* and macroeconomic variables are from the World Bank Database

report results that the decline in trade credit is more pronounced in countries with developed governance structure, financial institutions and markets. Finally, we show and investigate the considerable heterogeneity in the use of trade credit across industries and economies, and present evidence consistent with the changing industrial dynamics due to the diminishing dominance of the basic and manufacturing sectors. New and emerging industries, namely the services, technology and telecommunication sectors, progressively offer less trade credit.

Following these investigations into the determinants of the trend in trade credit, we examine the implications on corporate outcomes. Several studies show that trade credit enables firms to gain new customers and establish long-term relationships necessary to

boost sales and profits (Martínez-Sola et al. 2013; Box et al. 2018). Hill et al. (2012) also assert that firms can derive strategic benefits from trade credit because investors recognise it as a tool that drives sales growth. Our findings here indicate that increases in trade credit are associated with improvements in firm value, sales growth and employment, as well as with increases in capital expenditure. Further, we report diminishing returns to trade credit that is consistent with Hill et al. (2015), but find higher diminishing returns in the US relative to the other DMEs and EMEs. Thus, trade credit continues to be an important form of short-term finance, especially for EMEs who have limited access to external finance. These results support the arguments of Fisman and Love (2003), and suggest that the benefits of trade credit are greater for firms in countries with less developed capital markets. For these firms, trade credit is a permanent rather than a transitory or bridging form of finance and, consequently, they exhibit a less-pronounced average decrease in returns to trade credit.

Our study contributes to the trade credit literature in three ways. First, we show that trade credit plays an important role in the corporate finance function that is especially critical in emerging economies where firms rely more on short-term financing in light of limited access to external funding. The rationale for this contribution is motivated by the literature that shows that trade credit is used to alleviate imperfections in both financial and product markets (Ferrando and Mulier 2013), and as a tool for price discrimination across customers (Meltzer 1960; Petersen and Rajan 1997). Second, there is a secular decrease in trade credit around the world that tracks the bank credit booms across both developed and developing economies (Arena et al. 2015; Meng and Gonzalez 2017). We contribute to this strand of the literature by showing that country-level institutional and financial development are important influences on corporate trade credit policy. We find that changes in industrial dynamics, especially the declining influence of the traditional basic and manufacturing sectors, explain the trade credit trend. Third, we show that increases in trade credit are associated with increases in firm value, sales growth, investment, and employment, even though returns to trade credit are diminishing over time. Finally, we highlight the need to improve the currently limited access to alternative forms of financing for firms operating in emerging markets, as these are known to contribute significantly to growth and employment in these economies.

The remainder of this paper is organised as follows: Sect. 2 reviews the literature and formulates the hypotheses, Sect. 3 describes the data and the empirical methodology used, Sect. 4 presents the results and a discussion of their implications, Sect. 5 presents robustness analyses, and Sect. 6 concludes.

## 2 Literature review and hypotheses development

### 2.1 Trade credit policy

As a contract between a customer and a supplier to purchase goods and services with deferred payment, trade credit remains to be the most important source of short-term financing for US firms (Petersen and Rajan 1997; Barrot 2016). It also accounts for a sizeable proportion of global trade.<sup>4</sup> During the Global Financial Crisis (GFC) of 2007, constrained firms, especially SMEs, relied on trade credit as a source of financing (Garcia-Appendini and Montoriol-Garriga 2013) due to contractions in bank credit (Casey and O'Toole 2014; Carbo-Valverde et al. 2016). Trade credit continued to serve as a

<sup>4</sup> For example, Klapper et al. (2012) report that trade credit constitutes an amount of USD25 trillion of global trade.

stable source of finance for firms in the Euro area, and declined only after the bank credit boom in 2005 (Ferrando and Mulier 2013). Even though the GFC restricted access to both bank finance and trade credit (Kling et al. 2014), the latter increased comparatively to act as a buffer that compensates for the strong decline in short-term bank loans (Ferrando and Mulier 2013). Firms in emerging markets, such as South Africa (Fatoki and Smit 2010; Kwenda and Holden 2014), Ethiopia (Beck et al. 2019), Nigeria (Ojenike and Olowoniyi 2012, 2014), China (Ge and Qiu 2007), and those in Eastern Europe and Central Asia (Horen 2007), also rely on trade credit as a major source of external financing.

The rationale for trade credit financing has been widely argued in the empirical literature. First, suppliers are better equipped than financial institutions in acquiring detailed customer information, evaluating the creditworthiness of buyers (Biais and Gollier 1997), enforcing credit contracts, and mitigating opportunistic behaviour of buyers (Burkart and Ellingsen 2004; Fabbri and Menichini 2010; Chod et al. 2019). Trade credit also provides liquidity insurance to constrained customers (Ng et al. 1999; Wilner 2000; Cuñat 2007), represents an implicit guarantee of product quality (Long et al. 1993; Petersen and Rajan 1997), enhances favourable price discrimination for risky customers without the direct use of prices (Brennan et al. 1988), and improves the sharing of demand risk (Kouvelis and Zhao 2012; Yang and Birge 2017). The country in which a firm operates affects its use of trade credit in achieving these objectives. Trade credit is more important than bank credit in economies where there is imperfect legal protection of creditors and during times when firms are undercapitalised due to limited wealth (Burkart and Ellingsen 2004). Demircuc-Kunt and Maksimovic (2001) also emphasise that trade credit is relatively more prevalent in countries with worse legal institutions and less developed credit markets.

## 2.2 The trend in trade credit

Despite the enormous importance of trade credit as a source of financing, firms rely less on it when their access to bank credit improves. Since trade credit and bank credit are substitutes (Biais and Gollier 1997; Burkart and Ellingsen 2004; Bougheas et al. 2009), the evolution of trade credit should coincide with improved access to bank credit. There is evidence that trade credit can substitute for bank credit to mitigate liquidity shocks. This effect manifests itself more clearly during periods of financial distress that are characterised by tight bank lending conditions (Love et al. 2007). Firms that face constraints in borrowing from the banking sector use more trade credit as a financing source for their operations. Thus, credit-constrained firms increase their demand for trade credit when credit rationing intensifies (Biais and Gollier 1997; Burkart and Ellingsen 2004), and when suppliers provide liquidity to the customers who experience a temporary liquidity shock (Wilner 2000; Cuñat 2007).

The reliance on trade credit and bank credit differs across firms in developed and emerging countries due to disparities in financial and product market imperfections between these countries. EMEs that are more vulnerable to financial market imperfections rely more on the trade credit channel to manage growth and contractions in bank credit than DMEs (Ferrando and Mulier 2013). The reliance on trade credit by EMEs is more pronounced given the limited access to external financing (McMillan and Woodruff 1999). For instance, Beck et al. (2019) argue that informal firms in Ethiopia use trade credit financing to build a credit history to increase bank credit financing. This is similar in South Africa, where information relating to prior trade credit agreements alleviates information asymmetry and reduces agency problems between firms and banks (Madula 2017). Thus, a good history of trade credit transactions acts as a signal of creditworthiness that enhances firm access to

formal or bank credit. Ge and Qiu (2007) and Cull et al. (2009) also argue that trade credit is important in China because firms receive limited support from the banking system.

Accordingly, we predict that the growth of the financial sector, which is a substitute to informal lending through trade credit, might account for the downtrend in average trade credit shown in Fig. 1. As financial market deepening is concentrated in high-income countries (Beck et al. 2010), DMEs and the US should experience a greater decline in trade credit than EMEs. We, therefore, test the following hypothesis over a longer sample period and more countries than in the above literature:

**Hypothesis 1** There is a downward trend in trade credit over the years that is more pronounced in DMEs than in EMEs.

### 2.3 Stock market listing and trade credit

There is limited literature on whether stock market listing enables firms to rely more or less on trade credit. Firms that have gone public earlier than others, i.e., older listed firms, have built a reputation for stronger bargaining power with banks (Saunders and Steffen 2011), and have greater access to cheaper and less risky external sources of capital (Faulkender and Petersen 2006; Lins et al. 2010; Abdulla et al. 2017). Two hypotheses have been forwarded to explain how stock listing could affect trade credit. First, the ‘reputation hypothesis’ of Diamond (1989) purports that earlier listed firms have built a successful track record of debt repayment, enabling banks to lower their borrowing costs and increase bank lending (Sakai et al. 2010). Second, the ‘relationship banking’ hypothesis argues that lender-borrower relationships improve with firm age, and this enhances the efficiency of credit provision (Boot and Thakor 1994; Petersen and Rajan 1995). Consequently, it is logical to expect firms in developed economies, who are more likely to have been listed earlier, to rely less on trade credit. Accordingly, we conjecture that a firm’s year of stock market listing explains the downward trend in trade credit.

**Hypothesis 2** Firm listing age is associated with a decline in trade credit, and this is more pronounced in DMEs than in EMEs.

### 2.4 Institutional development and trade credit

The finance and law literature investigates how a country’s financial system interacts with its institutional environment (La Porta et al. 1997; Porta et al. 1998; Levine 1998). These studies argue that there are two main factors that determine bank loan risk, namely borrower creditworthiness and the quality of a country’s legal system and institutional environment. Therefore, bank loan contracting depends on the protection of creditor rights, which is linked to the development of a country’s institutional environment. Maksimovic (2001) argues that firms in countries with efficient legal systems tend to use more bank credit than trade credit. Further, there is empirical evidence that links financial development to economic growth, and it emphasises the effective role that financial markets play in allocating capital to firms. The development of financial institutions and financial markets enhances depth, efficiency, and access to both bank credit and external financing through capital markets. Rajan and Zingales (1998) argue that industrial sectors with a greater need for



external finance develop disproportionately faster in countries that have more developed financial markets. This literature suggests that without a well-developed financial market and access to external finance firms can achieve growth by either relying on internally generated funds or borrowing from suppliers through trade credit (Petersen and Rajan 1997). Fisman and Love (2003) find that firms in countries with poorly developed financial markets and weaker financial institutions achieve growth through implicit borrowing by the use of trade credit as an alternative source of funds. Accordingly, we argue that the downtrend in trade credit is more pronounced in countries with developed financial institutions and markets.

**Hypothesis 3** There is a more pronounced downward trend in trade credit in countries with significant institutional development.

## 2.5 Implications of trade credit

Finally, there is a large body of literature that examines the impact of trade credit on corporate outcomes. For example, Martínez-Sola et al. (2013) and Box et al. (2018) report that firms use trade credit to boost sales and profitability because it enables them to attract new customers and build new long-term relationships. However, an aggressive use of trade credit tends to increase marginal costs as a result of bottlenecks in debt collection, increases in default rates, and declines in firm liquidity. The consequence is diminishing returns to extensions of trade credit beyond an optimal level (see Martínez-Sola et al. 2013; Hill et al. 2015). This evidence suggests that trade credit increases firm value at low levels and decreases it at high levels. According to Fisman and Love (2003), firms in industries with a higher degree of dependence on trade credit exhibit greater performance, especially in countries that have less-developed financial markets or weaker financial institutions. Accordingly, we expect trade credit to increase shareholder value more for EMEs than for firms in the US or other DMEs, and that diminishing returns to trade credit are higher for DMEs. We also investigate similar implications of trade credit provision on firm investment and employment.

**Hypothesis 4** There is diminishing returns to trade credit that is more pronounced in DMEs than in EMEs.

## 3 Methodology and data

We investigate the evolution of trade credit by estimating several versions of the following baseline model:

$$TC_{it} = \alpha + \gamma Trend + \beta X_{it-1} + \epsilon_{it}, \quad (1)$$

where  $TC_{it}$  is trade credit (accounts receivable or payable) of firm  $i$  at time  $t$ ;  $Trend$  is a time trend;  $X_{it-1}$  is a vector of firm-specific, stock market, and macroeconomic variables (defined below);  $\alpha$ ,  $\gamma$  and  $\beta$  are parameters and vector of coefficients to be estimated; and  $\epsilon_{it}$  is an

error term. The vector of determinants of trade credit,  $\mathbf{X}_{it-1}$ , is informed by prior studies and, for the baseline model, consists of the following firm-specific variables: one-period lagged cash (*Cash*), long-term debt (*LTDA*), short-term debt (*STDA*), sales growth (*SGrowth*), return on assets (*ROA*), research and development (*R&D*), capital expenditure (*Capex*), and firm age (*LogAge*), and the following proxies for changes in capital markets and income distribution: inflation (*Inflation*) and GDP growth (*GDPgrowth*).<sup>5</sup>

To examine the implications of the change in trade credit on firm value, sales growth, investment, and employment, we estimate the following model:

$$y_{ijt} = \lambda_0 + \lambda_1 \Delta TC_{ijt} + \lambda_2 TC_{ijt-1} + \lambda_3 \Delta TC_{ijt} \cdot TC_{ijt-1} + \boldsymbol{\theta} \mathbf{Z}_{ijt-1} + \mu_j + \mu_t + \xi_{ijt}, \quad (2)$$

where  $y_{ijt}$  is firm value (*Tobin's q*), sales growth (*SGrowth*), investment (*Capex*), or employment (*LogEmp*) of firm  $i$  in industry  $j$  at time  $t$ ;  $\lambda_0$  is a constant;  $\lambda_1$ ,  $\lambda_2$ ,  $\lambda_3$ , and  $\boldsymbol{\theta}$  are parameters and vector of coefficients to be estimated;  $\Delta TC_{ijt}$  is the change in trade credit;  $TC_{ijt-1}$  is the lagged trade credit;  $\Delta TC_{ikt} \cdot TC_{ikt-1}$  is the interaction term between the change in trade credit and lagged trade credit;  $\mathbf{Z}_{ijt-1}$  is a vector of lagged cash (*Cash*), firm size (*Size*), property, plant and equipment (*PPE*), long-term debt (*LTDA*), short-term debt (*STDA*), return on assets (*ROA*), industrial median (*INDMedian*) where the median partials out the trend in the dependent variable, inflation (*Inflation*), and GDP growth (*GDPgrowth*);  $\mu_j$  and  $\mu_t$  are industry and year fixed effects, respectively; and  $\xi_{ijt}$  is an error term. We estimate Eq. (2) using fixed effects and report heteroskedasticity consistent standard errors. All the variables used are defined in Table 1.

We use *Thomson Reuters Datastream* to download data over the period 1990–2019 for publicly listed firms in the US (USA), developed economies other than the US (DMEs), and emerging economies (EMEs), according to the classification of the Morgan Stanley Capital International (MSCI) index. We initially consider the entire universe of firms and countries available in *Datastream* and separate the US from other DMEs for clearer comparison with the literature that focuses on the US. Following the literature, we apply five filters to this initial sample. We exclude firms in the financial and utility sectors (regulated sectors), those with missing data on key variables (see Love et al., 2007; Wu et al. 2012; Lin and Chou 2015), those with abnormal growth (100% or more of assets or sales), those with less than five consecutive firm-year observations, and countries with less than fifty observations (see Francis et al. 2016; Machokoto et al. 2021). This filtering leaves a final sample of 72 countries (41,767 firms and 528,954 firm-year observations), of which 23 are developed economies (USA and DMEs, with 26,590 firms and 351,842 firm-year observations) and 49 are emerging economies (EMEs, with 15,177 firms and 177,112 firm year observations). To further mitigate the influence of outliers we winsorise all variables at their lower and upper percentiles. Appendix 1 contains a breakdown of the filtering procedure and Appendix 2 presents a breakdown of the final sample by country.<sup>6</sup>

Table 2 presents summary statistics for all the variables used. For the full sample (Columns (1)–(3)), the average accounts receivable (*AR*), accounts payable (*AP*), and net trade credit (*NTC*) is 19.3%, 10.9%, and 8.3% of total assets, respectively. These numbers indicate the large ‘size’ of trade credit relative to total assets for the average firm. Further,

<sup>5</sup> Our choice of control variables is informed by previous work on US firms, such as Aktas et al. (2012), Hill et al. (2012), and Wu et al. (2012).

<sup>6</sup> Although the sample is not statistically balanced between EMEs and DMEs, it nonetheless represents the demographic distribution of the global population of firms on which data is available in *Datastream*.

