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ORIGINAL RESEARCH

Does CEO inside debt enhance firms' access to trade credit?

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Abstract
In this study, we investigate whether CEO inside debt, a compensation mechanism designed to align managers' and debtholders' interests, plays a role in facilitating firms' ability to secure higher trade credit from their suppliers. We argue that CEO inside debt offers heightened assurance to trade creditors, resulting in their greater willingness to extend higher levels of trade credit. Firms perceive this as a favourable source of short-term financing compared to traditional bank financing due to its cost-effectiveness and considerably lower barriers to access. Contrary to the previous studies, our empirical analysis encompassing a sample of non-financial firms in the United States reveals a significant positive relationship between CEO inside debt and firms' ability to secure trade credit. This confirms our assertion that trade credit suppliers' increased willingness to accept a higher level of risk is driven by the confidence instilled by the CEO inside debt holdings. Furthermore, we show that this relationship is significantly stronger in financially constrained firms, where it serves as a critical assurance mechanism for suppliers of trade credit. Suggesting that CEO inside debt play a key role in sustaining financially constrained firms that are typically neglected by formal lending institutions.

Keywords Trade credit · Short-term debt · Inside debt · Financial constraints · CEO compensation

JEL Classification G30 · G32 · G34

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1 Introduction

Executive compensation structure is an important governance mechanism that restricts managerial opportunism by reducing agency costs and information asymmetry between managers and shareholders (Cheng 2004; Lin et al. 2011; Nguyen 2018). While equity-based pay is presented as a suitable fix for the shareholder-manager agency conflict, encouraging risk-averse managers to pursue value-creating risky investment strategies (Guay 1999; Low 2009). However, it also encourages excessive risk-taking, which may worsen cash flow asymmetry problems and trigger risk transfer from shareholders to debtholders (Jensen and Meckling 1976), thereby increasing firms' cost of external financing (Ortiz-Molina 2006). As a suitable fix to this issue, Edmans and Liu (2011) recommend the inclusion of debt-like components in executive pay to ensure that managers act in the best interest of debtholders. Consequently, studies have demonstrated that CEO inside debt deters management from adopting risky financial policies (Cassell et al. 2012). This reduces the overall cost of capital (Shen and Zhang 2021), thereby benefitting both shareholders and debtholders (Borah et al. 2020; Lee et al. 2021). However, it remains unknown whether CEO inside debt reduces agency costs for firms' suppliers, who are providers of an important source of alternate finance to firms, i.e., trade credit.

Following the subprime crisis of 2008, trade credit has emerged as a prominent source of short-term finance for businesses (Baños-Caballero et al. 2023; Carbó-Valverde et al. 2016; Gonçalves et al. 2018). Though trade credit is technically a financing tool for working capital management, adequate use of trade credit has proven to be an important driver of firms' growth (Tingbani et al. 2022) by promoting corporate investments (Filomeni et al. 2023). Nevertheless, suppliers' interests are relatively weakly protected in comparison to bondholders and lending institutions due to the absence of formal collateral and contractual seniority (Garcia-Appendini and Montoriol-Garriga 2020). Additionally, international insolvency and bankruptcy legislations rank supplier claims lower than the claims of other creditors of the firms (i.e., lending institutions and bondholders) with suppliers being exposed to greater risk than shareholders in the event of default under certain circumstances (De Weijs 2018). Thus, the likelihood of a supplier encountering financial difficulties is directly associated with the likelihood of financial distress of its primary customer (Lian 2017). In such scenarios, it becomes prudent for suppliers to consider the valuable insights offered by the CEO inside debt information when determining their credit supply strategies. This is because a greater commitment through inside debt from CEOs signifies a deeper personal investment, instilling a sense of confidence and assurance among trade credit providers (Srivastav et al. 2014, 2018).

In this context, we investigate whether CEO inside debt leads to higher levels of trade credit (relative to short-term debt payable) for non-financial firms. Through the evaluation of the ratio of trade credit to a firm's outstanding short-term debt, our objective is to discern the extent to which a company relies on its suppliers to fulfil its short-term financial obligations. Conventional lending institutions, such as banks, often impose stringent covenant conditions on firms and curtail access to credit avenues once credit limits are reached or covenant stipulations are breached. Interestingly, suppliers may not possess this level of insight, and for agency purposes, may want to assess a firm's reliance on trade credit relative to institutional credit. An increased reliance on trade credit implies riskier financing strategies, thus emphasizing the significance of CEOs' internal debt in this context. Further, as the

default risk is comparatively higher in financially constrained firms (He and Ron, 2023), we believe that the significance of the assurance signalled by the CEO inside debt will be more important for suppliers of financially constrained firms.

To empirically test these predictions, we consider firm-level data of 1,132 publicly listed firms (obtained from the Compustat, ExecuComp and CRSP databases) in the United States (US) from the year 2007 to 2022.[1] Following prior studies, we use *CEO Relative Leverage* and *CEO Relative Incentive* as our primary measures of CEO inside debt (Dhole et al. 2016; Freund et al. 2018; Shen and Zhang 2020). Since we are interested in measuring the relative exposure of suppliers vis-à-vis other debtholders to the firm, we consider the ratio of accounts payable to the debt in current liabilities (*AP/DLC*) and the ratio of accounts payable to the debt maturing in one year (*AP/DD1*), as measures of firm's adoption of trade credit. As debt in current liabilities largely consists of unsecured bank debt (i.e., bank acceptances and overdrafts), notes payable to banks and others, and debt maturing in one year represent the short-term portion of secured long-term debt (particularly bank debt), these measures help in gauging the exposure of suppliers to the firm relative to the firm's other secured and unsecured creditors of similar maturity. This gauging is important to the suppliers, as, institutional lenders typically hold a higher priority than trade credit suppliers since failure to meet obligations to them can trigger bankruptcy risk and solvency concerns (Lin et al. 2013; Garcia-Appendini and Montoriol-Garriga 2020).

In line with the predictions of agency theory, our panel regression analysis reveals that an increase in levels of CEO inside debt leads to higher levels of trade credit. Economically, a 10% increase in CEO inside debt causes trade credit to increase by approximately 3%.[2] This affirms that the presence of CEO inside debt offers a higher level of confidence to trade credit suppliers, assuring them that their interests are safeguarded. Consequently, this leads to an increased willingness on the part of suppliers to extend higher trade credit to the firm. However, our findings are opposite to Hasan et al. (2022), who report that increasing level of CEO inside debt decreases the supply of trade credit. Which contradicts agency theory. This could be because unlike us, they focus only on trade credit measures that ignore the tension between two major recipients of a firm's short-term payments – banks and trade creditors. We elaborate on this further in the additional tests section. Regardless, our main results are robust to endogeneity concerns and a battery of additional tests.

Furthermore, we explore whether the association between CEO inside debt and the supply of trade credit is affected by firms' financial constraints. To investigate this, we interact the CEO inside debt measure with measures of financial constraints and consider the impact of this interaction term on trade credit. We consider three empirical proxies of financial constraints – the *SA Index* (Hadlock and Pierce 2010), the *WW Index* (Whited and Wu 2006) and the absence of dividend payments (Fazzari et al. 1988). Test results reveal that the coefficients of all interaction terms between CEO inside debt and all three measures of financial constraints are significantly positive. This indicates that the assurance signal conveyed by the CEO inside debt becomes increasingly consequential as the level of financial constraints

[1] We commence our sample from the year 2007 due to the implementation of SEC's heightened disclosure standards pertaining to CEO compensation, which took effect in 2006. Consequently, data regarding CEO inside debt is accessible solely from 2007 onward.

[2] We take the average effect of CEO inside debt measures discussed in Sect. 4.2 for a simpler interpretation. The regression results show that a 1% increase in *CEO Relative Leverage* leads to a 0.26% increase in *AP/DLC* and a 0.298% increase in *AP/DD1*. Similarly, a 1% increase in *CEO Relative Incentive* leads to a 0.307% increase in *AP/DLC* and a 0.335% increase in *AP/DD1*.

increases. This suggests that as the default risk increases with the level of financial constraints, trade credit suppliers increasingly rely on inside debt as a mitigating factor for the elevated default risk. Thus, CEO inside debt is critical for financially constrained firms in securing higher levels of trade credit.

Our contributions are as follows. Firstly, we expand the research on the benefits of CEO inside debt, highlighting its positive impacts on securing higher trade credit, particularly for financially constrained firms. By doing so, we also extend the literature on how management characteristics influence trade credit. While prior studies focus on the social capital of managers (Liu et al. 2016; Xia et al. 2019) and managerial competency (Khoo and Cheung 2022; Quan et al. 2023) in securing favourable credit terms, our focus on the compensation structure of the CEO, specifically the debt component, provides insights on how the alignment of CEO's incentives with those of the debtholders could lead to increased funding from the suppliers, via trade credit, to the firm.

Secondly, our research highlights that the relationship between trade credit and CEO inside debt is more pronounced in financially constrained firms. This sheds light on the vital role suppliers assume in sustaining financially constrained companies, particularly when accessing funds from formal institutional lenders seems difficult. In these circumstances, the CEO inside debt serves as a crucial source of assurance, symbolizing a more substantial personal commitment and instilling confidence and trust among trade credit providers.

2 Literature review and hypotheses development

2.1 Trade credit and short-term financing

Despite higher implicit costs due to cash discounts (Petersen and Rajan 1997), trade credit is an important source of short-term financing as it is relatively easier to obtain than bank credit (Barrot 2016). Additionally, firms that rely on higher trade credit deliver higher stock returns. This is because suppliers, armed with superior insights into their customers' potential, offer trade credit to seize upon the future profitability of these firms (Goto et al. 2015). During periods of systemic crisis when businesses usually face a credit crunch, trade credit is reported to help financially constrained firms weather the crisis (Carbó-Valverde et al. 2016). Hence, trade credit is an important component of short-term financing that influences operating performance (Afrifa et al. 2024) and the stability of supply chains (Ersahin et al. 2024). Therefore, understanding the factors that affect the supply of trade credit to firms has always been an important question. Information asymmetry and moral hazard problems, which create inefficiencies in credit allocation and hamper financial contracting (Akerlof 1970; Haselmann et al. 2018), are the primary factors that affect trade credit supply (Dao et al. 2022; Ouyang et al. 2024). Therefore, the reduction of information asymmetry and the associated agency problems can enhance the supply of trade credit (Wu et al. 2014).