**Table 2** Descriptive statistics

| Variables | 1990–2019   |              |              | 1990s (A)   |              |              | 2000s (B)   |              |              | 2010s (C)    |               |               |
|-----------|-------------|--------------|--------------|-------------|--------------|--------------|-------------|--------------|--------------|--------------|---------------|---------------|
|           | Mean<br>(1) | Stdev<br>(2) | Trend<br>(3) | Mean<br>(4) | Stdev<br>(5) | Trend<br>(6) | Mean<br>(7) | Stdev<br>(8) | Trend<br>(9) | Mean<br>(10) | Stdev<br>(11) | Trend<br>(12) |
| AR        | 0.193       | 0.132        | - 0.153***   | 0.212       | 0.130        | - 0.066***   | 0.197       | 0.134        | - 0.151***   | 0.182        | 0.131         | - 0.120***    |
| AP        | 0.109       | 0.097        | - 0.061***   | 0.121       | 0.097        | - 0.195***   | 0.108       | 0.097        | 0.105***     | 0.106        | 0.096         | - 0.021***    |
| ΔAR       | 0.013       | 0.061        | - 0.027***   | 0.018       | 0.061        | 0.016**      | 0.012       | 0.066        | - 0.038***   | 0.013        | 0.057         | - 0.098***    |
| ΔAP       | 0.009       | 0.047        | - 0.023***   | 0.011       | 0.048        | - 0.124***   | 0.008       | 0.051        | - 0.051***   | 0.008        | 0.042         | - 0.073***    |
| NTC       | 0.083       | 0.120        | - 0.091***   | 0.090       | 0.118        | 0.130***     | 0.089       | 0.122        | - 0.256***   | 0.076        | 0.118         | - 0.100***    |
| Cash      | 0.147       | 0.141        | 0.137***     | 0.128       | 0.122        | - 0.100***   | 0.144       | 0.144        | 0.252***     | 0.157        | 0.145         | - 0.066***    |
| LTDA      | 0.133       | 0.148        | - 0.092***   | 0.147       | 0.141        | - 0.078***   | 0.132       | 0.152        | - 0.327***   | 0.127        | 0.148         | 0.124***      |
| STDA      | 0.100       | 0.127        | - 0.015***   | 0.099       | 0.112        | 0.192***     | 0.103       | 0.144        | - 0.175***   | 0.098        | 0.117         | 0.015*        |
| SGrowth   | 0.072       | 0.183        | - 0.097***   | 0.080       | 0.166        | - 0.032*     | 0.086       | 0.189        | 0.536***     | 0.057        | 0.183         | 0.189***      |
| ROA       | 0.059       | 0.099        | - 0.070***   | 0.072       | 0.080        | - 0.146***   | 0.058       | 0.106        | 0.178***     | 0.054        | 0.099         | - 0.071***    |
| R&D       | 0.013       | 0.037        | - 0.001*     | 0.013       | 0.032        | 0.022***     | 0.014       | 0.040        | 0.001        | 0.013        | 0.036         | - 0.001       |
| Capex     | 0.051       | 0.054        | - 0.076***   | 0.061       | 0.065        | - 0.033***   | 0.053       | 0.054        | 0.059***     | 0.045        | 0.047         | - 0.095***    |
| LogAge    | 2.351       | 0.737        | 4.184***     | 1.918       | 0.761        | 3.054***     | 2.187       | 0.734        | 4.259***     | 2.665        | 0.578         | 5.944***      |
| Inflation | 0.029       | 0.142        | - 0.069***   | 0.041       | 0.318        | - 0.227***   | 0.028       | 0.046        | 0.239***     | 0.024        | 0.035         | - 0.039***    |
| GDPGrowth | 0.031       | 0.030        | 0.006***     | 0.027       | 0.028        | - 0.012***   | 0.035       | 0.028        | 0.057***     | 0.028        | 0.032         | 0.169***      |
| N         | 528,954     |              |              | 98,057      |              |              | 194,493     |              |              | 236,404      |               |               |
| Firms     | 41,767      |              |              | 15,890      |              |              | 17,764      |              |              | 8113         |               |               |

This table presents summary statistics for all the variables used over the full sample period (1990–2019) and decades (1990s, 2000s, and 2010s). The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datstream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively

the average values of  $AR$  for the 1990s, 2000s, and 2010s are 21.2%, 19.7%, and 18.2%, respectively, and of  $AP$  are 12.1%, 10.8%, and 10.6%, respectively. Thus, there is a general decline over these decades in both the average supply of ( $AR$ ) and average demand for ( $AP$ ) trade credit.

We next quantify and test the significance of trade credit changes by regressing the annual average trade credit on the time trend variable (*Trend*). Column (3) of Table 2 shows that the average trend for  $AR$ ,  $AP$ ,  $\Delta AR$ , and  $\Delta AP$  is negative and significant over the whole sample period. This confirms a general marked secular decrease in the average level and rate of change in both the supply and demand of trade credit across countries over the period 1990–2019. Columns (6), (9) and (12) present these numbers for the 1990, 2000, and 2010 decades separately. Importantly, the *rate* of decline in  $AR$  has increased over these decades, and in  $AP$  it has decreased considerably from the 1990s to the 2000s and increased slightly from the 2000s to the 2010s. The descriptive statistics for the other variables are as expected, and are in line with prior work.

Table 3 reports the correlations between the variables used. Trade credit is positively correlated with short-term debt (STDA) and sales growth (SGrowth), and negatively correlated with cash (Cash), long-term debt (LTDA), profitability (ROA), and capital expenditure (Capex). The signs of these correlations are as expected, and are consistent with the literature (see Petersen and Rajan 1995; Barrot 2016; Klapper et al. 2012). Combined with the trends in the determinants of trade credit in Table 2, the correlations on their own, however, do not clarify whether trade credit should be trending upwards or downwards. This will be confirmed in the regressions that include industry and country fixed effects as well as control variables. These are presented next.<sup>7</sup>

## 4 Results and analyses

### 4.1 The dynamics of trade credit

Table 4 summarises the estimation results of Eq. (1) that relates trade credit to the time trend after controlling for firm-specific and macroeconomic determinants. We estimate our models for  $AR$  and  $AP$  using OLS, Tobit and industry and country fixed effects (FE). To also account specifically for cross-country differences in the levels of economic or financial development, we control for country-level macro-economic factors by including inflation (*Inflation*) and GDP growth (*GDPGrowth*). The tabulated results show that  $AR$  (Column (1)) is significantly and negatively affected by *Cash*, *LTDA*, *Capex*, and *LogAge*; and is positively affected by *STDA*, *SGrowth*, *ROA*, and *R&D*. We also find that  $AP$  (Column (7)) is negatively affected by *Cash*, *LTDA*, *ROA*, *R & D*, and *Capex*; and is positively affected by *STDA*, *SGrowth*, and *LogAge*. In general, these results over our longer sample period and across more countries are consistent with prior studies (e.g., Wu et al. 2012; Dass et al. 2014; Lin and Chou 2015). The trend remains negative and significant in all estimations with control variables.

We further examine trade credit behaviour of firms in the 1990s relative to those in the 2000s and the 2010s using the dummy variables  $D2000s$  and  $D2010s$ . Column (2) for  $AR$  and Column (8) for  $AP$  in Table 4 indicate that both the trade credit supply ( $AR$ ) and demand ( $AP$ ) of the average firm are lower in the 2000s and 2010s relative to the 1990s. The test of the difference in the coefficients ( $D2000s$  vs  $D2010s$ ) is statistically significant, confirming

<sup>7</sup> Since our focus is on the analysis of the trend, we follow Custódio et al. (2013) in excluding firm fixed effects from most of our analyses, but for robustness we also report results that include them.

**Table 3** Correlations

| #    | Variables | (1)        | (2)        | (3)        | (4)        | (5)        | (6)        | (7)        | (8)        | (9)        |
|------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| (1)  | AR        | 1          |            |            |            |            |            |            |            |            |
| (2)  | AP        | 0.474***   | 1          |            |            |            |            |            |            |            |
| (3)  | ΔAR       | 0.292***   | 0.093***   | 1          |            |            |            |            |            |            |
| (4)  | ΔAP       | 0.098***   | 0.313***   | 0.387***   | 1          |            |            |            |            |            |
| (5)  | NTC       | 0.709***   | - 0.277*** | 0.244***   | - 0.143*** | 1          |            |            |            |            |
| (6)  | Cash      | - 0.058*** | - 0.089*** | 0.059***   | 0.007***   | 0.009***   | 1          |            |            |            |
| (7)  | LITDA     | - 0.238*** | - 0.137*** | - 0.057*** | - 0.029*** | - 0.152*** | - 0.288*** | 1          |            |            |
| (8)  | STDA      | 0.098***   | 0.072***   | - 0.031*** | - 0.002*** | 0.050***   | - 0.223*** | - 0.018*** | 1          |            |
| (9)  | SGrowth   | 0.009***   | 0.002*     | 0.098***   | 0.053***   | 0.009***   | 0.001      | - 0.004*** | - 0.030*** | 1          |
| (10) | ROA       | - 0.005*** | - 0.087*** | 0.095***   | 0.052***   | 0.066***   | 0.016***   | - 0.037*** | - 0.164*** | 0.237***   |
| (11) | R&D       | 0.049***   | - 0.053*** | 0.005***   | - 0.021*** | 0.097***   | 0.261***   | - 0.084*** | - 0.106*** | - 0.006*** |
| (12) | Capex     | - 0.199*** | - 0.095*** | 0.029***   | 0.031***   | - 0.141*** | - 0.140*** | 0.127***   | - 0.049*** | 0.128***   |
| (13) | LogAge    | - 0.075*** | 0.001      | - 0.087*** | - 0.067*** | - 0.084*** | - 0.064*** | 0.079***   | - 0.083*** | - 0.073*** |
| (14) | Inflation | - 0.015*** | - 0.009*** | 0.029***   | 0.024***   | - 0.010*** | - 0.029*** | 0.002      | 0.020***   | 0.048***   |
| (15) | GDPGrowth | - 0.046*** | - 0.038*** | 0.081***   | 0.056***   | - 0.020*** | - 0.002    | - 0.088*** | 0.091***   | 0.176***   |

| #    | Variables | (10)       | (11)       | (12)       | (13)       | (14)     | (15) |
|------|-----------|------------|------------|------------|------------|----------|------|
| (10) | ROA       | 1          |            |            |            |          |      |
| (11) | R & D     | - 0.176*** | 1          |            |            |          |      |
| (12) | Capex     | 0.130***   | - 0.050*** | 1          |            |          |      |
| (13) | LogAge    | 0.006***   | 0.040***   | - 0.109*** | 1          |          |      |
| (14) | Inflation | 0.030***   | - 0.029*** | 0.037***   | - 0.063*** | 1        |      |
| (15) | GDPGrowth | 0.049***   | - 0.086*** | 0.096***   | - 0.184*** | 0.059*** | 1    |

This table presents the Pearson pairwise correlations between the main variables used in the baseline model. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), 23 developed countries excluding the US (DME) and 49 emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively

the fact that the average firm has progressively relied less on trade credit since the 2000s. More importantly, and as a test of the first part of Hypothesis 1 about the downward trend in trade credit, we observe the coefficient on the *Trend* variable for *AR* in Columns (3)–(6) and for *AP* in Columns (9)–(12) is negative and significant. These results are robust to the choice of estimation method, whether OLS (Columns (3), (4), (9) and (10)), Tobit (Columns (5) and (11)), or FE (Columns (6) and (12)). This confirms that both the demand and supply of trade credit exhibit a statistically significant downward trend that is robust to control variables and estimation methods. The second part of Hypothesis 1 about the heterogeneity across DMEs and EMEs will be discussed in Sect. 5.2.

## 4.2 Vintage effects on the evolution of trade credit

Next, we test whether the decline in trade credit is linked to the listing age of firms (Hypothesis 2). Table 5 presents FE estimation results of a version of Eq. (1) augmented with listing or vintage dummies that equal one for listings in the 2000s and 2010s, respectively, and zero otherwise. We also include interaction terms, *Trend* · *L2000s* and *Trend* · *L2010s*, between the *Trend* and these dummies. The results are analysed relative to the 1990 listing decade and, hence, the 1990s dummy, *L1990s*, and its interaction with the trend, are omitted to avoid the multicollinearity trap.

Compared to firms that listed in the 1990s, we find those that listed in the 2000s and 2010s report lower supply of, and demand for, trade credit (Column (1) for *AR* and Column (6) for *AP*). For firms that listed in 1990s, the analysis shows a significant downtrend for both *AR* and *AP* (Columns (2) and (7)). For firms that listed in the 2000s and the 2010s, there are positive and significant trends in *AR* and *AP* (Columns (3), (4), (8), and (9)). These are confirmed with the positive and significant coefficients on the interaction terms *Trend* · *L2000s* and *Trend* · *L2010s* for *AR* in Column (5) and for *AP* in Column (10), which indicate that the negative trend in the 1990s decreased and turned positive for listed firms in the 2000s and 2010s. These results show that firms that listed later than others tended to rely more on trade credit. This evidence is consistent with the argument that earlier listing is associated with better credit profile and reputation that support long-lasting credit relationships, stronger bargaining power with banks, and greater access to cheaper credit (Faulkender and Petersen 2006; Abdulla et al. 2017).

On average, we observe a general decrease in trade credit that is more pronounced in firms that listed in the 1990s. This finding supports the hypothesis that early public listing is negatively related to trade credit. Studies such as Long et al. (1993) and Petersen and Rajan (1997) show that larger and older firms have a better reputation that compensates for the need to use trade credit as a guarantee of product quality. Our result here shows that this is also associated with, or reflected in, a decline in the use of trade credit. Consequently, these firms are less inclined to use trade credit as a competitive tool to win or maintain customers (Martínez-Sola et al. 2013; Box et al. 2018). As new firms enter the market, or start trading publicly, they offer trade credit to compete and build product awareness given the relative lack of reputation or established brands.<sup>8</sup> Thus, early public listing contributes in explaining the downward trend in trade credit, which is the first part of Hypothesis 2. The second part of Hypothesis 2 about the difference in this between DMEs and EMEs is discussed in Sect. 5.2.

<sup>8</sup> There has been a marked decline in new listings as reported by Gao et al. (2013) and Kahle and Stulz (2017), which explains the decreased reliance on trade credit given that the average listed firm is increasingly becoming larger and older.

Table 4 The trend in trade credit

| Variables | AR                   |                      |                      |                       |                      |                      |                      |                      |                      |                      |                      |                      |
|-----------|----------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|           | AR                   |                      |                      | AP                    |                      |                      | AP                   |                      |                      | AP                   |                      |                      |
|           | OLS                  | Tobit                | FE                   | OLS                   | Tobit                | FE                   | OLS                  | Tobit                | FE                   | OLS                  | Tobit                | FE                   |
| (1)       | (2)                  | (3)                  | (4)                  | (5)                   | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 | (12)                 |                      |
| Trend     |                      |                      | -0.132***<br>(0.002) | -0.0688***<br>(0.003) | -0.069***<br>(0.003) | -0.109***<br>(0.007) |                      |                      |                      |                      |                      |                      |
| D2000s    |                      | -0.011***<br>(0.000) |                      |                       |                      |                      | -0.012***<br>(0.000) |                      | -0.082***<br>(0.002) | -0.045***<br>(0.002) | -0.045***<br>(0.002) | -0.058***<br>(0.006) |
| D2010s    |                      | -0.014***<br>(0.001) |                      |                       |                      |                      | -0.012***<br>(0.000) |                      |                      |                      |                      |                      |
| Cash      | -0.169***<br>(0.002) | -0.169***<br>(0.002) | -0.169***<br>(0.002) | -0.169***<br>(0.002)  | -0.170***<br>(0.002) | -0.106***<br>(0.002) | -0.093***<br>(0.001) | -0.092***<br>(0.001) | -0.086***<br>(0.001) | -0.092***<br>(0.001) | -0.093***<br>(0.001) | -0.031***<br>(0.002) |
| LTDA      | -0.214***<br>(0.001) | -0.214***<br>(0.001) | -0.219***<br>(0.001) | -0.214***<br>(0.001)  | -0.214***<br>(0.001) | -0.048***<br>(0.002) | -0.107***<br>(0.001) | -0.107***<br>(0.001) | -0.113***<br>(0.001) | -0.107***<br>(0.001) | -0.107***<br>(0.001) | -0.033***<br>(0.002) |
| STDA      | 0.072***<br>(0.006)  | 0.072***<br>(0.006)  | 0.074***<br>(0.005)  | 0.072***<br>(0.006)   | 0.072***<br>(0.006)  | 0.004**<br>(0.002)   | 0.015***<br>(0.002)  | 0.014***<br>(0.002)  | 0.016***<br>(0.002)  | 0.014***<br>(0.002)  | 0.014***<br>(0.002)  | -0.012***<br>(0.003) |
| SGrowth   | 0.023***<br>(0.001)  | 0.022***<br>(0.001)  | 0.022***<br>(0.001)  | 0.022***<br>(0.001)   | 0.022***<br>(0.001)  | 0.012***<br>(0.001)  | 0.026***<br>(0.001)  | 0.025***<br>(0.001)  | 0.025***<br>(0.001)  | 0.025***<br>(0.001)  | 0.025***<br>(0.001)  | 0.013***<br>(0.000)  |
| ROA       | 0.043***<br>(0.002)  | 0.043***<br>(0.002)  | 0.041***<br>(0.002)  | 0.043***<br>(0.002)   | 0.045***<br>(0.002)  | 0.046***<br>(0.003)  | -0.104***<br>(0.002) | -0.103***<br>(0.002) | -0.100***<br>(0.002) | -0.102***<br>(0.002) | -0.102***<br>(0.002) | -0.042***<br>(0.002) |
| R&D       | 0.077***<br>(0.005)  | 0.077***<br>(0.005)  | 0.071***<br>(0.005)  | 0.077***<br>(0.005)   | 0.078***<br>(0.005)  | 0.179***<br>(0.012)  | -0.101***<br>(0.004) | -0.100***<br>(0.004) | -0.140***<br>(0.004) | -0.101***<br>(0.004) | -0.097***<br>(0.004) | 0.097***<br>(0.009)  |
| Capex     | -0.422***<br>(0.014) | -0.423***<br>(0.014) | -0.459***<br>(0.015) | -0.422***<br>(0.014)  | -0.423***<br>(0.014) | -0.090***<br>(0.007) | -0.128***<br>(0.004) | -0.129***<br>(0.004) | -0.150***<br>(0.005) | -0.128***<br>(0.004) | -0.125***<br>(0.004) | -0.028***<br>(0.003) |
| LogAge    | -0.015***<br>(0.000) | -0.016***<br>(0.000) | -0.010***<br>(0.000) | -0.015***<br>(0.000)  | -0.015***<br>(0.000) | -0.001<br>(0.001)    | 0.000**<br>(0.000)   | 0.001***<br>(0.000)  | 0.004***<br>(0.000)  | 0.001***<br>(0.000)  | 0.002***<br>(0.000)  | 0.006***<br>(0.001)  |
| Inflation | -0.005***<br>(0.001) | -0.006***<br>(0.001) | -0.012***<br>(0.002) | -0.005***<br>(0.001)  | -0.005***<br>(0.001) | -0.005***<br>(0.001) | -0.002***<br>(0.001) | -0.002***<br>(0.001) | -0.005***<br>(0.001) | -0.001<br>(0.001)    | -0.001<br>(0.001)    | -0.002***<br>(0.001) |