2.2 Information asymmetry and trade credit – the role of management

While early studies focused on firm characteristics as a source of information asymmetry in obtaining trade credit, recent studies have turned their attention towards firms' management as an enabling factor for symmetry in information and lowering agency costs. Based

on the premise that informal financing, such as trade credit, relies on trust and relationships (Ayyagari et al. 2010), Wu et al. (2014) find that firms operating in regions with stronger social trust have greater ease in accessing credit. This is attributed to the reduced moral hazard issues, which consequently lower the agency costs for credit-supplying firms. Applying this perspective to the social capital of management, Liu et al. (2016) reveal that board members' professional connections play a crucial role in mitigating information asymmetry and lowering credit risk for suppliers. Consequently, suppliers are more inclined to offer credit to firms whose managers have professional connections within industry associations. Likewise, Xia et al. (2019) explore the impact of social capital possessed by independent directors on trade credit. They find that well-connected independent directors enhance a firm's capacity to secure trade credit.

Focusing on managerial ability, Baik et al. (2018) emphasize that skilled managers play a crucial role in improving a firm's information environment, resulting in a reduced likelihood of default risk. As a result, competent managers are better positioned to obtain higher levels of trade credit compared to their less capable counterparts (Khoo and Cheung 2022). Similarly, firms led by award-winning CEOs also signal reduced credit risk, leading suppliers to extend more trade credit to these firms (Quan et al. 2023). However, it remains unknown whether the executive compensation structure, which can significantly influence managerial incentives, affects the supply of trade credit.

2.3 Executive compensation structure and trade credit – the role of inside debt

Executive compensation structure is an important corporate governance mechanism that mitigates the information asymmetry between shareholders and management, thereby reducing agency costs (Cheng 2004). Since equity-based compensation encourages risk-averse managers to employ value-added risk strategies (Guay 1999; Low 2009), studies have found that CEO's equity incentives lead to higher investment in research and development, and corporate innovation (Coles et al. 2006; Lin et al. 2011; Nguyen 2018). Nevertheless, within a leveraged company, an equity-aligned manager might embark on a high-risk venture, even if it yields a negative net present value (NPV), as shareholders reap the rewards of the potential gain while facing limited liability on the potential loss (Jensen and Meckling 1976). Supporting this proposition, Jebran et al. (2022) reveal that when CEOs receive overly generous compensation packages, it tends to fuel their inclination towards greed, prompting them to adopt high-risk corporate strategies that can ultimately erode the value of the firm. Thus, equity-based compensation exacerbates firms' information asymmetry problems associated with cash flow (Xu 2013) and increases the cost of external financing (Ortiz-Molina 2006). Elsilä (2015) reveals that CEOs with higher levels of equity incentives undertake greater risks including the provision of trade credit even to financially distressed customers.

Therefore, although equity-based compensation addresses the shareholder-manager agency conflict, it can trigger a shareholder-bondholder conflict by incentivizing excessive risk-taking and transferring risk from shareholders to debtholders (Jensen and Meckling 1976). The convexity of equity holders' claims against the firm's assets leads to their expected returns growing exponentially as the firm's risk increases. In contrast, debtholders experience concave payoffs because their claims' value has limited upside potential. There-

fore, taking on higher risks results in a greater likelihood of losses for debtholders without the corresponding potential for gains enjoyed by equity holders (Srivastav et al. 2014).

Thus, the inclusion of debt-like components, like pensions and deferred compensation, in executive pay packages would incentivize managers to cater to the debtholders' interests as well (Edmans and Liu 2011). Such inside debt in the top executive's compensation reduces default risk (Sundaram and Yermack 2007) by curbing managerial overconfidence (Galariotis et al. 2023) and reducing investment in risky projects (Cassell et al. 2012). Further, CEO inside debt has also been found to curb managerial opportunism by constraining earnings management (Dhole et al. 2016) and improving the value of cash holdings (Liu et al. 2014). Consequently, the implementation of inside debt has been found to reduce the overall risk and cost of capital for the firm, leading to improved firm performance, which ultimately benefits both shareholders and debtholders (Borah et al. 2020; Shen and Zhang 2020; Lee et al. 2021).

Given that CEO inside debt mitigates the transfer of risk from shareholders to bondholders (Edmans and Liu 2011; Srivastav et al. 2014), Freund et al. (2018) find that higher levels of inside debt increase the proportion of debt financing while at the same time enabling the firm to issue such debt at lower costs. Thus, when the CEO's debt and equity incentives are aligned with the capital structure of the company, the CEO becomes dedicated to balancing the interests of shareholders and debtholders optimally (Jensen and Meckling 1976; Edmans and Liu 2011).

However, the question of whether CEO inside debt holdings lead to higher trade credit remains unanswered. Since suppliers' claims rank lower in preference to that of the claims of financial institutions and bondholders (De Weijs 2018), suppliers are at a higher risk than financial institutions in extending credit to the firm. By signifying CEOs' deeper personal investment and instilling a sense of confidence and assurance among trade credit providers, CEO inside debt may act as an assurance to suppliers regarding the repayment of credit. Against this backdrop, we put forward the following hypothesis:

H1: There is a positive association between CEO inside debt and the supply of trade credit.

2.4 Financial constraint, CEO inside debt and supply of trade credit

According to the pecking order theory of capital structure (Myers and Majluf 1984), managers resort to external financing only when internal funds have been exhausted. Among external funds, debt is preferred due to the lower information cost associated with debt, when compared to equity. While Modigliani and Miller (1958) hypothesize that internal and external funds bear the same cost, market imperfections like information asymmetry and agency problems lead to financial constraints resulting in external funds becoming costlier than internal funds (Akerlof 1970; Jensen and Meckling 1976). Cash inadequacy in financially constrained firms, not only leads to missed investment opportunities (Fazzari et al. 1988) but also increases the probability of a crash in stock prices (He and Ren 2023) and affects the optimal level of trade credit in a firm (Baker et al. 2022; Wang et al. 2024). Moreover, Bussoli et al. (2023) show that financially constrained firms are more likely to resort to trade credit financing during times of crisis when access to bank credit becomes highly limited. Therefore, the fulfilment of suppliers' claims vis-à-vis the bankers' claims becomes a perti-

nent issue in financially constrained firms. Hence, it follows that the assurance function of the CEO inside debt to suppliers becomes more important in financially constrained firms than in unconstrained firms. We formally test this prediction using the following hypothesis:

H2: The positive association between CEO inside debt and trade credit is more pronounced in financially constrained firms.

3 Data, covariates and empirical methodology

3.1 Sample selection

As the SEC's enhanced executive compensation disclosure requirements came into effect in December 2006, we began our sample in 2007 (Hasan et al. 2022). Thus, the study period is from 2007 to 2022. Our dataset comprises executive compensation data sourced from the ExecuComp database. Accounting and stock-related data have been collected from Compustat and CRSP databases. We first merge the annual financial statement data obtained from the Compustat database with the CEO inside debt data extracted from the ExecuComp database. This gives us 31,481 firm-year observations of 2,760 firms. To maintain comparability with previous studies, we exclude utility (SIC code 4900–4999) and financial (SIC code 6000–6999) firms, since the business model and financial reporting practices of firms in these industries are usually very different from firms in other non-financial industries (Hasan et al. 2022, 2023).[3] Next, to account for any potential bias in our analysis resulting from non-reporting of inside debt information by firms, we restrict our sample to those firms whose CEOs have been reported to have non-zero inside debt holdings (Freund et al. 2018). This excludes 1,291 observations for missing CEO inside debt measures and 11,665 observations for CEOs with zero inside debt. Finally, after removing firm-year observations with missing information for control variables, we ended up with 1,132 firms comprising 9,233 firm-year observations. The detailed sampling procedure has been outlined in Appendix A.

3.2 Definition of variables

3.2.1 Defining CEO inside debt

Jensen and Meckling (1976) and Edmans and Liu (2011) suggest that when the level of debt-like components (pension and deferred compensation) in the CEO's compensation matches the firm's debt-to-equity ratio, the management acts in the best interests of both debtholders and shareholders thereby preventing the transfer of risk from shareholders to debtholders. Since we are interested in testing whether suppliers' interests are protected when there is such alignment, we consider two relative measures of the CEO leverage ratio namely, *CEO Relative Leverage* and *CEO Relative Incentive* developed by Edmans and Liu (2011) and Wei and Yermack (2011). *CEO Relative Leverage* is measured as the ratio of CEO inside debt holdings to equity-based holdings scaled by the firm's debt-equity ratio.

[3] Utility firms and financial firms account for approximately 25% of our initial observations, which is in alignment with Hasan et al. (2023).

CEO Relative Incentive is measured as the ratio of the marginal change in the value of CEO inside debt holdings to the marginal change in CEO inside equity holdings given the change in firm value, all scaled by the firm's respective debt-equity ratio. These measures have been extensively used in the literature to proxy the alignment of CEO's incentives with that of the debtholders (Cassell et al. 2012; Dhole et al. 2016; Freund et al. 2018, 2021; Shen and Zhang 2020; Hasan et al. 2022, 2023). We use the natural log-transformed version of these variables to address concerns relating to skewness (Freund et al. 2021).[4] See Appendix B for further details.

3.2.2 Defining trade credit

In any typical financial year, depending on the company's chosen financial strategy, the bulk of mandatory payments is funnelled toward its two primary creditors: trade creditors and banks (or similar lending institutions). To assess the dynamics between trade creditors and financial entities, we employ two measures. One evaluates the ratio of accounts payable to the company's short-term debt (*AP/DLC*), while the other assesses accounts payable relative to the debt due to the company's lenders within a year (*AP/DD1*).

Trade credit, although categorized as short-term debt, differs substantially from the short-term credit offered by financial institutions in terms of its purpose, nature, and associated risks. The fundamental purpose of trade credit is to mitigate information asymmetry within product markets (Biais and Gollier 1997; Long et al. 1993; Smith 1987). However short-term lending is a core business activity for financial institutions. Consequently, trade credit manifests as the short-term provision of goods and services, in contrast to the short-term cash loans extended by banking institutions (Cuñat and Garcia-Appendini 2012). Moreover, trade credit lacks the formal contracts or covenants typically used to enforce credit terms (Wu et al. 2014). As a result, suppliers face a higher level of credit risk compared to bankers, and the recovery rates for trade credit are generally lower than those for bank credit in the case of default (Garcia-Appendini and Montoriol-Garriga 2020). In certain situations, the systemic treatment of suppliers' claims, inferior to those of financial institutions, can expose suppliers to greater risk than shareholders in the event of default (De Weijs 2018).

Additionally, applying the Pecking Order Theory of Myers and Majluf (1984), Petersen and Rajan (1994) suggest that firms prefer cost-effective bank loans as their primary source of financing and only resort to more expensive trade credit when bank loans are no longer accessible. Due to its high cost, Wilner (2000) and Cuñat (2007) argue that trade credit is typically used as a last resort, particularly during liquidity crises or financial turmoil. However, several studies, such as those by Marotta (2005) and Miwa and Ramseyer (2008), challenge the assumption that the cost of trade credit invariably exceeds that of bank loans by raising questions about the exogeneity of bank loan availability.