Table 4 continued

| Variables          | AP                  |                     |                      |                     |                     |                     |                     |                     |                      |                     |                     |                     |
|--------------------|---------------------|---------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|---------------------|
|                    | AR                  | Tobit               |                      |                     | FE                  | OLS                 |                     |                     | Tobit                |                     |                     | FE                  |
|                    | (1)                 | (2)                 | (3)                  | (4)                 | (5)                 | (6)                 | (7)                 | (8)                 | (9)                  | (10)                | (11)                | (12)                |
| GDPGrowth          | 0.071***<br>(0.009) | 0.072***<br>(0.007) | -0.237***<br>(0.006) | 0.070***<br>(0.007) | 0.070***<br>(0.007) | 0.069***<br>(0.004) | 0.032***<br>(0.007) | 0.050***<br>(0.006) | -0.134***<br>(0.005) | 0.040***<br>(0.006) | 0.040***<br>(0.006) | 0.049***<br>(0.003) |
| Constant           | 0.207***<br>(0.015) | 0.206***<br>(0.015) | 0.213***<br>(0.002)  | 0.207***<br>(0.015) | 0.300***<br>(0.003) | 0.233***<br>(0.001) | 0.042***<br>(0.014) | 0.035**<br>(0.014)  | 0.105***<br>(0.001)  | 0.033***<br>(0.014) | 0.194***<br>(0.002) | 0.116***<br>(0.001) |
| D2000s vs D2010s   |                     | 88.55***            |                      |                     |                     |                     |                     | 2.25                |                      |                     |                     |                     |
| Firm FE            | No                  | No                  | No                   | No                  | No                  | Yes                 | No                  | No                  | No                   | No                  | No                  | Yes                 |
| Industry FE        | Yes                 | Yes                 | Yes                  | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | Yes                 | Yes                 |
| Country FE         | Yes                 | Yes                 | No                   | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | No                   | Yes                 | Yes                 | Yes                 |
| Year FE            | Yes                 | No                  | No                   | No                  | No                  | No                  | Yes                 | No                  | No                   | No                  | No                  | No                  |
| N                  | 528,954             | 528,954             | 528,954              | 528,954             | 528,954             | 528,954             | 528,954             | 528,954             | 528,954              | 528,954             | 528,954             | 528,954             |
| Adj.R <sup>2</sup> | 0.251               | 0.250               | 0.210                | 0.250               |                     | 0.048               | 0.131               | 0.128               | 0.078                | 0.127               |                     | 0.014               |

This table presents OLS (ordinary least squares), Tobit, and FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend, period dummies and a set of firm-specific and macroeconomic control variables. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *DataStream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses



### 4.3 Institutional development and the evolution of trade credit

Next, we examine whether or not a country's 'institutional environment' explains the trend in trade credit. The institutional environment of a country refers to its legal origin and the levels of governance quality and economic and financial development. Governance quality is usually measured by the first principal component of the six dimensions of national governance quality identified by the Worldwide Governance Indicators (WGI) project.<sup>9</sup> Accordingly, we perform analyses on sub-samples created based on the median of the measures of institutional environment. We categorise countries into high and low groups around the median of each of the following three measures: Governance Quality, Economic Development, and Financial Development. In addition, we test the trend in trade credit in countries grouped by their legal origin, whether civil law or common law. These analyses constitute tests of Hypothesis 3 concerning the impact of the institutional environment on the evolution of trade credit. The results are reported in Table 6.

The results in Panel A (*AR*) show a positive trend in Column (1) and a negative trend in Column (2), indicating that the negative trend in trade credit is more pronounced for firms in countries with high governance quality relative to those with low governance quality. For the sub-samples based on legal origin, we find a marginal difference in the declining trend in trade credit between civil and common law countries (Columns (3) and (4)), where firms in civil law countries show a more negative trend than those in common law countries. Further, from Columns (5)–(8), we find a decline in trade credit for firms in countries with high economic and financial development, but an increase in trade credit for firms in countries with low economic and financial development. Beside confirming Hypothesis 3, this latter result also supports Hypothesis 2 in that there seems to be a more pronounced substitution of funding alternatives in countries with developed capital markets. We examine these emerging dynamics further and split the 'financial development' measure into financial institution development and financial market development. The results, reported in Columns (9)–(12), show that the more pronounced downtrend in trade credit for high developed countries is similar across institutional and market developments, but the trend for countries with low developments in financial institutions is significantly positive, while that for countries with low developments in financial markets is insignificantly positive. This heterogeneity supports the hypothesis that firms in countries with less-developed financial institutions, but not necessarily less-developed financial markets, have increased both their demand and supply of trade credit over the years than other firms (see also Panel B Columns (9)–(12) for qualitatively similar results on *AP*).

Overall, the findings confirm Hypothesis 3, and are consistent with the empirical evidence relating to institutional environment and trade credit financing. As argued by Petersen and Rajan (1997) and Fisman and Love (2003), institutional development reduces the cost and improves the depth, efficiency, and access to external finance through bank credit. Firms in countries with developed governance quality, financial institutions, and markets can obtain cheaper bank credit because of a reduction in bank loan risk (La Porta et al. 1997; Levine 1998). Accordingly, our findings for trade credit suggest that firms tend to reduce the supply of trade credit as their countries develop governance and financial institutions. Consequently, the average downtrend in trade credit that we observe can be attributed, at least partly, to developments in the institutional environment around the world.

<sup>9</sup> These dimensions are: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.

Table 5 Vintage effects on the evolution of trade credit

| Variables    | AR                    |                       |                       |                       |                       | AP                    |                       |                       |                       |                       |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|              | 1990-2019<br>(1)      | 1990s<br>(2)          | 2000s<br>(3)          | 2010s<br>(4)          | 1990-2019<br>(5)      | 1990-2019<br>(6)      | 1990s<br>(7)          | 2000s<br>(8)          | 2010s<br>(9)          | 1990-2019<br>(10)     |
| Trend        |                       | - 0.040***<br>(0.004) | 0.093***<br>(0.008)   | 0.088***<br>(0.023)   | - 0.036***<br>(0.003) |                       | - 0.056***<br>(0.003) | 0.094***<br>(0.006)   | 0.048***<br>(0.017)   | - 0.034***<br>(0.003) |
| Trend-L2000s |                       |                       |                       |                       | 0.094***<br>(0.006)   |                       |                       |                       |                       | 0.076***<br>(0.005)   |
| Trend-L2010s |                       |                       |                       |                       | 0.076***<br>(0.021)   |                       |                       |                       |                       | 0.004<br>(0.016)      |
| L2000s       | - 0.012***<br>(0.000) |                       |                       |                       | - 0.029***<br>(0.001) | - 0.006***<br>(0.000) |                       |                       |                       | - 0.020***<br>(0.001) |
| L2010s       | - 0.015***<br>(0.001) |                       |                       |                       | - 0.031***<br>(0.006) | - 0.009***<br>(0.000) |                       |                       |                       | - 0.006<br>(0.004)    |
| Cash         | - 0.167***<br>(0.002) | - 0.189***<br>(0.002) | - 0.156***<br>(0.003) | - 0.128***<br>(0.004) | - 0.167***<br>(0.002) | - 0.091***<br>(0.001) | - 0.096***<br>(0.002) | - 0.090***<br>(0.002) | - 0.076***<br>(0.003) | - 0.091***<br>(0.001) |
| LITDA        | - 0.212***<br>(0.001) | - 0.227***<br>(0.002) | - 0.197***<br>(0.002) | - 0.188***<br>(0.004) | - 0.213***<br>(0.001) | - 0.106***<br>(0.001) | - 0.124***<br>(0.001) | - 0.094***<br>(0.002) | - 0.085***<br>(0.003) | - 0.106***<br>(0.001) |
| STDA         | 0.073***<br>(0.006)   | 0.073***<br>(0.003)   | 0.063***<br>(0.010)   | 0.118***<br>(0.005)   | 0.072***<br>(0.006)   | 0.015***<br>(0.002)   | - 0.002<br>(0.002)    | 0.018***<br>(0.003)   | 0.052***<br>(0.005)   | 0.014***<br>(0.002)   |
| SGrowth      | 0.023***<br>(0.001)   | 0.020***<br>(0.002)   | 0.028***<br>(0.001)   | 0.021***<br>(0.003)   | 0.023***<br>(0.001)   | 0.025***<br>(0.001)   | 0.029***<br>(0.001)   | 0.027***<br>(0.001)   | 0.017***<br>(0.002)   | 0.025***<br>(0.001)   |
| ROA          | 0.041***<br>(0.002)   | 0.035***<br>(0.003)   | 0.036***<br>(0.003)   | 0.040***<br>(0.006)   | 0.040***<br>(0.002)   | - 0.104***<br>(0.002) | - 0.119***<br>(0.003) | - 0.095***<br>(0.003) | - 0.093***<br>(0.005) | - 0.104***<br>(0.002) |
| R&D          | 0.077***<br>(0.005)   | 0.132***<br>(0.007)   | 0.024***<br>(0.008)   | 0.081***<br>(0.016)   | 0.077***<br>(0.005)   | - 0.101***<br>(0.004) | - 0.161***<br>(0.006) | - 0.084***<br>(0.007) | - 0.033***<br>(0.013) | - 0.101***<br>(0.004) |

Table 5 continued

| Variables                    | AR                   |                      |                      |                      |                      | AP                   |                      |                      |                      |                      |
|------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                              | 1990-2019<br>(1)     | 1990s<br>(2)         | 2000s<br>(3)         | 2010s<br>(4)         | 1990-2019<br>(5)     | 1990-2019<br>(6)     | 1990s<br>(7)         | 2000s<br>(8)         | 2010s<br>(9)         | 1990-2019<br>(10)    |
| Capex                        | -0.424***<br>(0.014) | -0.409***<br>(0.028) | -0.450***<br>(0.005) | -0.410***<br>(0.009) | -0.424***<br>(0.014) | -0.128***<br>(0.004) | -0.132***<br>(0.009) | -0.135***<br>(0.004) | -0.099***<br>(0.007) | -0.129***<br>(0.004) |
| LogAge                       | -0.019***<br>(0.000) | -0.016***<br>(0.000) | -0.023***<br>(0.001) | -0.022***<br>(0.001) | -0.019***<br>(0.000) | -0.002***<br>(0.000) | 0.003***<br>(0.000)  | -0.006***<br>(0.000) | -0.008***<br>(0.001) | -0.001***<br>(0.000) |
| Inflation                    | -0.005***<br>(0.001) | -0.004***<br>(0.001) | -0.017*<br>(0.009)   | -0.046**<br>(0.022)  | -0.006***<br>(0.001) | -0.001<br>(0.001)    | -0.001<br>(0.001)    | -0.014**<br>(0.007)  | -0.006<br>(0.017)    | -0.002*<br>(0.001)   |
| GDPGrowth                    | 0.073***<br>(0.007)  | 0.155***<br>(0.009)  | 0.005<br>(0.012)     | 0.034<br>(0.036)     | 0.076***<br>(0.007)  | 0.044***<br>(0.006)  | 0.074***<br>(0.007)  | 0.028***<br>(0.009)  | 0.023<br>(0.026)     | 0.045***<br>(0.006)  |
| Constant                     | 0.212***<br>(0.015)  | 0.216***<br>(0.009)  | 0.155***<br>(0.009)  | 0.143***<br>(0.010)  | 0.309***<br>(0.003)  | 0.035***<br>(0.014)  | 0.120***<br>(0.011)  | 0.110***<br>(0.011)  | 0.071***<br>(0.007)  | 0.204***<br>(0.002)  |
| L2000s vs L2010s             | 590.70***            |                      |                      |                      | 249.10***            | 309.60***            |                      |                      |                      | 188.50***            |
| Trend:L2000s vs Trend:L2010s |                      |                      |                      |                      | 0.68                 |                      |                      |                      |                      | 20.46***             |
| Controls                     | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Firm FE                      | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   |
| Industry FE                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Country FE                   | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Year FE                      | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   |
| N                            | 528,954              | 265,037              | 206,545              | 57,372               | 528,954              | 528,954              | 265,037              | 206,545              | 57,372               | 528,954              |
| Adj.R <sup>2</sup>           | 0.251                | 0.277                | 0.241                | 0.244                | 0.251                | 0.127                | 0.152                | 0.111                | 0.126                | 0.128                |

This table presents FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend, listing/vintage dummies and a set of firm-specific and macroeconomic control variables. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

#### 4.4 The effects of changes in trade credit on corporate outcomes and employment

Having documented the marked time variation and decline in trade credit, as well as the heterogeneity therein, we now examine whether these decreases affect firm value (measured by Tobin's  $q$ ), sales growth ( $SGrowth$ ), capital expenditure ( $Capex$ ) and change in employment ( $\Delta Emp$ ). It is important to investigate these implications because trade credit is a major form of financing, especially in developing countries where access to external finance is relatively limited. Hill et al. (2012, 2013), for example, argue that while suppliers could derive strategic benefits from trade credit, investors also recognise it as an effective tool for boosting sales growth and profitability. Another implication is that companies might be able to gain competitive advantages by using trade credit strategically to fight competition without resorting to detrimental and endless price wars. The resulting gain in the competitive advantage should be more recognisable by investors through stock returns and profitability (Ferrando and Mulier 2013). A third implication is that companies can use trade credit as a possible, and often legal, channel for customer discrimination that bypasses illegal price discrimination by tailoring the credit terms to specific customers (see Brennan et al. 1988; Meltzer 1960; Petersen and Rajan 1997). In the process, companies might be able to tap into new customer bases that would otherwise be more difficult or impossible.

Table 7 summarises the analysis of the implications of changes in trade credit by estimating Eq. (2), which relates firm value, sales growth, capital expenditure, and employment to changes in trade credit ( $\Delta TC$ ) and control variables.  $TC_{ikt-1}$  is lagged trade credit (accounts receivable or payable), and  $\Delta TC_{ikt}$  is the change in trade credit relative to the prior year. Following Hill et al. (2015), we scale the change in trade credit by the lagged total assets. In Eq. (2),  $\lambda_1$  represents the total asset value of an incremental USD1 of trade credit, and  $\lambda_3$  on the interaction term  $\Delta TC_{ikt} \cdot TC_{ikt-1}$  captures the diminishing returns to trade credit.

The results show that Tobin's  $q$ ,  $SGrowth$ ,  $Capex$ , and  $\Delta Emp$  are positively and significantly related to changes in trade credit ( $\Delta TC_{ikt}$ ) and to lagged trade credit ( $TC_{ikt-1}$ ). These indicate that increases in trade credit are associated with improvements or increases in firm value, sales growth, capital expenditure, and change in employment. This finding has significant economic welfare implications. If trade credit positively affects firm value, current and future firm growth opportunities, and employment at the firm level (micro level), these effects would aggregate to the level of the economy (macro level).<sup>10</sup> Accordingly, policymakers would be interested in placing, adjusting, and monitoring controls and mechanisms through which they could amplify or attenuate the firm-specific shocks on trade credit provision.

Further analyses, however, reveal a negative and significant incremental non-linear effect. The statistically significant  $\lambda_3$  in Columns (1)–(8) is negative throughout; a result that is consistent with diminishing returns to trade credit provision (see Hill et al. 2015). According to Hill et al. (2015), the reason for the diminishing returns to trade credit provision relates to the fact that aggressive extensions of trade credit ( $AR$ ) exacerbate collection bottlenecks and increase default rates and borrowing costs, which, in turn, reduce firm liquidity. Also, aggressive use of trade credit ( $AP$ ) is associated with diminishing returns since it is a relatively more expensive form of financing. For example, Murfin and Njoroge (2015) find an increased opportunity cost in the form of crowding of

<sup>10</sup> Bustamante and Frésard (2020) show that shocks in capital expenditure at the firm level filter through to aggregate investment, thereby affecting aggregate economic welfare.

**Table 6** The institutional environment and variations in trade credit

| Panel A: AR        |                     |                       |                       |                       |                      |                       |                       |                       |                        |                       |                     |                       |
|--------------------|---------------------|-----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|-----------------------|---------------------|-----------------------|
| Variables          | Governance quality  |                       | Legal origin          |                       | Economic development |                       | Financial development |                       | Financial institutions |                       | Financial markets   |                       |
|                    | Low (1)             | High (2)              | Civil (3)             | Common (4)            | Low (5)              | High (6)              | Low (7)               | High (8)              | Low (9)                | High (10)             | Low (11)            | High (12)             |
| Trend              | 0.133***<br>(0.006) | - 0.111***<br>(0.003) | - 0.101***<br>(0.003) | - 0.045***<br>(0.004) | 0.095***<br>(0.006)  | - 0.110***<br>(0.003) | 0.112***<br>(0.010)   | - 0.084***<br>(0.003) | 0.141***<br>(0.008)    | - 0.092***<br>(0.003) | 0.009<br>(0.009)    | - 0.079***<br>(0.003) |
| Diff               | 1259,00***          |                       |                       | 111,20***             |                      | 1018,00***            |                       | 374,20***             |                        | 776,30***             |                     | 96,41***              |
| Controls           | Yes                 | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                    | Yes                   | Yes                 | Yes                   |
| Firm FE            | No                  | No                    | No                    | No                    | No                   | No                    | No                    | No                    | No                     | No                    | No                  | No                    |
| Industry FE        | Yes                 | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                    | Yes                   | Yes                 | Yes                   |
| Country FE         | Yes                 | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                    | Yes                   | Yes                 | Yes                   |
| Year FE            | No                  | No                    | No                    | No                    | No                   | No                    | No                    | No                    | No                     | No                    | No                  | No                    |
| N                  | 142,291             | 386,663               | 306,082               | 222,872               | 177,112              | 351,842               | 70,183                | 458,771               | 96,008                 | 432,946               | 66,971              | 461,983               |
| Adj.R <sup>2</sup> | 0.240               | 0.260                 | 0.261                 | 0.225                 | 0.221                | 0.270                 | 0.236                 | 0.256                 | 0.242                  | 0.254                 | 0.226               | 0.253                 |
| Panel B: AP        |                     |                       |                       |                       |                      |                       |                       |                       |                        |                       |                     |                       |
| Variables          | Governance quality  |                       | Legal origin          |                       | Economic development |                       | Financial development |                       | Financial institutions |                       | Financial markets   |                       |
|                    | Low (1)             | High (2)              | Civil (3)             | Common (4)            | Low (5)              | High (6)              | Low (7)               | High (8)              | Low (9)                | High (10)             | Low (11)            | High (12)             |
| Trend              | 0.038***<br>(0.005) | - 0.057***<br>(0.002) | - 0.059***<br>(0.003) | - 0.030***<br>(0.003) | 0.031***<br>(0.004)  | - 0.057***<br>(0.002) | 0.113***<br>(0.008)   | - 0.056***<br>(0.002) | 0.059***<br>(0.006)    | - 0.055***<br>(0.002) | - 0.013*<br>(0.007) | - 0.048***<br>(0.002) |
| Diff               | 289,40***           |                       |                       | 50,70***              |                      | 305,70***             |                       | 429,90***             |                        | 304,30***             |                     | 19,92***              |
| Controls           | Yes                 | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                    | Yes                   | Yes                 | Yes                   |
| Firm FE            | No                  | No                    | No                    | No                    | No                   | No                    | No                    | No                    | No                     | No                    | No                  | No                    |
| Industry FE        | Yes                 | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                    | Yes                   | Yes                 | Yes                   |

Table 6 continued

| Panel B: AP        |         | Governance quality |           | Legal origin |         | Economic development |         | Financial development |         | Financial institutions |          | Financial markets |  |
|--------------------|---------|--------------------|-----------|--------------|---------|----------------------|---------|-----------------------|---------|------------------------|----------|-------------------|--|
| Variables          | Low (1) | High (2)           | Civil (3) | Common (4)   | Low (5) | High (6)             | Low (7) | High (8)              | Low (9) | High (10)              | Low (11) | High (12)         |  |
| Country FE         | Yes     | Yes                | Yes       | Yes          | Yes     | Yes                  | Yes     | Yes                   | Yes     | Yes                    | Yes      | Yes               |  |
| Year FE            | No      | No                 | No        | No           | No      | No                   | No      | No                    | No      | No                     | No       | No                |  |
| N                  | 142,291 | 386,663            | 306,082   | 222,872      | 177,112 | 351,842              | 70,183  | 458,771               | 96,008  | 432,946                | 66,971   | 461,983           |  |
| Adj.R <sup>2</sup> | 0.120   | 0.136              | 0.138     | 0.117        | 0.117   | 0.137                | 0.122   | 0.132                 | 0.123   | 0.130                  | 0.144    | 0.127             |  |

This table presents FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend based on the level of institutional and financial development and a set of firm-specific and macroeconomic control variables (the controls are not reported but available upon request). The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

profitable investments and reductions in cash holdings, especially when small suppliers extend more trade credit, or to large creditworthy buyers at favourable terms.

Further analyses, reported in Appendix 3, explore the implications of trade credit for three sub-samples. We rerun Eq. (2) for the US (Panel A), DMEs excluding the US (Panel B), and EMEs (Panel C). We observe positive coefficients on  $\Delta TC_{ikt}$  and  $TC_{ikt-1}$  in all three panels. Also, the benefits of trade credit on corporate outcomes are lower in DMEs and EMEs than in the US. The more pronounced positive impact of trade credit on firm performance in the US is likely due to the higher intensity of competition, where in such an environment a marginal change in trade credit would have a higher impact even if the level of trade credit is relatively lower than that in other environments (Philippon 2015; Kahle and Stulz 2017). We also observe negative and significant coefficients on the interaction term  $\Delta TC_{ikt} \cdot TC_{ikt-1}$ , which indicates diminishing returns to trade credit. The rate at which these returns diminish is significantly higher in the US relative to DMEs and EMEs. Had the US been combined with other DMEs, the results would show higher diminishing returns for the combined group than for EMEs (Hypothesis 4). However, a closer comparison between Panels B and C show higher diminishing returns to Tobin's  $q$  for EMEs in  $AR$  and  $AP$ , and to  $SGrowth$  and  $Capex$  in  $AP$ , but not so much in  $AR$ . Thus, there is some evidence that diminishing returns are higher in EMEs than in DMEs, but only when the US is excluded from the latter group.

Based on the above results, we conclude that extensions of trade credit improve firm value, sales growth, and employment, and increase capital expenditure, which is one determinant of growth opportunities. By delaying payments on accounts payable, firms seem to redirect resources to increase capital expenditure and employment. Further, whereas increases in accounts receivable can lock up working capital, firms can build relationships with customers and enhance the competitiveness of their products, thereby boosting sales and profitability (Martínez-Sola et al. 2013). While prevalent across the sub-groupings, the diminishing returns to trade credit are more pronounced for firms in the US relative to those in other developed markets and emerging markets. This is most probably due to the fact that US firms operate in a more competitive environment. This evidence highlights the relative importance of trade credit to firms in other developed and emerging markets that rely heavily on it as an alternative form of short-term financing.<sup>11</sup>

## 5 Further analyses and robustness

### 5.1 The industrial heterogeneity of trade credit

Having established that both the average demand and supply of trade credit are decreasing, we now investigate whether or not this trend is heterogeneous across industries. We examine the effects of changes in industrial dynamics by conducting analyses on sub-samples created according to the following industrial groupings: Basic Materials ( $BM$ ), Consumer Discretionary ( $CD$ ), Consumer Staples ( $CS$ ), Energy ( $EE$ ), Health Care ( $HC$ ), Industrials ( $ID$ ), Real Estate ( $RE$ ), Technology ( $TC$ ), and Telecommunications ( $TL$ ). Table 8 presents a brief summary of the results for the *Trend* only, which is the main variable of interest. For brevity, we also omit the results on the control variables. All results are available from the authors.

<sup>11</sup> Several studies show the importance of trade credit when other forms of financing are not available (Beck et al. 2019; Fisman and Love 2003; McMillan and Woodruff, 1999). However, our findings emphasise that trade credit is more important to firms in emerging market economies than those in developed markets.

Table 7 The implications of changes in trade credit

| Variables                        | AAR                  |                      |                      |                      | AAP                  |                      |                      |                      |
|----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                  | AAR                  |                      | AAR                  |                      | AAP                  |                      | AAP                  |                      |
|                                  | Tobin's $q$          | SGrowth              | Capex                | $\Delta$ Emp         | Tobin's $q$          | SGrowth              | Capex                | $\Delta$ Emp         |
| (1)                              | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  |                      |
| $\Delta TC_{it}$                 | 1.244***<br>(0.055)  | 1.529***<br>(0.016)  | 1.529***<br>(0.016)  | 0.026***<br>(0.002)  | 0.841***<br>(0.094)  | 1.127***<br>(0.034)  | 1.127***<br>(0.034)  | 0.060***<br>(0.013)  |
| $TC_{it-1}$                      | 0.826***<br>(0.045)  | 0.180***<br>(0.006)  | 0.180***<br>(0.006)  | 0.011***<br>(0.002)  | 0.928***<br>(0.045)  | 0.277***<br>(0.010)  | 0.277***<br>(0.010)  | 0.020***<br>(0.002)  |
| $\Delta TC_{it} \cdot TC_{it-1}$ | -1.458***<br>(0.169) | -1.471***<br>(0.042) | -1.471***<br>(0.042) | -0.078***<br>(0.014) | -0.977***<br>(0.447) | -0.665***<br>(0.165) | -0.665***<br>(0.165) | -0.101**<br>(0.046)  |
| Cash                             | 0.665***<br>(0.031)  | 0.001<br>(0.004)     | 0.001<br>(0.004)     | 0.026***<br>(0.001)  | 0.583***<br>(0.029)  | 0.051***<br>(0.004)  | 0.051***<br>(0.004)  | 0.024***<br>(0.001)  |
| Size                             | -0.158***<br>(0.008) | -0.038***<br>(0.001) | -0.038***<br>(0.001) | -0.007***<br>(0.000) | -0.169***<br>(0.008) | -0.048***<br>(0.001) | -0.048***<br>(0.001) | -0.006***<br>(0.000) |
| PPE                              | 0.092***<br>(0.026)  | -0.026***<br>(0.004) | -0.026***<br>(0.004) | 0.009***<br>(0.001)  | 0.018<br>(0.024)     | 0.001<br>(0.004)     | 0.001<br>(0.004)     | 0.008***<br>(0.001)  |
| LTDA                             | 0.063**<br>(0.027)   | 0.032***<br>(0.004)  | 0.032***<br>(0.004)  | -0.026***<br>(0.002) | 0.054***<br>(0.027)  | 0.024***<br>(0.004)  | 0.024***<br>(0.004)  | -0.026***<br>(0.002) |
| STDA                             | 0.216***<br>(0.032)  | -0.024***<br>(0.005) | -0.024***<br>(0.005) | -0.029***<br>(0.004) | 0.224***<br>(0.033)  | -0.044***<br>(0.007) | -0.044***<br>(0.007) | -0.028***<br>(0.004) |
| ROA                              | 2.089***<br>(0.052)  | -0.166***<br>(0.005) | -0.166***<br>(0.005) | 0.064***<br>(0.003)  | 2.196***<br>(0.053)  | -0.128***<br>(0.006) | -0.128***<br>(0.006) | 0.064***<br>(0.003)  |
| Industrial median                | 0.457***<br>(0.012)  | 0.125***<br>(0.005)  | 0.125***<br>(0.005)  | 0.438***<br>(0.009)  | 0.461***<br>(0.012)  | 0.132***<br>(0.005)  | 0.132***<br>(0.005)  | 0.439***<br>(0.010)  |



**Table 7** continued

| ATC Proxy          | ΔAR                   |                     |                     |                       | ΔAAP                  |                     |                     |                       |
|--------------------|-----------------------|---------------------|---------------------|-----------------------|-----------------------|---------------------|---------------------|-----------------------|
|                    | Tobin's <i>q</i>      | SGrowth             | Capex               | ΔEmp                  | Tobin's <i>q</i>      | SGrowth             | Capex               | ΔEmp                  |
|                    | (1)                   | (2)                 | (3)                 | (4)                   | (5)                   | (6)                 | (7)                 | (8)                   |
| Inflation          | - 0.060***<br>(0.010) | - 0.001<br>(0.002)  | - 0.001<br>(0.002)  | - 0.001***<br>(0.000) | - 0.060***<br>(0.010) | 0.000<br>(0.003)    | 0.000<br>(0.003)    | - 0.001***<br>(0.000) |
| GDPGrowth          | 1.239***<br>(0.076)   | 0.301***<br>(0.016) | 0.301***<br>(0.016) | 0.079***<br>(0.004)   | 1.267***<br>(0.076)   | 0.343***<br>(0.016) | 0.343***<br>(0.016) | 0.077***<br>(0.004)   |
| Constant           | 2.951***<br>(0.129)   | 0.573***<br>(0.013) | 0.573***<br>(0.013) | 0.119***<br>(0.005)   | 3.202***<br>(0.127)   | 0.715***<br>(0.014) | 0.715***<br>(0.014) | 0.112***<br>(0.005)   |
| Controls           | Yes                   | Yes                 | Yes                 | Yes                   | Yes                   | Yes                 | Yes                 | Yes                   |
| Firm FE            | Yes                   | Yes                 | Yes                 | Yes                   | Yes                   | Yes                 | Yes                 | Yes                   |
| Year FE            | Yes                   | Yes                 | Yes                 | Yes                   | Yes                   | Yes                 | Yes                 | Yes                   |
| N                  | 528,954               | 528,954             | 528,954             | 528,954               | 528,954               | 528,954             | 528,954             | 528,954               |
| Adj.R <sup>2</sup> | 0.136                 | 0.195               | 0.195               | 0.015                 | 0.134                 | 0.135               | 0.135               | 0.015                 |

**Panel B: Differences between increases and decreases**

| Description   | AR               |         |         |         | AP               |         |         |         |
|---------------|------------------|---------|---------|---------|------------------|---------|---------|---------|
|               | Tobin's <i>q</i> | SGrowth | Capex   | ΔEmp    | Tobin's <i>q</i> | SGrowth | Capex   | ΔEmp    |
|               | (1)              | (2)     | (3)     | (4)     | (5)              | (6)     | (7)     | (8)     |
| Decreases (A) | N                | 206,785 | 206,785 | 206,785 | 210,914          | 210,914 | 210,914 | 210,914 |
|               | Mean             | 1.369   | - 0.005 | - 0.005 | 1.428            | 0.011   | 0.011   | 0.045   |
|               | Median           | 1.092   | - 0.006 | - 0.006 | 1.119            | 0.006   | 0.006   | 0.031   |
|               | SD               | 0.992   | 0.171   | 0.171   | 1.070            | 0.177   | 0.177   | 0.049   |

**Table 7** continued

Panel B: Differences between increases and decreases

| Description       | AR               |          |          |          | AP               |          |          |          |
|-------------------|------------------|----------|----------|----------|------------------|----------|----------|----------|
|                   | Tobin's <i>q</i> | SGrowth  | Capex    | ΔEmp     | Tobin's <i>q</i> | SGrowth  | Capex    | ΔEmp     |
|                   | (1)              | (2)      | (3)      | (4)      | (5)              | (6)      | (7)      | (8)      |
| Increases (B)     |                  |          |          |          |                  |          |          |          |
| N                 | 322,169          | 322,169  | 322,169  | 322,169  | 318,040          | 318,040  | 318,040  | 318,040  |
| Mean              | 1.623            | 0.123    | 0.123    | 0.052    | 1.587            | 0.114    | 0.114    | 0.052    |
| Median            | 1.247            | 0.094    | 0.094    | 0.037    | 1.225            | 0.087    | 0.087    | 0.037    |
| SD                | 1.235            | 0.183    | 0.183    | 0.133    | 1.201            | 0.186    | 0.186    | 0.134    |
| Differences (B-A) |                  |          |          |          |                  |          |          |          |
| Mean              | 0.254***         | 0.128*** | 0.128*** | 0.007*** | 0.159***         | 0.103*** | 0.103*** | 0.007*** |
| Median            | 0.155***         | 0.100*** | 0.100*** | 0.006*** | 0.106***         | 0.081*** | 0.081*** | 0.006*** |
| SD                | 0.243***         | 0.012*** | 0.012*** | 0.083*** | 0.131***         | 0.009*** | 0.009*** | 0.085*** |

This table presents the estimation results of Eq. (2) that relates firm performance, employment, growth, and investment to changes in trade credit ( $\Delta TC$ ), lagged trade credit ( $TC_{it-1}$ ), an interaction term between these two ( $\Delta TC_{it} \cdot TC_{it-1}$ ), and a set of control variables. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datstream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

The *Trend* variable in Panel A for accounts receivable is negative and significant across all industries, except for Industrials and Telecommunications. Thus, the decline in trade credit is prevalent across most industries. However, we find a marked difference in the magnitude of this decline across the industries that show a negative trend. The negative trend in the supply of trade credit is most pronounced for firms in the Health Care sector and least pronounced in the Energy sector. Conversely, the trend is positive and statistically significant for firms in the Industrials and Telecommunications sectors. Further, Panel B for accounts payable, reports a negative trend for all industries, except for the Telecommunications and Energy sectors where it is positive and significant. The negative trend for the demand of trade credit (*AP*) is most pronounced for the Technology sector and least pronounced for the Consumer Staples sector (the negative trend for Basic Materials and Real Estate is not significant). In particular, firms in the Energy sector significantly increased their demand but reduced their supply for trade credit, while firms in the Industrials sector did the opposite. The only sector in which both the demand and supply of trade credit increased is the Telecommunications sector.