Furthermore, studies by Aktas et al. (2012), Biais and Gollier (1997), and Jain (2001) suggest that suppliers might possess an informational advantage over banks. This explains why the absence of effective internal control systems does not deter trade creditors (Dao et al. 2022). In fact, the quantum of trade credit possessed by a firm can influence banks' lending decisions to the firm. Accordingly, Atanasova (2012) shows that trade credit can have a

[4] Additionally, to prevent the possibility of values less than one becoming negative after the log transformation, we added one to the inside debt measures before applying the natural log transformation. See Appendix B.

positive impact on securing bank loans for firms with substantial agency costs, supporting the idea that trade credit serves as a signal of borrowers' creditworthiness. In this context, the use of trade credit can be seen as a favourable signal to financial intermediaries (Jatmiko et al. 2023), prompting firms facing high agency costs to rely on supplier debt for financing their operations (Dao et al. 2022). However, as suppliers function as unsecured lenders in contrast to banks who are secured lenders (Tsuruta 2015), suppliers incur significant losses when customers default on trade credit (Lian 2017).

Considering the above discussion, we want to see if CEOs inside debt can act as an assurance for the suppliers to compensate for the increased credit risk borne by them and make suppliers trust companies more and offer higher trade credit. The conventional measures of trade credit (accounts payable divided by total assets, accounts payable divided by the cost of goods sold) used in prior studies (Petersen and Rajan 1997; Wu et al. 2014; Liu et al. 2016; Xia et al. 2019; Hasan et al. 2022; Hasan et al. 2023) fail to capture the increased credit risk that suppliers bear relative to bankers. Hence, it is not possible to study the impact of assurance provided by the CEO inside debt to the suppliers using these conventional measures.

Therefore, to assess the credit risk borne by the suppliers, we measured trade credit in a manner that captures the risk suppliers face relative to other formal creditors like bondholders, banks, and financial institutions. Accordingly, the first measure looks at the value of accounts payable relative to the company's short-term debt (*AP/DLC*), and the other looks at the value of accounts payable relative to the debt that needs to be paid to the firm's lenders within one year (*AP/DD1*).

Our measures are arguably superior to the usual way of measuring trade credit in the literature that involves scaling accounts payable by total assets or cost of goods sold. This is because our measures let us compare how much suppliers lend to the company relative to other short-term debts in the company, like short-term bank loans, notes payable, and the debt that needs to be paid before they are paid. This helps us understand how much risk suppliers take compared to bank creditors, as suppliers are at a lower priority than banks when it comes to getting paid. When *AP/DLC* and *AP/DD1* are greater than one, it means that suppliers are taking on more risk compared to secured bank creditors and thus, CEO inside debt is more likely to play an important role in assessing credit supply decisions. As these measures are also heavily skewed like the CEO inside debt measures, we use the natural log transformation of these measures to mitigate estimation issues arising from extreme skewness. See Appendix B for details.

3.2.3 Control variables

We employ a standard set of controls identified in prior studies as determinants of trade credit supply (Liu et al. 2016; Xia et al. 2019; Wu et al. 2014; Hasan et al. 2022). First, we control for *Firm Size* since large and mature firms have better access to external financing and, therefore, these firms use less trade credit (Petersen and Rajan 1997; Hasan et al. 2022). Next, we control for the firm's indebtedness by including *Leverage* (Hasan et al. 2022). We then control for the level of *Cash Holdings* since the liquidity position of the firm affects the use of trade credit as a source of financing (Petersen and Rajan 1997; Hasan et al. 2022). Since profitable firms gain more trade credit, we include a control for the firm's *Profitability* (Petersen and Rajan 1997; Chod et al. 2019; Hasan et al. 2022). As a firm with more

investment opportunities has an advantage to extend and gain more trade credit from suppliers (Petersen and Rajan 1997; Chod et al. 2019), we control for the market-to-book ratio (*MTB*). Next, we include a control for asset tangibility, *PPE*, since retailers' access to external financing could be related to their tangible assets, which are easier to collateralize (Chod et al. 2019; Shang 2020; Hasan et al. 2022). We then control for the firm's market power (*Market Share*) which can result in higher access to trade credit (Wilner 2000; Chod et al. 2019). Next, we include controls for growth opportunities (*Sales Growth*) as in D'Mello and Toscano (2020). As firms with more asymmetric information tend to use more trade credit, we control for the level of research and development expenses (*R&D*) (Kling et al. 2014). We then control for operating performance by considering return on assets (*ROA*) as firms with high potential for growth and operating performance have a competitive advantage in gaining credit from suppliers (Petersen and Rajan 1997; Chod et al. 2019). Since a greater cash flow generating capacity indicates a better liquidity position (Love et al. 2007), we include a control for *Cash Flow* as well. As it is more likely that trade credit drops for firms that cut capital expenditure (Zhang 2019), we control for *CAPEX*. Lastly, we include a few controls for other CEO characteristics like *CEO Age* and *CEO Tenure*, since older CEOs and those with longer tenure are more likely to have higher inside debt (Dang and Phan 2016; Freund et al. 2021). The measurement of all variables is described in Appendix B.