These results highlight significant industrial heterogeneity in the time variation in trade credit. The composition of this heterogeneity is consistent with the narrative that changes in industrial dynamics, especially the shift towards technology and services, has a pronounced impact on trade credit policies. Our findings extend those of Giannetti et al. (2011) and suggest that firms in industries with less observable product quality, such as technology and services, extend more trade credit to signal or guarantee product quality.<sup>12</sup>

## 5.2 Cross-country heterogeneity of trade credit

Figure 1 provided preliminary visual indications of marked differences in trade credit across US firms, DMEs and EMEs. We now test differences in the trend variable across these sub-groups of countries. Panel A of Table 9 (*AR*) confirms a significantly negative *Trend* coefficient for the US and DMEs. However, there is a positive trend in trade credit for EME firms, suggesting that firms in EMEs continue to rely on trade credit financing. Further, we find that US firms and DMEs are progressively relying less on trade credit since the 2000s. This finding is in line with Fig. 1, confirms the second parts of Hypotheses 1 and 2, and extends the US findings of Hill et al. (2012, 2015) to other developed countries and over a longer period.

Similarly, Panel B of Table 9 for *AP* reports a *Trend* that is negative for both the US and DMEs, and positive for EMEs. Thus, the decrease in the average demand for trade credit reported earlier is driven by DMEs and the US, and is more pronounced in DMEs than in the US. The positive trend in EMEs is significant, which confirms a continued reliance on trade credit financing in emerging economies. Moreover, the demand for trade credit continues to exhibit a downward trajectory since the 2000s, especially for DMEs.

Taken together, these results show that firms in developed economies grant or take progressively less trade credit over time than their counterparts in emerging economies. While there is an average decline in the supply of trade credit, firms in emerging economies increased their reliance on trade credit relative to those in developed economies. Our results support the arguments that access to bank credit (Arena et al. 2015; Meng and Gonzalez

<sup>12</sup> Several studies document a significant industrial shift from predominantly manufacturing sectors towards service and technology sectors in the US (see Aghion et al. 2004; Damodaran 2009; Buera and Kaboski 2012; Lim et al. 2020; Moshirian et al. 2017). We provide international evidence of these findings on the evolution of trade credit.

**Table 8** The change in trade credit across industries

| Panel A: AR        |                      |                      |                      |                      |                      |                      |                      |                      |                     |
|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|
| Variables          | BM<br>(1)            | CD<br>(2)            | CS<br>(3)            | EE<br>(4)            | HC<br>(5)            | ID<br>(6)            | RE<br>(7)            | TC<br>(8)            | TL<br>(9)           |
| Trend              | -0.092***<br>(0.006) | -0.148***<br>(0.005) | -0.074***<br>(0.007) | -0.053***<br>(0.012) | -0.220***<br>(0.010) | 0.028***<br>(0.005)  | -0.111***<br>(0.018) | -0.155***<br>(0.010) | 0.080***<br>(0.013) |
| Controls           | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 |
| Firm FE            | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 |
| Industry FE        | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                  |
| Country FE         | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                  |
| Year FE            | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                  |
| N                  | 64,367               | 123,881              | 55,240               | 21,522               | 33,105               | 148,823              | 9,405                | 50,646               | 21,965              |
| Adj.R <sup>2</sup> | 0.300                | 0.177                | 0.190                | 0.273                | 0.248                | 0.231                | 0.231                | 0.267                | 0.370               |
| Panel B: AP        |                      |                      |                      |                      |                      |                      |                      |                      |                     |
| Variables          | BM<br>(1)            | CD<br>(2)            | CS<br>(3)            | EE<br>(4)            | HC<br>(5)            | ID<br>(6)            | RE<br>(7)            | TC<br>(8)            | TL<br>(9)           |
| Trend              | -0.006<br>(0.005)    | -0.054***<br>(0.004) | -0.013*<br>(0.007)   | 0.020**<br>(0.010)   | -0.067***<br>(0.007) | -0.064***<br>(0.004) | -0.015<br>(0.012)    | -0.121***<br>(0.008) | 0.172***<br>(0.009) |
| Controls           | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 |
| Firm FE            | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                  |
| Industry FE        | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 |
| Country FE         | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 |
| Year FE            | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                   | No                  |
| N                  | 64,367               | 123,881              | 55,240               | 21,522               | 33,105               | 148,823              | 9,405                | 50,646               | 21,965              |

**Table 8** continued

| Panel B: AP         |           |           |           |           |           |           |           |           |           |
|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Variables           | BM<br>(1) | CD<br>(2) | CS<br>(3) | EE<br>(4) | HC<br>(5) | ID<br>(6) | RE<br>(7) | TC<br>(8) | TL<br>(9) |
| Adj. R <sup>2</sup> | 0.171     | 0.106     | 0.160     | 0.202     | 0.197     | 0.173     | 0.121     | 0.192     | 0.209     |

This table presents the estimation results of a version of Eq. (1) that relates trade credit to a time trend and a set of control variables (not reported but available upon request). The industries are sub-divided into Basic Materials (BM), Consumer Discretionary (CD), Consumer Staples (CS), Energy (EE), Health Care (HC), Industrials (ID), Real Estate (RE), Technology (TC) and Telecommunications (TL). The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles. \*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

2017) and financial deepening (Beck et al. 2010) account for the difference in trade credit use between developed and emerging economies.

### 5.3 The effect of the financial crisis on trade credit

Next, we investigate the effect of the financial crisis on the trend in trade credit through the use of a *PostCrisis* dummy for the period 2010–2019, where 2010 is chosen as the start of the post-crisis period. The results of estimating Eq. (1) with this dummy is reported in Table 10.

Columns (1) and (6) of Table 10 show that the financial crisis slowed down the decline in both the supply (*AR*) and demand (*AP*) for trade credit for the average global firm. Although the trend for this average firm continued to be negative following the crisis, the slow down was statistically significant. This suggests that the adverse effects of the financial crisis on bank credit and liquidity reported in the literature forced the average firm to substitute and alleviate the squeeze in financing and liquidity with trade credit. This supports and extends the findings of Bastos and Pindado (2013) of an increase in trade credit around the financial crisis in Brazil, Turkey, and Argentina. However, it contrasts with the findings of Campello et al. (2010) who report strategic reduction of trade credit by US firms around the financial crisis over a shorter period. For a more precise comparison with these countries, however, we run separate regressions for the US, DMEs and EMEs in Columns (2)–(4) for *AR* and (7)–(9) for *AP*.

Column (2) shows that the average US firm slowed down its declining demand for trade credit significantly, from a pre-crisis negative trend of  $-0.197$  to a post-crisis trend of  $-0.09$  ( $-0.197 + 0.107$ ), which is a change of 46% in the trend. Column (3) shows that the average DME firm also slowed down its pre-crisis decline in the demand for trade credit, but insignificantly. In contrast, Column (4) shows that EMEs had a positive trend of  $0.07$  before the crisis that slowed down significantly to  $0.026$  after the crisis, which is a change of 63% in the trend. These results confirm that the crisis had generally slowed down the demand for trade credit, but heterogeneously across countries and most prominently in EMEs followed by the US, while DMEs' pre-crisis decline was not affected significantly. Column (5) shows that the lack of a crisis effect on the trend in DMEs was significantly different than the slow down experienced by the US and EMEs. Thus, the crisis significantly affected the pre-crisis rate of increase in the supply of trade credit in EMEs and significantly decelerated the pre-crisis rate of decline in the US but not in that of the DMEs.

With regard to the demand for trade credit *AP* following the crisis, and while the average global firm (Column (6)) experienced a slow down in its pre-crisis rate of decline, the average US firm (Column (7)) experienced a significant increase in the pre-crisis rate of decline (more negative trend). The average DME firm (Column (8)) experienced a deceleration in its decline, and the average EME firm (Column (9)) experienced a significant reversal from a pre-crisis increase to a post-crisis decline. Column (10) confirms that the difference in these experiences between DMEs and firms in other countries is significant. Thus, the crisis significantly affected the pre-crisis rate of decrease in the demand for trade credit in the US and DMEs and reversed the pre-crisis rate of increase of EMEs.

In summary, and relative to the period prior to the crisis, the average US firm reduced its declining rate of supplying and increased its declining rate of demanding trade credit. The average DME firm continued its declining rate of supplying and reduced its declining rate of demanding trade credit. Finally, the average EME firm reduced its increasing rate of supplying and reversed its increasing rate of demanding trade credit.

**Table 9** Time trend in trade credit across countries

| Panel A: AR        |                       |                       |                     |                       |                       |                     |                       |                       |                       |
|--------------------|-----------------------|-----------------------|---------------------|-----------------------|-----------------------|---------------------|-----------------------|-----------------------|-----------------------|
| Variables          | USA<br>(1)            | DME<br>(2)            | EME<br>(3)          | USA<br>(4)            | DME<br>(5)            | EME<br>(6)          | USA<br>(7)            | DME<br>(8)            | EME<br>(9)            |
| Trend              | - 0.169***<br>(0.007) | - 0.192***<br>(0.004) | 0.093***<br>(0.005) |                       |                       |                     |                       |                       |                       |
| D2000s             |                       |                       |                     | - 0.022***<br>(0.001) | - 0.008***<br>(0.001) | 0.002<br>(0.001)    |                       |                       |                       |
| D2010s             |                       |                       |                     | - 0.033***<br>(0.001) | - 0.021***<br>(0.001) | 0.013***<br>(0.001) |                       |                       |                       |
| L2000s             |                       |                       |                     |                       |                       |                     | - 0.012***<br>(0.000) | - 0.012***<br>(0.000) | - 0.012***<br>(0.000) |
| L2010s             |                       |                       |                     |                       |                       |                     | - 0.015***<br>(0.001) | - 0.015***<br>(0.001) | - 0.015***<br>(0.001) |
| Constant           | 0.282***<br>(0.003)   | 0.341***<br>(0.002)   | 0.269***<br>(0.002) | 0.279***<br>(0.003)   | 0.192***<br>(0.004)   | 0.188***<br>(0.016) | 0.212***<br>(0.015)   | 0.212***<br>(0.015)   | 0.212***<br>(0.015)   |
| D2000s vs D2010s   |                       |                       |                     | 88.15***              | 535.90***             | 268.40***           | 30.65***              | 30.65***              | 30.65***              |
| L2000s vs L2010s   |                       |                       |                     |                       |                       |                     |                       |                       |                       |
| Controls           | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   |
| Firm FE            | No                    | No                    | No                  | No                    | No                    | No                  | No                    | No                    | No                    |
| Industry FE        | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   |
| Country FE         | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   |
| Year FE            | No                    | No                    | No                  | No                    | No                    | No                  | No                    | No                    | No                    |
| N                  | 72,804                | 279,038               | 177,112             | 72,804                | 279,038               | 177,112             | 528,954               | 528,954               | 528,954               |
| Adj.R <sup>2</sup> | 0.168                 | 0.157                 | 0.110               | 0.245                 | 0.273                 | 0.221               | 0.251                 | 0.251                 | 0.251                 |

Table 9 continued

| Panel B: AP      |  | USA<br>(1)            | DME<br>(2)            | EME<br>(3)          | USA<br>(4)            | DME<br>(5)            | EME<br>(6)          | USA<br>(7)            | DME<br>(8)            | EME<br>(9)            |
|------------------|--|-----------------------|-----------------------|---------------------|-----------------------|-----------------------|---------------------|-----------------------|-----------------------|-----------------------|
| Trend            |  | - 0.034***<br>(0.005) | - 0.130***<br>(0.003) | 0.033***<br>(0.004) |                       |                       |                     |                       |                       |                       |
| D2000s           |  |                       |                       |                     | - 0.005***<br>(0.001) | - 0.015***<br>(0.001) | - 0.001<br>(0.001)  |                       |                       |                       |
| D2010s           |  |                       |                       |                     | - 0.006***<br>(0.001) | - 0.018***<br>(0.001) | 0.003***<br>(0.001) |                       |                       |                       |
| L2000s           |  |                       |                       |                     |                       |                       |                     | - 0.006***<br>(0.000) | - 0.006***<br>(0.000) | - 0.006***<br>(0.000) |
| L2010s           |  |                       |                       |                     |                       |                       |                     | - 0.009***<br>(0.000) | - 0.009***<br>(0.000) | - 0.009***<br>(0.000) |
| Constant         |  | 0.135***<br>(0.002)   | 0.186***<br>(0.001)   | 0.122***<br>(0.001) | 0.128***<br>(0.002)   | 0.111***<br>(0.003)   | 0.021<br>(0.014)    | 0.035***<br>(0.014)   | 0.035***<br>(0.014)   | 0.035***<br>(0.014)   |
| D2000s vs D2010s |  |                       |                       |                     | 0.20                  | 42.13***              | 59.86***            | 33.75***              | 33.75***              | 33.75***              |
| L2000s vs L2010s |  |                       |                       |                     |                       |                       |                     |                       |                       |                       |
| Controls         |  | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   |
| Firm FE          |  | No                    | No                    | No                  | No                    | No                    | No                  | No                    | No                    | No                    |
| Industry FE      |  | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   |
| Country FE       |  | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   |
| Year FE          |  | No                    | No                    | No                  | No                    | No                    | No                  | No                    | No                    | No                    |
| N                |  | 72,804                | 279,038               | 177,112             | 72,804                | 279,038               | 177,112             | 528,954               | 528,954               | 528,954               |



**Table 9** continued

| Panel B: AP         |            |            |            |            |            |            |            |            |            |
|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Variables           | USA<br>(1) | DME<br>(2) | EME<br>(3) | USA<br>(4) | DME<br>(5) | EME<br>(6) | USA<br>(7) | DME<br>(8) | EME<br>(9) |
| Adj. R <sup>2</sup> | 0.097      | 0.084      | 0.033      | 0.114      | 0.135      | 0.117      | 0.127      | 0.127      | 0.127      |

This table presents FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend and a set of firm-specific and macroeconomic control variables across three country classifications (US, DMEs, and EMEs). The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

These results show a clear shift in the trend of trade credit, and significant heterogeneity in this across developed and developing countries and relative to the US. These results extend to other countries those of Bastos and Pindado (2013) on Brazil, Argentina and Turkey, and of Carbo-Valverde et al. (2016) on SMEs in Spain. These studies use shorter windows and report increases in the use of trade credit just after the crisis. However, our results over a longer period and across more countries show that this increase was temporary and the decline in trade credit in the US and DMEs continued but at a lower rate. Importantly, the decrease in the rate of decline following the crisis is more pronounced and statistically significant for the US but not for DMEs, while EMEs experienced a slowing down of their increasing supply and a reversal of their increasing demand for trade credit. This partly explains the convergence in trade credit use depicted in Fig. 1 that we reveal between DMEs and EMEs following the crisis. Further, given the well-documented bank liquidity and credit tightness that the GFC had caused (Carbo-Valverde et al. 2016; Ivashina and Scharfstein 2010; Kahle and Stulz 2013), our results imply that changes in the substitution of bank credit with trade credit following the crisis could indeed be heterogeneous in that it seems to have been stronger in DMEs and the US than in EMEs.

Thus far we used the PostCrisis dummy for the entire period after the crisis, while the studies cited above for the US and Spain used shorter windows. As a robustness check and a more careful investigation of short-term versus long-term effects of the crisis we conduct a further analysis that uses different window widths to represent the crisis period. We do this for the average firm only. This allows for the separation of transitory changes over the short term around the crisis from the permanent changes over the long term that we have so far documented. We use two window lengths to define the period of the financial crisis: a five-year window over the period 2008–2012, and a two-year window over the period 2008–2009 (see Almeida et al. 2012; Kahle and Stulz 2013). The shorter window allows for comparability with prior studies and better mitigation of possible confounding effects, and the longer window is considered for longer-term robustness. We create a dummy variable, *Crisis*, that equals one for the crisis period (2008–2012 or 2008–2009) and zero otherwise. We then run regressions over two restricted periods around the crisis: 2002–2012 in the case of the five-year window, and 2006–2009 in the case of the two-year window. This allows for a pre-crisis period of equal length to the crisis window in each case. Similar to the previous sections, we control for both firm-specific and macroeconomic variables. Appendix 4 summarises the results for the average firm only. These confirm that relative to shorter prior periods the crisis caused a significant reduction in both the supply and demand of trade credit ( $AR$  and  $AP$ ), a reduction in their rate of decline ( $\Delta AR$  and  $\Delta AP$ ) and in net trade credit for the average firm.

## 5.4 Alternative definitions of trade credit

We also test the robustness of our results to alternative definitions of trade credit by considering the first difference, or changes, in accounts receivable ( $\Delta AR$ ) and payable ( $\Delta AP$ ), and the ratio of net trade credit to total assets (NTC). Using both fixed effects regressions (FE) (Columns (1)–(3)) and Fama-MacBeth regressions (Columns (4)–(11)), the results presented in Table 11 are consistent in showing that the trend variable is negative and significant for  $\Delta AR$ . This suggests that the changes in trade credit we document are robust to this alternative measure (rate) of trade credit.

Similarly, the *Trend* coefficient in Column (3) for NTC, is negative and significant, indicating that firms consistently supply more trade credit ( $AR$ ) than they demand ( $AP$ ), on

**Table 10** The structural changes in the trend of trade credit after the financial crisis

| Variables            | AR                    |                       |                       |                       | AP                    |                       |                       |                       |                       |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                      | ALL<br>(1)            | USA<br>(2)            | DME<br>(3)            | EME<br>(4)            | ALL<br>(5)            | USA<br>(7)            | DME<br>(8)            | EME<br>(9)            | ALL<br>(10)           |
| Trend                | - 0.092***<br>(0.004) | - 0.197***<br>(0.010) | - 0.081***<br>(0.006) | 0.070***<br>(0.010)   | 0.035***<br>(0.010)   | - 0.083***<br>(0.003) | - 0.103***<br>(0.005) | 0.030***<br>(0.008)   | 0.046***<br>(0.008)   |
| PostCrisis           | - 0.012***<br>(0.002) | - 0.021***<br>(0.007) | - 0.007**<br>(0.003)  | 0.016***<br>(0.004)   | 0.017***<br>(0.004)   | - 0.006***<br>(0.002) | - 0.006***<br>(0.003) | 0.013***<br>(0.003)   | 0.017***<br>(0.003)   |
| Trend×PostCrisis     | 0.061***<br>(0.009)   | 0.107***<br>(0.030)   | 0.005<br>(0.014)      | - 0.044***<br>(0.017) | - 0.045***<br>(0.016) | 0.050***<br>(0.007)   | - 0.051**<br>(0.022)  | - 0.046***<br>(0.013) | - 0.061***<br>(0.013) |
| Trend×DME            |                       |                       |                       |                       | - 0.127***<br>(0.011) |                       |                       |                       | - 0.142***<br>(0.008) |
| PostCrisis×DME       |                       |                       |                       |                       | - 0.030***<br>(0.005) |                       |                       |                       | - 0.024***<br>(0.004) |
| Trend×PostCrisis×DME |                       |                       |                       |                       | 0.088***<br>(0.020)   |                       |                       |                       | 0.110***<br>(0.016)   |
| Constant             | 0.303***<br>(0.003)   | 0.261***<br>(0.003)   | 0.324***<br>(0.003)   | 0.279***<br>(0.004)   | 0.281***<br>(0.003)   | 0.202***<br>(0.002)   | 0.140***<br>(0.002)   | 0.183***<br>(0.002)   | 0.182***<br>(0.002)   |
| Firm FE              | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    |
| Industry FE          | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Country FE           | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Year FE              | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    |
| N                    | 528,954               | 72,804                | 279,038               | 177,112               | 528,954               | 528,954               | 279,038               | 177,112               | 528,954               |

Table 10 continued

| Variables           | AR         |            |            | AP         |            |            |             |
|---------------------|------------|------------|------------|------------|------------|------------|-------------|
|                     | USA<br>(2) | DME<br>(3) | EME<br>(4) | ALL<br>(5) | USA<br>(7) | EME<br>(9) | ALL<br>(10) |
| Adj. R <sup>2</sup> | 0.244      | 0.273      | 0.222      | 0.252      | 0.127      | 0.134      | 0.129       |

This table presents FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend and a set of firm-specific and macroeconomic control variables across three country classifications (US, DMEs, and EMEs). The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. *PostCrisis* is a dummy variable that takes the value of one for the period 2010–2019 and otherwise zero. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

average. This is somewhat expected given that our sample is composed of publicly-listed firms that are, on average, larger and have better access to external finance relative to non-listed or private firms. The results of the Fama-MacBeth regressions in Columns (4)–(11) show that the effects of the control variables on trade credit remain relatively stable over the sample period, indicating that changes in the firm-specific and macroeconomic characteristics do not appear to drive the trade credit trend we observe.

## 5.5 Individual components of national governance quality and financial development

In the final set of robustness checks, we examine the sensitivity of our results to the use of each of the individual dimensions of national governance quality and financial development. According to the Worldwide Governance Indicators (WGI) project, national governance quality consists of six dimensions: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. An examination of the degree to which each of these dimensions explains the trend in trade credit would supplement our earlier analysis in Sect. 4.3 that considered the first principal component of these six dimensions. Table 12 presents the results. These indicate that high governance quality is associated with a significant downward trend in trade credit for both accounts receivable and payable regardless of which of the six variables is used to represent governance quality.

We perform similar analyses using the components of the indexes for financial institutions and financial markets, namely, depth, access, and efficiency. Table 13 shows that our results remain qualitatively similar to those in Sect. 4.3. Specifically, firms that operate in countries with high depth, access, and efficiency in financial institutions and financial markets exhibit a significant decline in trade credit. This confirms that our results are robust to the use of alternative measures of financial development. Overall, institutional development explains the marked secular decline in trade credit.

## 6 Conclusions

This study analyses the evolution of trade credit as an essential form of short-term finance over the period 1990–2019 among firms in developed and emerging market economies and compares them with firms in the US. We report a significant and pervasive decrease in overall average trade credit worldwide, but this downtrend is more pronounced in the US and developed economies. There is considerable heterogeneity across countries and industries in this trend, with similarities within groups of countries. Our analyses show that this decrease in trade credit is due to changes in industrial dynamics and is localised within specific sectors, namely the Consumer Goods and Consumer Services sectors. Older firms that listed in the 1990s, especially those in emerging market economies, exhibit a more pronounced downward trend in trade credit than younger firms. The financial crisis caused a structural shift in the rate of decline in trade credit for firms in the US, did not affect significantly the rate of decline for firms in developed economies and reversed the rate of increase for firms in emerging market economies.

Our analyses also show that trade credit has significant positive implications on firm value, sales growth, investment, and employment. However, we document diminishing returns to increases in trade credit, with US firms suffering more decreases in corporate outcomes following aggressive increases in trade credit. Understanding the effect of trade

Table 11 Alternative definitions and models of trade credit

| Variables | FE                   |                      |                      |                      | FM                   |                      |                      |                      |                      |                      |                      |                      |
|-----------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|           | ΔAR                  |                      | ΔAP                  |                      | AR                   |                      | AP                   |                      |                      |                      |                      |                      |
|           | ALL<br>(1)           | ALL<br>(2)           | ALL<br>(3)           | ALL<br>(4)           | 1990s<br>(5)         | 2000s<br>(6)         | 2010s<br>(7)         | ALL<br>(8)           | 1990s<br>(9)         | 2000s<br>(10)        | 2010s<br>(11)        | ALL<br>(11)          |
| Trend     | -0.008***<br>(0.001) | -0.012***<br>(0.001) | -0.023***<br>(0.003) | -0.172***<br>(0.003) | -0.171***<br>(0.004) | -0.134***<br>(0.004) | -0.159***<br>(0.004) | -0.081***<br>(0.004) | -0.090***<br>(0.006) | -0.083***<br>(0.002) | -0.083***<br>(0.002) | -0.085***<br>(0.002) |
| Cash      | 0.020***<br>(0.001)  | 0.003***<br>(0.001)  | -0.075***<br>(0.002) | -0.235***<br>(0.003) | -0.227***<br>(0.003) | -0.229***<br>(0.004) | -0.230***<br>(0.002) | -0.159***<br>(0.005) | -0.107***<br>(0.003) | -0.114***<br>(0.002) | -0.114***<br>(0.002) | -0.126***<br>(0.005) |
| LTDA      | -0.014***<br>(0.001) | -0.007***<br>(0.000) | -0.106***<br>(0.001) | -0.235***<br>(0.003) | -0.227***<br>(0.003) | -0.229***<br>(0.004) | -0.230***<br>(0.002) | -0.159***<br>(0.005) | -0.107***<br>(0.003) | -0.114***<br>(0.002) | -0.114***<br>(0.002) | -0.126***<br>(0.005) |
| STDA      | -0.007***<br>(0.001) | -0.001**<br>(0.001)  | 0.058***<br>(0.005)  | 0.135***<br>(0.013)  | 0.035***<br>(0.010)  | 0.105***<br>(0.002)  | 0.092***<br>(0.009)  | 0.026**<br>(0.008)   | 0.009<br>(0.007)     | 0.035***<br>(0.002)  | 0.035***<br>(0.002)  | 0.023***<br>(0.004)  |
| SGrowth   | 0.019***<br>(0.001)  | 0.007***<br>(0.000)  | -0.003***<br>(0.001) | 0.039***<br>(0.010)  | 0.022**<br>(0.008)   | 0.025***<br>(0.006)  | 0.029***<br>(0.005)  | 0.042***<br>(0.009)  | 0.022***<br>(0.003)  | 0.021***<br>(0.002)  | 0.021***<br>(0.002)  | 0.028***<br>(0.004)  |
| ROA       | 0.044***<br>(0.001)  | 0.016***<br>(0.001)  | 0.147***<br>(0.002)  | 0.043***<br>(0.013)  | 0.028***<br>(0.005)  | 0.048***<br>(0.004)  | 0.040***<br>(0.005)  | -0.126***<br>(0.006) | -0.090***<br>(0.003) | -0.096***<br>(0.002) | -0.096***<br>(0.002) | -0.104***<br>(0.004) |
| R&D       | 0.003<br>(0.003)     | -0.011***<br>(0.002) | 0.181***<br>(0.005)  | 0.455***<br>(0.013)  | 0.176***<br>(0.027)  | 0.204***<br>(0.007)  | 0.278***<br>(0.025)  | -0.320***<br>(0.030) | -0.157***<br>(0.020) | -0.123***<br>(0.003) | -0.123***<br>(0.003) | -0.200***<br>(0.020) |
| Capex     | 0.008***<br>(0.002)  | 0.009***<br>(0.001)  | -0.288***<br>(0.010) | -0.438***<br>(0.038) | -0.485***<br>(0.018) | -0.520***<br>(0.009) | -0.481***<br>(0.015) | -0.195***<br>(0.020) | -0.119***<br>(0.021) | -0.123***<br>(0.007) | -0.123***<br>(0.007) | -0.146***<br>(0.012) |
| LogAge    | -0.005***<br>(0.000) | -0.003***<br>(0.000) | -0.016***<br>(0.000) | -0.015***<br>(0.003) | -0.016***<br>(0.002) | -0.013***<br>(0.001) | -0.015***<br>(0.001) | -0.004<br>(0.003)    | 0.001<br>(0.002)     | 0.004***<br>(0.001)  | 0.004***<br>(0.001)  | 0.000<br>(0.001)     |
| Inflation | 0.004***<br>(0.001)  | 0.002***<br>(0.001)  | -0.004***<br>(0.001) | -0.237***<br>(0.045) | -0.094**<br>(0.041)  | -0.054<br>(0.034)    | -0.129***<br>(0.027) | -0.143***<br>(0.032) | -0.067*<br>(0.031)   | 0.074**<br>(0.026)   | 0.074**<br>(0.026)   | -0.046*<br>(0.024)   |
| GDPGrowth | 0.088***<br>(0.004)  | 0.042***<br>(0.003)  | 0.029***<br>(0.007)  | -0.364**<br>(0.115)  | -0.715***<br>(0.088) | -0.260***<br>(0.040) | -0.447***<br>(0.060) | -0.333**<br>(0.110)  | -0.295***<br>(0.074) | -0.157***<br>(0.025) | -0.157***<br>(0.025) | -0.262***<br>(0.046) |

Table 11 continued

| Variables          | FE               |                  |                     | FM                  |                     |                     |                     |                     |                     |                     |
|--------------------|------------------|------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                    | ΔAR              | ΔAP              | NTC                 | AR                  | AP                  |                     |                     |                     |                     |                     |
| ALL (1)            | ALL (2)          | ALL (3)          | ALL (4)             | 1990s (5)           | 2010s (6)           | ALL (7)             | 1990s (8)           | 2000s (9)           | 2010s (10)          | ALL (11)            |
| Constant           | 0.003<br>(0.015) | 0.012<br>(0.014) | 0.173***<br>(0.022) | 0.319***<br>(0.007) | 0.332***<br>(0.009) | 0.281***<br>(0.005) | 0.311***<br>(0.006) | 0.157***<br>(0.012) | 0.134***<br>(0.004) | 0.162***<br>(0.007) |
| Firm FE            | No               | No               | No                  | No                  | No                  | No                  | No                  | No                  | No                  | No                  |
| Industry FE        | Yes              | Yes              | Yes                 | No                  | No                  | No                  | No                  | No                  | No                  | No                  |
| Country FE         | Yes              | Yes              | Yes                 | No                  | No                  | No                  | No                  | No                  | No                  | No                  |
| Year FE            | No               | No               | No                  | No                  | No                  | No                  | No                  | No                  | No                  | No                  |
| N                  | 528,954          | 528,954          | 528,954             | 98,057              | 194,493             | 236,404             | 528,954             | 194,493             | 236,404             | 528,954             |
| Adj.R <sup>2</sup> | 0.037            | 0.017            | 0.172               |                     |                     |                     |                     |                     |                     |                     |

This table presents the estimation results of Eq. (1) that relates trade credit to firm-specific variables, where three alternative measures of trade credit are used. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

**Table 12** The impact of national governance quality on the variations in trade credit

| Panel A: AR        |                     |                       |                     |                       |                     |                       |                     |                       |                     |                       |                     |                       |
|--------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|
| Variables          | VAE                 |                       | PVE                 |                       | GEE                 |                       | RQE                 |                       | RLE                 |                       | CCE                 |                       |
|                    | Low<br>(1)          | High<br>(2)           | Low<br>(3)          | High<br>(4)           | Low<br>(5)          | High<br>(6)           | Low<br>(7)          | High<br>(8)           | Low<br>(9)          | High<br>(10)          | Low<br>(11)         | High<br>(12)          |
| Trend              | 0.192***<br>(0.005) | - 0.141***<br>(0.003) | 0.098***<br>(0.006) | - 0.116***<br>(0.003) | 0.112***<br>(0.007) | - 0.102***<br>(0.003) | 0.133***<br>(0.006) | - 0.111***<br>(0.003) | 0.138***<br>(0.006) | - 0.110***<br>(0.003) | 0.130***<br>(0.006) | - 0.112***<br>(0.003) |
| Diff               | 2778.00***          | 2778.00***            | 1125.00***          | 1125.00***            | 866.20***           | 866.20***             | 1259.00***          | 1259.00***            | 1292.00***          | 1292.00***            | 1255.00***          | 1255.00***            |
| Controls           | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   |
| Firm FE            | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    |
| Industry FE        | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   |
| Country FE         | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   |
| Year FE            | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    |
| N                  | 171,460             | 357,494               | 177,342             | 351,612               | 132,082             | 396,872               | 142,291             | 386,663               | 142,323             | 386,631               | 142,858             | 386,096               |
| Adj.R <sup>2</sup> | 0.228               | 0.264                 | 0.224               | 0.269                 | 0.246               | 0.258                 | 0.240               | 0.260                 | 0.232               | 0.262                 | 0.241               | 0.260                 |

| Panel B: AP |                     |                       |                     |                       |                     |                       |                     |                       |                     |                       |                     |                       |
|-------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|
| Variables   | VAE                 |                       | PVE                 |                       | GEE                 |                       | RQE                 |                       | RLE                 |                       | CCE                 |                       |
|             | Low<br>(1)          | High<br>(2)           | Low<br>(3)          | High<br>(4)           | Low<br>(5)          | High<br>(6)           | Low<br>(7)          | High<br>(8)           | Low<br>(9)          | High<br>(10)          | Low<br>(11)         | High<br>(12)          |
| Trend       | 0.069***<br>(0.004) | - 0.074***<br>(0.002) | 0.050***<br>(0.004) | - 0.067***<br>(0.002) | 0.022***<br>(0.006) | - 0.053***<br>(0.002) | 0.038***<br>(0.005) | - 0.057***<br>(0.002) | 0.035***<br>(0.005) | - 0.057***<br>(0.002) | 0.037***<br>(0.005) | - 0.057***<br>(0.002) |
| Diff        | 866.20***           | 866.20***             | 535.40***           | 535.40***             | 152.10***           | 152.10***             | 289.40***           | 289.40***             | 270.50***           | 270.50***             | 290.40***           | 290.40***             |
| Controls    | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   | Yes                 | Yes                   |
| Firm FE     | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    | No                  | No                    |



Table 12 continued

| Panel B: AP        |         | PVE     |         | GEE     |         | RQE     |         | RLE     |         | CCE     |         |         |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Variables          | VAE     | Low     | High    | Low     | High    | Low     | High    | Low     | High    | Low     | High    |         |
|                    | (1)     | (2)     | (3)     | (4)     | (5)     | (6)     | (7)     | (8)     | (9)     | (10)    | (11)    | (12)    |
| Industry FE        | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     |
| Country FE         | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     | Yes     |
| Year FE            | No      | No      | No      | No      | No      | No      | No      | No      | No      | No      | No      | No      |
| N                  | 171,460 | 357,494 | 177,342 | 351,612 | 132,082 | 396,872 | 142,291 | 386,663 | 142,323 | 386,631 | 142,858 | 386,096 |
| Adj.R <sup>2</sup> | 0.098   | 0.146   | 0.114   | 0.141   | 0.128   | 0.133   | 0.120   | 0.136   | 0.127   | 0.133   | 0.123   | 0.135   |

This table presents FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend and a set of firm-specific and macroeconomic control variables (the controls are not reported but available upon request). The sub-sample analyses are based on six component measures of national governance quality. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