3.3 Regression model

To investigate whether debt in the CEO's compensation impacts trade credit, we consider the following multivariate regression model:

$$\begin{aligned} TradeCredit_{i,t} = \beta_0 + \beta_1 CEOLeverage_{i,t-1} \\ + Controls_{i,t-1} + IndFE + YearFE + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where *TradeCredit* is the dependent variable which represents the extent of credit provided by the suppliers of the firm relative to bank credit as defined in Sect. 3.2.2. Our primary independent variable is *CEOLeverage* which represents the extent of debt-like components in the CEO's compensation. As explained in the previous sections, *TradeCredit* is measured by *AP/DLC* and *AP/DD1* while *CEOLeverage* is measured by *CEO Relative Leverage* and *CEO Relative Incentive*. We employ a pooled cross-sectional regression model with industry (*IndFE)* and year-fixed effects (*YearFE*) to account for the influence of unobserved or latent factors specific to different industries or years within the dataset. *Controls* represent the vector of control variables for other firm-specific attributes and CEO characteristics that may influence the level of trade credit extended by suppliers. Since the information available in the current time period is generally used to make credit supply decisions in the next time period, we lagged all the time-varying regressors by one time period. Further, to account for any potential outliers, all continuous variables are winsorized at their 1st and 99th percentile values.

Since financially constrained firms are more likely to default on their payments to creditors than non-financially constrained firms, we conjecture that the importance of the assurance provided by the CEO inside debt to suppliers will increase with the rise in financial constraints in the firm. We consider three proxies to measure financial constraints – the SA index developed by Hadlock and Pierce (2010), the WW index developed by Whited and

Wu (2006) and dividend payments (Fazzari et al. 1988).[5] The financial constraint of a firm increases with increasing values of the SA index and the WW index. As Fazzari et al. (1988) and Denis and Sibilkov (2010) explain, firms that do not pay dividends typically signal financial constraints. To test our hypothesis, *H2*, which posits that the positive association between CEO inside debt and trade credit is more pronounced in financially constrained firms, we modify Eq. (1) as follows:

$$\begin{aligned} TradeCredit_{i,t} = {} & \beta_0 + \beta_1 CEOLeverage_{i,t-1} + \beta_2 Constraints_{i,t-1} \\ & + \beta_3 CEOLeverage_{i,t-1} \times Constraints_{i,t-1} \\ & + Controls_{i,t-1} + IndFE + YearFE + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where *Constraints* represents financial constraints measured by *SA Index*, *WW Index* or Dividend payments. If the relationship between CEO inside debt and trade credit is more pronounced in financially constrained firms, we would expect β_3 to be positive and significant in Eq. (2).

4 Empirical results and discussion

4.1 Descriptive and univariate regression analysis

Table 1 presents the descriptive statistics of the variables employed in this study. The trade credit measures, *AP/DLC* and *AP/DD1* have a mean of 1.592 and 2.085, and a median of 1.385 and 1.885, respectively.[6] The mean (median) values of *CEO Relative Leverage* and *CEO Relative Incentive*, after the natural log transformation as explained in Sect. 3.2.1, are 0.790 (0.466) and 0.690 (0.383) respectively. These values are comparable to those reported by Freund et al. (2021).[7] Further, similar to Hasan et al. (2022), we find that on average, the firms in our sample are fairly large in size (*Firm Size*=8.403), have lower levels of debt (*Leverage*=0.297) and are mostly profitable (*Profitability*=11%). The summary statistics reported for other control variables are similar to those reported by D'Mello and Toscano (2020).

Next, the correlation matrix in Table 2 indicates a positive and significant correlation between our *CEOLeverage* measures (*CEO Relative Leverage* and *CEO Relative Incentive*) and *TradeCredit* measures (*AP/DLC* and *AP/DD1*). The pair-wise correlation coefficients between *CEO Relative Leverage* and the other control variables are less than 0.5. Similarly, the correlations between *CEO Relative Incentive* and other control variables are less than 0.5. This indicates that there is no serious multicollinearity concern in our baseline regression models.

[5] The SA Index and WW Index have also been winsorized at their 1st and 99th percentile values.

[6] The mean (median) values of *AP/DLC* and *AP/DD1* before log transformation are 37.07 (4.404) and 72.329 (7.855), respectively, which suggests that these variables are highly skewed. This justifies the use of natural log transformation for mitigating skewness-related issues.

[7] The mean (median) values of *CEO Relative Leverage* and *CEO Relative Incentive* before log transformation are 3.291 (0.594) and 2.564 (0.466) respectively. These values are comparable to the untransformed values reported by Freund et al. (2018). They report a mean (median) value of 3.236 (0.201) and 2.542 (0.160) for *CEO Relative Leverage* and *CEO Relative Incentive* respectively.

Table 1 Descriptive statistics

Variable	*N*	Mean	Median	Q1	Q3	Min	Max	Sigma
AP/DLC	9233	1.592	1.385	0.243	2.689	–2.775	7.254	1.931
AP/DD1	8664	2.085	1.885	0.628	3.248	–2.534	7.612	2.033
CEO Relative Leverage	9233	0.790	0.466	0.149	1.086	0.002	5.170	0.942
CEO Relative Incentive	9233	0.690	0.383	0.120	0.911	0.002	4.959	0.880
Firm Size	9233	8.403	8.286	7.350	9.381	4.375	11.813	1.458
Leverage	9233	0.297	0.276	0.172	0.393	0.000	0.955	0.182
Cash Holding	9233	0.102	0.072	0.032	0.142	0.001	0.758	0.097
Profitability	9233	0.110	0.104	0.059	0.160	–1.902	0.444	0.129
MTB	9233	1.844	1.530	1.176	2.121	0.671	9.049	1.096
PPE	9233	0.284	0.214	0.115	0.403	0.008	0.893	0.220
Market Share	9233	0.024	0.008	0.003	0.026	0.000	0.200	0.039
R&D	9233	0.016	0.001	0.000	0.020	0.000	0.375	0.031
ROA	9233	0.138	0.132	0.096	0.173	–0.409	0.427	0.076
Cash Flow	9233	0.090	0.091	0.059	0.127	–0.516	0.335	0.076
Capex	9227	0.045	0.033	0.019	0.056	0.001	0.294	0.041
Sales Growth	9230	0.063	0.050	–0.020	0.129	–0.502	1.472	0.198
CEO Age	9116	4.033	4.043	3.970	4.111	3.689	4.317	0.111
CEO Tenure	8934	1.856	1.792	1.386	2.398	0.000	3.555	0.733
SA Index	9233	–4.473	–4.373	–5.156	–3.829	–5.892	–2.781	0.775
WW Index	9230	–0.412	–0.409	–0.465	–0.355	–0.593	–0.165	0.079
Non_Div	9233	0.307	0	0	1	0	1	0.461

Notes: The descriptive statistics for the variables used in this study are depicted in this table. It shows the mean, standard deviation, minimum and maximum values, 1st quartile, median and 3rd quartile for each variable. All variables are defined in Appendix B

Then, we perform univariate analysis to first check whether the major control variables adopted by previous studies have significant effects on the variables of interest in our study, *AP/DLC* and *AP/DD1*. The results in Table 3 show that the univariate regression coefficients are significant for the following control variables: *Firm Size*, *Leverage*, *Cash Holdings*, *Profitability*, *MTB*, *PPE* and *Market Share*. Interestingly, the univariate analysis also reveals that several of the control variables (*R&D*, *ROA, Cash Flow, Capex, Sales Growth, CEO Age, and CEO Tenure*) have an insignificant relationship with trade credit. Hence, we exclude these insignificant control variables from our subsequent multivariate regression analysis but include them back later in the robustness tests. It is worth noticing that in the univariate regressions of both *AP/DLC* and *AP/DD1*, both measures of inside debt, *CEO Relative Leverage* and *CEO Relative Incentive*, have positive and significant coefficients. The magnitude of these coefficients suggests that a 1% increase in *CEO Relative Leverage* leads to an increase in *AP/DLC* and *AP/DD1* by 0.4% and 0.45%, respectively. Similarly, a 1% increase in *CEO Relative Incentive* causes a 0.46% increase in *AP/DLC* and a 0.49% increase in *AP/DD1*, respectively.

Further, our graphical depiction of the relationship between our CEO inside debt measures (*CEO Relative Leverage* and *CEO Relative Incentive*) and trade credit measures (*AP/DLC* and *AP/DD1*) shows a dramatic rise in trade credit for the higher decile groups (8 to 10) of CEO inside debt (Figs. 1 and 2). This suggests that information pertaining to CEO inside debt is critical for suppliers of firms showing significantly higher reliance on trade credit. Overall, our preliminary findings add credence to our alignment argument that debt-

Table 2 Correlation matrix

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
AP/DLC	(1)	1										
AP/DD1	(2)	**0.834**	1									
CEO Relative Leverage	(3)	**0.208**	**0.224**	1								
CEO Relative Incentive	(4)	**0.223**	**0.227**	**0.990**	1							
Firm Size	(5)	**–0.157**	**–0.119**	**–0.098**	**–0.133**	1						
Leverage	(6)	**–0.300**	**–0.313**	**–0.415**	**–0.414**	**0.159**	1					
Cash Holding	(7)	**0.037**	**0.026**	**0.237**	**0.245**	**–0.115**	**–0.240**	1				
Profitability	(8)	**–0.165**	**–0.131**	**0.055**	**0.039**	**0.185**	**0.024**	**0.068**	1			
MTB	(9)	**–0.067**	**–0.040**	**0.221**	**0.212**	**–0.033**	–0.008	**0.273**	**0.322**	1		
PPE	(10)	–0.002	**–0.065**	**–0.101**	**–0.089**	**0.067**	**0.131**	**–0.239**	**–0.141**	**–0.172**	1	
Market Share	(11)	**–0.109**	**–0.066**	**0.034**	0.014	**0.549**	**0.057**	**–0.028**	**0.094**	0.018	**–0.053**	1
R&D	(12)	**–0.038**	–0.002	**0.184**	**0.175**	**–0.025**	**–0.151**	**0.377**	**0.129**	**0.315**	**–0.266**	–0.017
ROA	(13)	–0.007	**0.028**	**0.149**	**0.135**	–0.015	**–0.037**	**0.064**	**0.518**	**0.533**	0.016	**0.030**
Cash Flow	(14)	–0.012	0.019	**0.15**	**0.138**	**0.034**	**–0.141**	**0.083**	**0.496**	**0.457**	**0.056**	**0.040**
Capex	(15)	**0.033**	0.005	**–0.042**	**–0.036**	0.017	–0.004	**–0.143**	**–0.066**	**–0.036**	**0.658**	**–0.057**
Sales Growth	(16)	–0.005	–0.009	–0.004	0.003	0.010	**–0.044**	**–0.034**	**0.240**	**0.104**	**–0.041**	**–0.025**
CEO Age	(17)	–0.008	–0.011	**0.075**	**0.080**	**0.109**	0.002	–0.001	**0.037**	–0.001	**0.024**	**0.058**
CEO Tenure	(18)	0.004	–0.009	**0.046**	**0.059**	**–0.084**	**–0.040**	–0.003	0.008	**0.036**	0.021	**–0.061**
SA Index	(19)	**0.074**	0.004	**–0.050**	**–0.026**	**–0.297**	**0.006**	**0.070**	–0.012	–0.002	–0.014	**–0.199**
WW Index	(20)	**0.131**	**0.083**	0.014	**0.050**	**–0.919**	**–0.055**	**0.113**	**–0.232**	**–0.031**	**–0.068**	**–0.520**
Non_Div	(21)	**0.038**	0.003	**–0.087**	**–0.069**	**–0.295**	**0.056**	**0.096**	**–0.117**	**–0.043**	**–0.047**	**–0.187**