**Table 13** The impact of financial development on the variations in trade credit

| Panel A: AR        |                        |                       |                     |                       |                       |                       |                     |                       |                    |                       |                     |                       |
|--------------------|------------------------|-----------------------|---------------------|-----------------------|-----------------------|-----------------------|---------------------|-----------------------|--------------------|-----------------------|---------------------|-----------------------|
| Variables          | Financial institutions |                       |                     |                       |                       |                       | Financial markets   |                       |                    |                       |                     |                       |
|                    | Depth                  |                       | Access              |                       | Efficiency            |                       | Depth               |                       | Access             |                       | Efficiency          |                       |
|                    | Low<br>(1)             | High<br>(2)           | Low<br>(3)          | High<br>(4)           | Low<br>(5)            | High<br>(6)           | Low<br>(7)          | High<br>(8)           | Low<br>(9)         | High<br>(10)          | Low<br>(11)         | High<br>(12)          |
| Trend              | 0.083***<br>(0.010)    | - 0.083***<br>(0.003) | 0.090***<br>(0.005) | - 0.120***<br>(0.003) | - 0.055***<br>(0.004) | - 0.086***<br>(0.003) | 0.110***<br>(0.009) | - 0.083***<br>(0.003) | - 0.002<br>(0.006) | - 0.085***<br>(0.003) | 0.052***<br>(0.008) | - 0.085***<br>(0.003) |
| Diff               |                        | 276.80***             |                     | 1,249.00***           |                       | 29.82***              |                     | 410.20***             |                    | 158.20***             |                     | 283.80***             |
| Controls           | Yes                    | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   | Yes                 | Yes                   | Yes                | Yes                   | Yes                 | Yes                   |
| Firm FE            | No                     | No                    | No                  | No                    | No                    | No                    | No                  | No                    | No                 | No                    | No                  | No                    |
| Industry FE        | Yes                    | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   | Yes                 | Yes                   | Yes                | Yes                   | Yes                 | Yes                   |
| Country FE         | Yes                    | Yes                   | Yes                 | Yes                   | Yes                   | Yes                   | Yes                 | Yes                   | Yes                | Yes                   | Yes                 | Yes                   |
| Year FE            | No                     | No                    | No                  | No                    | No                    | No                    | No                  | No                    | No                 | No                    | No                  | No                    |
| N                  | 73,877                 | 455,077               | 167,442             | 361,512               | 185,214               | 343,740               | 68,052              | 460,902               | 157,188            | 371,766               | 72,612              | 456,342               |
| Adj.R <sup>2</sup> | 0.258                  | 0.252                 | 0.241               | 0.257                 | 0.221                 | 0.255                 | 0.225               | 0.257                 | 0.262              | 0.251                 | 0.211               | 0.254                 |

| Panel B: AP |                        |                       |                     |                       |                   |                       |                     |                       |                       |                       |                  |                       |
|-------------|------------------------|-----------------------|---------------------|-----------------------|-------------------|-----------------------|---------------------|-----------------------|-----------------------|-----------------------|------------------|-----------------------|
| Variables   | Financial institutions |                       |                     |                       |                   |                       | Financial markets   |                       |                       |                       |                  |                       |
|             | Depth                  |                       | Access              |                       | Efficiency        |                       | Depth               |                       | Access                |                       | Efficiency       |                       |
|             | Low<br>(1)             | High<br>(2)           | Low<br>(3)          | High<br>(4)           | Low<br>(5)        | High<br>(6)           | Low<br>(7)          | High<br>(8)           | Low<br>(9)            | High<br>(10)          | Low<br>(11)      | High<br>(12)          |
| Trend       | 0.138***<br>(0.008)    | - 0.059***<br>(0.002) | 0.025***<br>(0.004) | - 0.066***<br>(0.002) | 0.005*<br>(0.003) | - 0.073***<br>(0.003) | 0.141***<br>(0.007) | - 0.056***<br>(0.002) | - 0.028***<br>(0.004) | - 0.047***<br>(0.002) | 0.004<br>(0.006) | - 0.051***<br>(0.002) |
| Diff        |                        | 565.30***             |                     | 399.80***             |                   | 366.70***             |                     | 673.10***             |                       | 14.23***              |                  | 68.01***              |

Table 13 continued

| Variables          | Financial institutions |             |            |             |            |             | Financial markets |             |            |              |             |              |
|--------------------|------------------------|-------------|------------|-------------|------------|-------------|-------------------|-------------|------------|--------------|-------------|--------------|
|                    | Depth                  |             | Access     |             | Efficiency |             | Depth             |             | Access     |              | Efficiency  |              |
|                    | Low<br>(1)             | High<br>(2) | Low<br>(3) | High<br>(4) | Low<br>(5) | High<br>(6) | Low<br>(7)        | High<br>(8) | Low<br>(9) | High<br>(10) | Low<br>(11) | High<br>(12) |
| Controls           | Yes                    | Yes         | Yes        | Yes         | Yes        | Yes         | Yes               | Yes         | Yes        | Yes          | Yes         | Yes          |
| Firm FE            | No                     | No          | No         | No          | No         | No          | No                | No          | No         | No           | No          | No           |
| Industry FE        | Yes                    | Yes         | Yes        | Yes         | Yes        | Yes         | Yes               | Yes         | Yes        | Yes          | Yes         | Yes          |
| Country FE         | Yes                    | Yes         | Yes        | Yes         | Yes        | Yes         | Yes               | Yes         | Yes        | Yes          | Yes         | Yes          |
| Year FE            | No                     | No          | No         | No          | No         | No          | No                | No          | No         | No           | No          | No           |
| N                  | 73,877                 | 455,077     | 167,442    | 361,512     | 185,214    | 343,740     | 68,052            | 460,902     | 157,188    | 371,766      | 72,612      | 456,342      |
| Adj.R <sup>2</sup> | 0.116                  | 0.134       | 0.129      | 0.129       | 0.113      | 0.130       | 0.112             | 0.134       | 0.132      | 0.128        | 0.144       | 0.126        |

This table presents FE (fixed effects) estimation results of an augmented Eq. (1) that relates trade credit to a time trend and a set of firm-specific and macroeconomic control variables (the controls are not reported but available upon request). The sub-sample analyses are based on the individual components of the measures of development in financial institutions and markets. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

credit on corporate outcomes is important for three main reasons: (1) firms in emerging markets are smaller and much younger, which are characteristics that limit access to institutional credit; (2) capital markets and financial institutions in emerging countries are less developed and this constrains firm growth further and, consequently, hampers efforts to boost employment; and (3) trade credit helps firms to absorb the effect of credit contraction stemming from either tighter monetary policy or macroeconomic shocks.

Overall, our results indicate that the role of trade credit as a source of short-term financing and a guarantee of quality has been, on average, diminishing in recent years against a backdrop of significant changes in industrial composition and capital markets. This trend could be of concern at the policy level since small and young firms that dominate the corporate landscape, especially in emerging markets, tend to rely on trade credit to finance their operations given the limited access to capital markets. Such a decrease in informal or non-intermediated financing squeezes startups and smaller firms and might stifle innovation, hamper growth, and reduce employment.

## Appendix 1

See Table 14

**Table 14** Sample screening/filters

| Description  | Countries | Industries | Firms    | Observations |
|--|-----------|------------|----------|--------------|
| Opening sample   | 110       | 11         | 98,616   | 1,765,283    |
| <i>Less</i> : Firms in regulated sectors (financials and utilities)        | (10)      | (2)        | (23,453) | (413,679)    |
| <i>Less</i> : Missing data on key variables                                | (10)      | 0          | (9,418)  | (610,385)    |
| <i>Less</i> : Abnormal growth ( $\geq 100\%$ growth in assets or sales)    | 0         | 0          | 0        | (84,090)     |
| <i>Less</i> : Firms with less than five consecutive firm-year observations | (3)       | 0          | (23,965) | (127,922)    |
| <i>Less</i> : Countries with <i>less</i> than fifty observations           | (15)      | 0          | (13)     | (253)        |
| Final sample   | 72        | 9          | 41,767   | 528,954      |

This table presents the sample screening/filters applied to the data. The sample is drawn from *Datastream* over the period 1990–2019

**Appendix 2**

See Table 15

**Table 15** Cross-country trends in trade credit

| #  | Country/Region | Group | N      | Firms | AR    |        |       |           | AP    |        |       |           |
|----|----------------|-------|--------|-------|-------|--------|-------|-----------|-------|--------|-------|-----------|
|    |                |       |        |       | Mean  | Median | SD    | Trend     | Mean  | Median | SD    | Trend     |
| 1  | Australia      | DME   | 8093   | 805   | 0.163 | 0.137  | 0.131 | 0.000***  | 0.108 | 0.076  | 0.105 | 0.052***  |
| 2  | Austria        | DME   | 3128   | 205   | 0.203 | 0.180  | 0.110 | -0.029    | 0.095 | 0.088  | 0.059 | 0.106***  |
| 3  | Belgium        | DME   | 4035   | 295   | 0.194 | 0.183  | 0.125 | -0.312*** | 0.126 | 0.110  | 0.086 | -0.037**  |
| 4  | Canada         | DME   | 7054   | 779   | 0.148 | 0.123  | 0.122 | -0.214*** | 0.128 | 0.104  | 0.105 | -0.192*** |
| 5  | Denmark        | DME   | 6404   | 433   | 0.207 | 0.196  | 0.100 | -0.161*** | 0.090 | 0.076  | 0.060 | 0.077***  |
| 6  | Finland        | DME   | 6445   | 391   | 0.205 | 0.189  | 0.100 | -0.039**  | 0.092 | 0.077  | 0.075 | 0.154***  |
| 7  | France         | DME   | 16,208 | 1153  | 0.267 | 0.243  | 0.148 | -0.247*** | 0.148 | 0.125  | 0.100 | -0.155*** |
| 8  | Germany        | DME   | 15,285 | 1123  | 0.214 | 0.198  | 0.117 | -0.147*** | 0.103 | 0.081  | 0.081 | -0.015*   |
| 9  | Hong Kong      | DME   | 28,548 | 2618  | 0.160 | 0.127  | 0.130 | -0.083*** | 0.094 | 0.065  | 0.095 | -0.071*** |
| 10 | Ireland        | DME   | 2018   | 156   | 0.147 | 0.126  | 0.117 | -0.166*** | 0.111 | 0.093  | 0.092 | -0.108*** |
| 11 | Israel         | DME   | 2727   | 261   | 0.223 | 0.202  | 0.134 | -0.058    | 0.109 | 0.086  | 0.087 | 0.035     |
| 12 | Italy          | DME   | 1052   | 88    | 0.257 | 0.251  | 0.115 | -0.143*** | 0.170 | 0.152  | 0.091 | 0.041     |
| 13 | Japan          | DME   | 79,614 | 4516  | 0.230 | 0.219  | 0.138 | -0.194*** | 0.142 | 0.120  | 0.114 | -0.186*** |
| 14 | Netherlands    | DME   | 8143   | 562   | 0.227 | 0.197  | 0.140 | -0.442*** | 0.114 | 0.101  | 0.072 | -0.134*** |
| 15 | New Zealand    | DME   | 2820   | 236   | 0.119 | 0.092  | 0.104 | -0.026    | 0.085 | 0.069  | 0.083 | 0.025     |
| 16 | Norway         | DME   | 5675   | 501   | 0.149 | 0.117  | 0.114 | -0.159*** | 0.067 | 0.052  | 0.071 | -0.008    |
| 17 | Portugal       | DME   | 1343   | 103   | 0.142 | 0.108  | 0.115 | -0.212*** | 0.101 | 0.067  | 0.091 | 0.152***  |
| 18 | Singapore      | DME   | 15,302 | 1318  | 0.182 | 0.154  | 0.139 | 0.154***  | 0.116 | 0.087  | 0.106 | 0.021*    |
| 19 | Spain          | DME   | 10,323 | 722   | 0.209 | 0.173  | 0.142 | -0.308*** | 0.134 | 0.102  | 0.108 | 0.045***  |
| 20 | Sweden         | DME   | 16,309 | 1182  | 0.217 | 0.210  | 0.111 | -0.037*** | 0.092 | 0.079  | 0.064 | 0.069***  |

Table 15 continued

| #  | Country/Region | Group | N       | Firms  | AR    |        |       |           | AP    |        |       |           |
|----|----------------|-------|---------|--------|-------|--------|-------|-----------|-------|--------|-------|-----------|
|    |                |       |         |        | Mean  | Median | SD    | Trend     | Mean  | Median | SD    | Trend     |
| 21 | Switzerland    | DME   | 12,690  | 763    | 0.202 | 0.189  | 0.103 | -0.045*** | 0.088 | 0.073  | 0.066 | -0.018**  |
| 22 | United Kingdom | DME   | 25,822  | 2164   | 0.205 | 0.186  | 0.143 | -0.291*** | 0.125 | 0.101  | 0.104 | -0.182*** |
| 23 | United States  | DME   | 72,804  | 6216   | 0.167 | 0.146  | 0.123 | -0.234*** | 0.089 | 0.066  | 0.080 | -0.062*** |
|    | Total          |       | 351,842 | 26,590 | 0.198 | 0.180  | 0.133 | -0.182*** | 0.112 | 0.086  | 0.097 | -0.082*** |

| #  | Country              | Group | N      | Firms | AR    |        |       |           | AP    |        |       |           |
|----|----------------------|-------|--------|-------|-------|--------|-------|-----------|-------|--------|-------|-----------|
|    |                      |       |        |       | Mean  | Median | SD    | Trend     | Mean  | Median | SD    | Trend     |
| 1  | Argentina            | EME   | 1614   | 142   | 0.171 | 0.137  | 0.126 | 0.456***  | 0.122 | 0.093  | 0.097 | 0.464***  |
| 2  | Bangladesh           | EME   | 217    | 32    | 0.136 | 0.137  | 0.096 | 0.560*    | 0.066 | 0.037  | 0.096 | -0.606**  |
| 3  | Bosnia & Herzegovina | EME   | 238    | 28    | 0.127 | 0.104  | 0.100 | -0.041    | 0.064 | 0.046  | 0.058 | -0.008    |
| 4  | Brazil               | EME   | 7741   | 654   | 0.179 | 0.158  | 0.110 | -0.104*** | 0.083 | 0.061  | 0.075 | 0.026*    |
| 5  | Bulgaria             | EME   | 847    | 90    | 0.183 | 0.165  | 0.128 | -0.111    | 0.114 | 0.082  | 0.125 | -0.268*** |
| 6  | Chile                | EME   | 3261   | 229   | 0.167 | 0.144  | 0.111 | 0.117***  | 0.080 | 0.061  | 0.065 | 0.145***  |
| 7  | China                | EME   | 26,278 | 2509  | 0.161 | 0.139  | 0.117 | 0.366***  | 0.096 | 0.078  | 0.072 | 0.070***  |
| 8  | Colombia             | EME   | 208    | 28    | 0.080 | 0.065  | 0.044 | 0.073     | 0.054 | 0.046  | 0.037 | 0.432***  |
| 9  | Croatia              | EME   | 814    | 87    | 0.157 | 0.124  | 0.145 | 0.234*    | 0.111 | 0.088  | 0.128 | 0.072     |
| 10 | Cyprus               | EME   | 285    | 36    | 0.114 | 0.055  | 0.133 | -0.319    | 0.065 | 0.038  | 0.069 | 0.001     |
| 11 | Czech Republic       | EME   | 125    | 19    | 0.163 | 0.150  | 0.102 | -0.064    | 0.111 | 0.063  | 0.118 | -0.248    |
| 12 | Egypt                | EME   | 1211   | 121   | 0.187 | 0.144  | 0.154 | 0.365***  | 0.099 | 0.065  | 0.135 | 0.349***  |
| 13 | Estonia              | EME   | 208    | 18    | 0.050 | 0.032  | 0.038 | 0.035     | 0.083 | 0.047  | 0.066 | 0.247*    |
| 14 | Greece               | EME   | 5431   | 411   | 0.269 | 0.255  | 0.148 | -0.460*** | 0.119 | 0.094  | 0.097 | 0.215***  |
| 15 | Hungary              | EME   | 1299   | 94    | 0.176 | 0.147  | 0.116 | 0.055     | 0.111 | 0.098  | 0.070 | 0.216***  |
| 16 | India                | EME   | 10,891 | 969   | 0.231 | 0.207  | 0.138 | -0.035    | 0.138 | 0.114  | 0.106 | -0.013    |

Table 15 continued

| #  | Country      | Group | N      | Firms | AR    |        |       |           | AP    |        |       |           |
|----|--------------|-------|--------|-------|-------|--------|-------|-----------|-------|--------|-------|-----------|
|    |              |       |        |       | Mean  | Median | SD    | Trend     | Mean  | Median | SD    | Trend     |
| 17 | Indonesia    | EME   | 11,492 | 909   | 0.145 | 0.116  | 0.118 | -0.062*** | 0.095 | 0.065  | 0.095 | 0.034***  |
| 18 | Ivory Coast  | EME   | 60     | 6     | 0.194 | 0.160  | 0.124 | 0.231     | 0.050 | 0.000  | 0.105 | 0.625     |
| 19 | Jordan       | EME   | 929    | 98    | 0.182 | 0.150  | 0.142 | -0.050    | 0.060 | 0.049  | 0.053 | 0.031     |
| 20 | Kenya        | EME   | 277    | 28    | 0.186 | 0.178  | 0.095 | 0.386***  | 0.129 | 0.084  | 0.112 | 0.428**   |
| 21 | Kuwait       | EME   | 594    | 58    | 0.166 | 0.121  | 0.141 | -0.092    | 0.075 | 0.050  | 0.079 | 0.466***  |
| 22 | Latvia       | EME   | 217    | 23    | 0.178 | 0.163  | 0.130 | 0.216     | 0.070 | 0.057  | 0.071 | 0.033     |
| 23 | Lithuania    | EME   | 182    | 19    | 0.183 | 0.146  | 0.126 | -0.163    | 0.105 | 0.102  | 0.050 | 0.125     |
| 24 | Luxembourg   | EME   | 539    | 49    | 0.144 | 0.136  | 0.095 | -0.380*** | 0.073 | 0.062  | 0.058 | -0.248*** |
| 25 | Malaysia     | EME   | 15,672 | 1269  | 0.192 | 0.171  | 0.129 | -0.047*** | 0.085 | 0.062  | 0.078 | 0.100***  |
| 26 | Mauritius    | EME   | 93     | 9     | 0.131 | 0.097  | 0.082 | -0.384*   | 0.103 | 0.056  | 0.104 | -0.068    |
| 27 | Mexico       | EME   | 7773   | 515   | 0.127 | 0.109  | 0.087 | 0.004     | 0.096 | 0.073  | 0.081 | 0.059***  |
| 28 | Morocco      | EME   | 458    | 44    | 0.364 | 0.318  | 0.186 | 0.503**   | 0.173 | 0.148  | 0.100 | 0.214*    |
| 29 | Nigeria      | EME   | 353    | 44    | 0.182 | 0.157  | 0.136 | 0.286     | 0.151 | 0.118  | 0.154 | 0.889***  |
| 30 | Oman         | EME   | 640    | 60    | 0.229 | 0.191  | 0.161 | 0.716***  | 0.123 | 0.074  | 0.122 | -0.247**  |
| 31 | Pakistan     | EME   | 3014   | 270   | 0.148 | 0.117  | 0.123 | 0.205***  | 0.104 | 0.068  | 0.117 | 0.329***  |
| 32 | Peru         | EME   | 2058   | 176   | 0.136 | 0.112  | 0.099 | -0.097*** | 0.074 | 0.055  | 0.067 | 0.305***  |
| 33 | Philippines  | EME   | 3186   | 261   | 0.126 | 0.103  | 0.095 | -0.021    | 0.076 | 0.058  | 0.069 | -0.079*** |
| 34 | Poland       | EME   | 4473   | 438   | 0.233 | 0.205  | 0.151 | -0.186*** | 0.149 | 0.116  | 0.129 | 0.244***  |
| 35 | Qatar        | EME   | 62     | 8     | 0.070 | 0.060  | 0.058 | 0.559*    | 0.035 | 0.010  | 0.068 | 0.407     |
| 36 | Russia       | EME   | 2484   | 254   | 0.133 | 0.094  | 0.113 | 0.027     | 0.084 | 0.052  | 0.107 | 0.241***  |
| 37 | Saudi Arabia | EME   | 1018   | 99    | 0.119 | 0.081  | 0.111 | 0.144*    | 0.060 | 0.040  | 0.070 | 0.177***  |
| 38 | Serbia       | EME   | 78     | 11    | 0.210 | 0.196  | 0.097 | 1.102*    | 0.131 | 0.129  | 0.063 | -0.439    |
| 39 | Slovenia     | EME   | 227    | 26    | 0.138 | 0.129  | 0.092 | -0.630*** | 0.095 | 0.067  | 0.084 | -0.020    |
| 40 | South Africa | EME   | 8831   | 679   | 0.203 | 0.179  | 0.142 | -0.153*** | 0.164 | 0.124  | 0.137 | -0.281*** |

Table 15 continued

| #  | Country              | Group | N       | Firms  | AR    |        |       | AP        |       |        |       |           |
|----|----------------------|-------|---------|--------|-------|--------|-------|-----------|-------|--------|-------|-----------|
|    |                      |       |         |        | Mean  | Median | SD    | Trend     | Mean  | Median | SD    | Trend     |
| 41 | South Korea          | EME   | 23,517  | 2030   | 0.201 | 0.179  | 0.112 | -0.178*** | 0.094 | 0.072  | 0.079 | -0.043*** |
| 42 | Sri Lanka            | EME   | 1683    | 162    | 0.156 | 0.119  | 0.126 | -0.256*** | 0.072 | 0.045  | 0.091 | -0.338*** |
| 43 | Thailand             | EME   | 15,048  | 1065   | 0.153 | 0.125  | 0.123 | -0.002    | 0.091 | 0.065  | 0.087 | 0.057***  |
| 44 | Tunisia              | EME   | 713     | 70     | 0.206 | 0.192  | 0.104 | 0.209**   | 0.166 | 0.130  | 0.112 | 0.524***  |
| 45 | Turkey               | EME   | 6027    | 493    | 0.245 | 0.216  | 0.167 | -0.253*** | 0.143 | 0.106  | 0.128 | 0.348***  |
| 46 | Ukraine              | EME   | 76      | 10     | 0.330 | 0.295  | 0.147 | 0.749     | 0.227 | 0.211  | 0.132 | 3.038***  |
| 47 | United Arab Emirates | EME   | 395     | 37     | 0.162 | 0.108  | 0.150 | 0.010     | 0.058 | 0.041  | 0.063 | -0.004    |
| 48 | Venezuela            | EME   | 53      | 7      | 0.116 | 0.106  | 0.048 | 0.758***  | 0.098 | 0.070  | 0.076 | 2.000***  |
| 49 | Vietnam              | EME   | 4222    | 483    | 0.228 | 0.203  | 0.153 | 0.431***  | 0.119 | 0.092  | 0.101 | 0.163***  |
|    | Total                |       | 177,112 | 15,177 | 0.182 | 0.155  | 0.130 | -0.002    | 0.103 | 0.076  | 0.095 | 0.044***  |

This table presents summary statistics for all the variables used. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively



### Appendix 3

See Table 16

Table 16 The implications of changes in trade credit

| Panel A: USA                       |                       |                       |                       |                       |                       |                       |                       |                       |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| ATC Proxy                          |                       |                       |                       | AAP                   |                       |                       |                       |                       |
| Variables                          | Tobin's $q$<br>(1)    | SGrowth<br>(2)        | Capex<br>(3)          | $\Delta$ Emp<br>(4)   | Tobin's $q$<br>(5)    | SGrowth<br>(6)        | Capex<br>(7)          | $\Delta$ Emp<br>(8)   |
| $\Delta TC_{ikt}$                  | 2.771***<br>(0.206)   | 2.230***<br>(0.047)   | 2.230***<br>(0.047)   | 0.037***<br>(0.007)   | 2.399***<br>(0.205)   | 1.919***<br>(0.048)   | 1.919***<br>(0.048)   | 0.139***<br>(0.009)   |
| $TC_{ikt-1}$                       | 1.337***<br>(0.157)   | 0.318***<br>(0.019)   | 0.318***<br>(0.019)   | 0.026***<br>(0.005)   | 1.821***<br>(0.180)   | 0.544***<br>(0.028)   | 0.544***<br>(0.028)   | 0.077***<br>(0.007)   |
| $\Delta TC_{ikt} \cdot TC_{ikt-1}$ | - 3.306***<br>(0.602) | - 2.581***<br>(0.131) | - 2.581***<br>(0.131) | - 0.102***<br>(0.017) | - 5.500***<br>(0.926) | - 2.826***<br>(0.203) | - 2.826***<br>(0.203) | - 0.402***<br>(0.033) |
| Constant                           | 5.260***<br>(0.321)   | 0.383***<br>(0.033)   | 0.383***<br>(0.033)   | 0.108***<br>(0.009)   | 5.595***<br>(0.307)   | 0.544***<br>(0.034)   | 0.544***<br>(0.034)   | 0.086***<br>(0.009)   |
| Controls                           | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Firm FE                            | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Year FE                            | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| N                                  | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                |
| Adj.R <sup>2</sup>                 | 0.130                 | 0.276                 | 0.276                 | 0.110                 | 0.124                 | 0.175                 | 0.175                 | 0.117                 |

| Panel B: DME (excluding the USA)   |                       |                       |                       |                       |                       |                       |                       |                       |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| ATC Proxy                          |                       |                       |                       | AAP                   |                       |                       |                       |                       |
| Variables                          | Tobin's $q$<br>(1)    | SGrowth<br>(2)        | Capex<br>(3)          | $\Delta$ Emp<br>(4)   | Tobin's $q$<br>(5)    | SGrowth<br>(6)        | Capex<br>(7)          | $\Delta$ Emp<br>(8)   |
| $\Delta TC_{ikt}$                  | 2.771***<br>(0.206)   | 2.230***<br>(0.047)   | 2.230***<br>(0.047)   | 0.037***<br>(0.007)   | 2.399***<br>(0.205)   | 1.919***<br>(0.048)   | 1.919***<br>(0.048)   | 0.139***<br>(0.009)   |
| $TC_{ikt-1}$                       | 1.337***<br>(0.157)   | 0.318***<br>(0.019)   | 0.318***<br>(0.019)   | 0.026***<br>(0.005)   | 1.821***<br>(0.180)   | 0.544***<br>(0.028)   | 0.544***<br>(0.028)   | 0.077***<br>(0.007)   |
| $\Delta TC_{ikt} \cdot TC_{ikt-1}$ | - 3.306***<br>(0.602) | - 2.581***<br>(0.131) | - 2.581***<br>(0.131) | - 0.102***<br>(0.017) | - 5.500***<br>(0.926) | - 2.826***<br>(0.203) | - 2.826***<br>(0.203) | - 0.402***<br>(0.033) |
| Constant                           | 5.260***<br>(0.321)   | 0.383***<br>(0.033)   | 0.383***<br>(0.033)   | 0.108***<br>(0.009)   | 5.595***<br>(0.307)   | 0.544***<br>(0.034)   | 0.544***<br>(0.034)   | 0.086***<br>(0.009)   |
| Controls                           | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Firm FE                            | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| Year FE                            | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| N                                  | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                | 72,804                |
| Adj.R <sup>2</sup>                 | 0.130                 | 0.276                 | 0.276                 | 0.110                 | 0.124                 | 0.175                 | 0.175                 | 0.117                 |

Table 16 continued

| Panel B: DME (excluding the USA) |                      | ΔAR                  |                      | ΔAAP                 |                      |                      |                      |                      |
|----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Variables                        | Tobin's $q$<br>(1)   | SGrowth<br>(2)       | Capex<br>(3)         | ΔEmp<br>(4)          | Tobin's $q$<br>(5)   | SGrowth<br>(6)       | Capex<br>(7)         | ΔEmp<br>(8)          |
| $\Delta TC_{it}$                 | 1.263***<br>(0.080)  | 1.538***<br>(0.022)  | 1.538***<br>(0.022)  | 0.020***<br>(0.003)  | 1.034***<br>(0.076)  | 1.092***<br>(0.019)  | 1.092***<br>(0.019)  | 0.040***<br>(0.003)  |
| $TC_{it-1}$                      | 0.966***<br>(0.056)  | 0.164***<br>(0.008)  | 0.164***<br>(0.008)  | 0.005**<br>(0.002)   | 0.718***<br>(0.050)  | 0.256***<br>(0.009)  | 0.256***<br>(0.009)  | 0.013***<br>(0.002)  |
| $\Delta TC_{it} \cdot TC_{it-1}$ | -1.063***<br>(0.256) | -1.355***<br>(0.056) | -1.355***<br>(0.056) | -0.072***<br>(0.009) | -1.605***<br>(0.258) | -0.451***<br>(0.066) | -0.451***<br>(0.066) | -0.094***<br>(0.010) |
| Constant                         | 2.259***<br>(0.141)  | 0.437***<br>(0.017)  | 0.437***<br>(0.017)  | 0.101***<br>(0.007)  | 2.763***<br>(0.145)  | 0.599***<br>(0.018)  | 0.599***<br>(0.018)  | 0.094***<br>(0.006)  |
| Controls                         | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Firm FE                          | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Year FE                          | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| N                                | 279,038              | 279,038              | 279,038              | 279,038              | 279,038              | 279,038              | 279,038              | 279,038              |
| Adj.R <sup>2</sup>               | 0.179                | 0.212                | 0.212                | 0.100                | 0.175                | 0.143                | 0.143                | 0.100                |

| Panel C: EME     |                     | ΔAR                 |                     | ΔAAP                |                     |                     |                     |                     |
|------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Variables        | Tobin's $q$<br>(1)  | SGrowth<br>(2)      | Capex<br>(3)        | ΔEmp<br>(4)         | Tobin's $q$<br>(5)  | SGrowth<br>(6)      | Capex<br>(7)        | ΔEmp<br>(8)         |
| $\Delta TC_{it}$ | 0.617***<br>(0.074) | 1.357***<br>(0.024) | 1.357***<br>(0.024) | 0.027***<br>(0.004) | 0.305***<br>(0.074) | 1.036***<br>(0.049) | 1.036***<br>(0.049) | 0.080***<br>(0.026) |
| $TC_{it-1}$      | 0.237***<br>(0.068) | 0.189***<br>(0.012) | 0.189***<br>(0.012) | 0.016***<br>(0.005) | 0.759***<br>(0.072) | 0.285***<br>(0.018) | 0.285***<br>(0.018) | 0.024***<br>(0.005) |

**Table 16** continued

| Panel C: EME                     |                       | ΔAR                   |                       | ΔAP                  |                     |                       |                       |                     |
|----------------------------------|-----------------------|-----------------------|-----------------------|----------------------|---------------------|-----------------------|-----------------------|---------------------|
| ATC Proxy                        | Tobin's <i>q</i>      | SGrowth               | Capex                 | ΔEmp                 | Tobin's <i>q</i>    | SGrowth               | Capex                 | ΔEmp                |
| Variables                        | (1)                   | (2)                   | (3)                   | (4)                  | (5)                 | (6)                   | (7)                   | (8)                 |
| $\Delta TC_{it} \cdot TC_{it-1}$ | - 1.336***<br>(0.206) | - 1.367***<br>(0.067) | - 1.367***<br>(0.067) | - 0.070**<br>(0.034) | - 0.258<br>(0.278)  | - 0.603***<br>(0.218) | - 0.603***<br>(0.218) | - 0.100<br>(0.064)  |
| Constant                         | 4.273***<br>(0.277)   | 0.771***<br>(0.029)   | 0.771***<br>(0.029)   | 0.149***<br>(0.014)  | 4.127***<br>(0.274) | 0.838***<br>(0.031)   | 0.838***<br>(0.031)   | 0.133***<br>(0.015) |
| Controls                         | Yes                   | Yes                   | Yes                   | Yes                  | Yes                 | Yes                   | Yes                   | Yes                 |
| Firm FE                          | Yes                   | Yes                   | Yes                   | Yes                  | Yes                 | Yes                   | Yes                   | Yes                 |
| Year FE                          | Yes                   | Yes                   | Yes                   | Yes                  | Yes                 | Yes                   | Yes                   | Yes                 |
| N                                | 177,112               | 177,112               | 177,112               | 177,112              | 177,112             | 177,112               | 177,112               | 177,112             |
| Adj.R <sup>2</sup>               | 0.139                 | 0.175                 | 0.175                 | 0.008                | 0.140               | 0.134                 | 0.134                 | 0.009               |

This table presents the estimation results of Eq. (2) that relates firm performance, employment, growth, and investment to changes in trade credit ( $\Delta TC$ ), lagged trade credit ( $TC_{it-1}$ ), an interaction term between these two ( $\Delta TC_{it} \cdot TC_{it-1}$ ), and a set of control variables. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME) and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively. Robust standard errors are in parentheses

## Appendix 4

See Table 17

Table 17 The changes in trade credit around the financial crisis

| Variables          | 2002–2012             |                       |                       |                       |                       | 2006–2009             |                       |                       |                       |                     |
|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------|
|                    | AR<br>(1)             | ΔAR<br>(2)            | AP<br>(3)             | ΔAP<br>(4)            | NTC<br>(5)            | AR<br>(6)             | ΔAR<br>(7)            | AP<br>(8)             | ΔAP<br>(9)            | NTC<br>(10)         |
| Crisis             | - 0.004***<br>(0.001) | - 0.005***<br>(0.000) | - 0.002***<br>(0.000) | - 0.005***<br>(0.000) | - 0.002***<br>(0.000) | - 0.006***<br>(0.001) | - 0.018***<br>(0.000) | - 0.005***<br>(0.001) | - 0.010***<br>(0.000) | - 0.001*<br>(0.001) |
| Constant           | - 0.283<br>(0.000)    | - 0.097<br>(0.000)    | 0.113<br>(0.000)      | 0.010<br>(59.398)     | - 0.396<br>(0.000)    | 0.201<br>(18.010)     | 0.012<br>(0.000)      | 0.137<br>(13.728)     | 0.012<br>(9.816)      | 0.061<br>(0.000)    |
| Controls           | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                 |
| Firm FE            | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                  |
| Industry FE        | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                 |
| Country FE         | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                 |
| Year FE            | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                    | No                  |
| N                  | 236,732               | 236,732               | 236,732               | 236,732               | 236,732               | 88,814                | 88,814                | 88,814                | 88,814                | 88,814              |
| Adj.R <sup>2</sup> | 0.253                 | 0.037                 | 0.128                 | 0.019                 | 0.179                 | 0.265                 | 0.072                 | 0.139                 | 0.046                 | 0.188               |

This table presents the estimation results of a version of Eq. (1) that relates trade credit to a crisis dummy and a set of control variables. Crisis is a dummy variable that takes a value of one for the period 2008–2012 (window [-5, +5]) and 2008–2009 (window [-2, +2]). The alternative windows reduce the effect of other confounding events. The sample consists of listed non-utility and non-financial firms from 72 countries, including the US (USA), developed countries excluding the US (DME), and emerging economies (EME) drawn from *Datastream* over the period 1990–2019. The macroeconomic variables are drawn from the World Bank and Federal Reserve Economic Data. All variables used are defined in Table 1, and are winsorised at the lower and upper one percentiles

\*\*\*, \*\*, \* denote significance at the one, five, and ten percent levels, respectively

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