		(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
R&D	(12)	1									
ROA	(13)	**0.085**	1								
Cash Flow	(14)	**0.071**	**0.671**	1							
Capex	(15)	**–0.124**	**0.203**	**0.201**	1						
Sales Growth	(16)	**0.041**	**0.219**	**0.231**	**0.029**	1					
CEO Age	(17)	**–0.033**	0.020	**0.031**	0.011	0.006	1				

Table 2 (continued)

		(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
CEO Tenure	(18)	–0.010	0.013	**0.041**	**0.043**	**0.062**	**0.422**	1			
SA Index	(19)	0.004	**0.026**	–0.016	**0.033**	**0.097**	**–0.111**	**0.026**	1		
WW Index	(20)	**0.042**	**–0.103**	**–0.172**	**–0.024**	**–0.036**	**–0.121**	**0.070**	**0.356**	1	
Non_Div	(21)	**0.094**	**–0.130**	**–0.142**	–0.008	**0.068**	**–0.080**	**0.028**	**0.324**	**0.615**	1

Notes: This table reports pairwise correlation coefficients between variables. A correlation coefficient in bold indicates the statistical significance at 5% or better. All correlation coefficients are estimated at the firm level. All variables are defined in Appendix B

Table 3 Univariate regression analysis

Variable	AP/DLC		AP/DD1	
	Coefficient	t–statistics	Coefficient	t–statistics
(1)	(2)	(3)	(4)	(5)
CEO Relative Leverage	0.401***	8.849	0.447***	10.150
CEO Relative Incentive	0.461***	9.794	0.493***	10.761
Firm Size	–0.156***	–5.173	–0.083***	–2.607
Leverage	–2.796***	–11.327	–2.925***	–12.748
Cash Holdings	0.703*	1.772	0.465	1.136
Profitability	–1.621***	–5.371	–1.250***	–4.321
MTB	–0.007*	–1.697	0.001	0.300
PPE	–0.473*	–1.760	–0.770***	–2.969
Market Share	–2.730**	–2.325	0.198	0.159
R&D	–2.339	–1.514	–0.728	–0.486
ROA	–0.318	–0.607	0.504	0.976
Cash Flow	–0.433	–1.040	0.428	1.050
Capex	0.064	0.056	0.124	0.108
Sales Growth	–0.025	–0.229	–0.136	–1.223
CEO Age	–0.112	–0.344	0.135	0.406
CEO Tenure	–0.001	–0.014	0.014	0.287

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). This table reports univariate OLS regression estimates of respective covariates using *AP/DLC and AP/DD1* as the dependent variable. The sample period ranges from the year 2007 to 2022. Only those control variables which show significance in the univariate regression are included in the multivariate regression models estimated using Eq. (1). Column 2 reports the regression coefficient (β) for *AP/DLC* as the dependent variable, Column 3 indicates the *t*-statistics for the respective coefficient, Column 4 the regression coefficient (β) for *AP/DD1* as dependent variable, column 5 indicates the *t*-statistics for the respective coefficient. Detailed variable definitions are provided in Appendix B

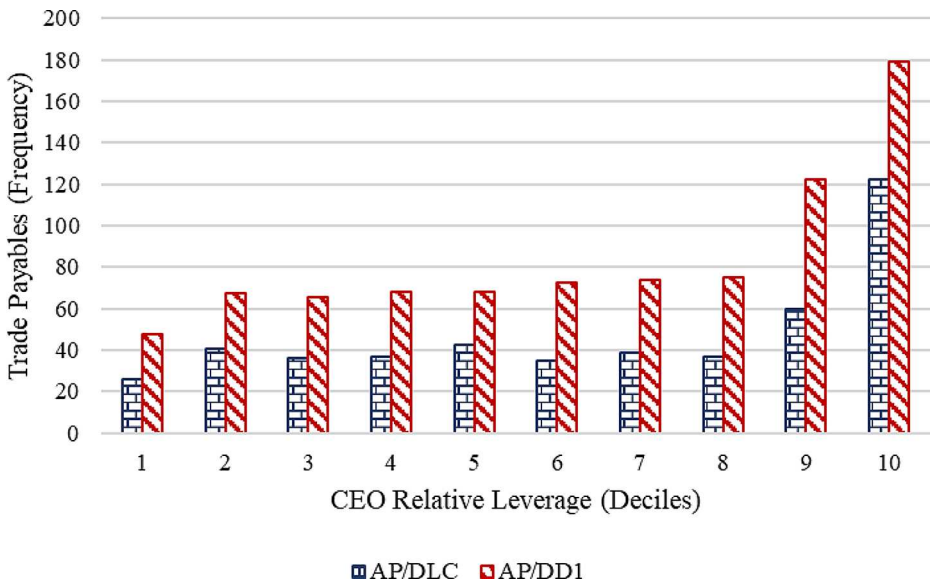

Fig. 1 Trade payables and CEO relative leverage

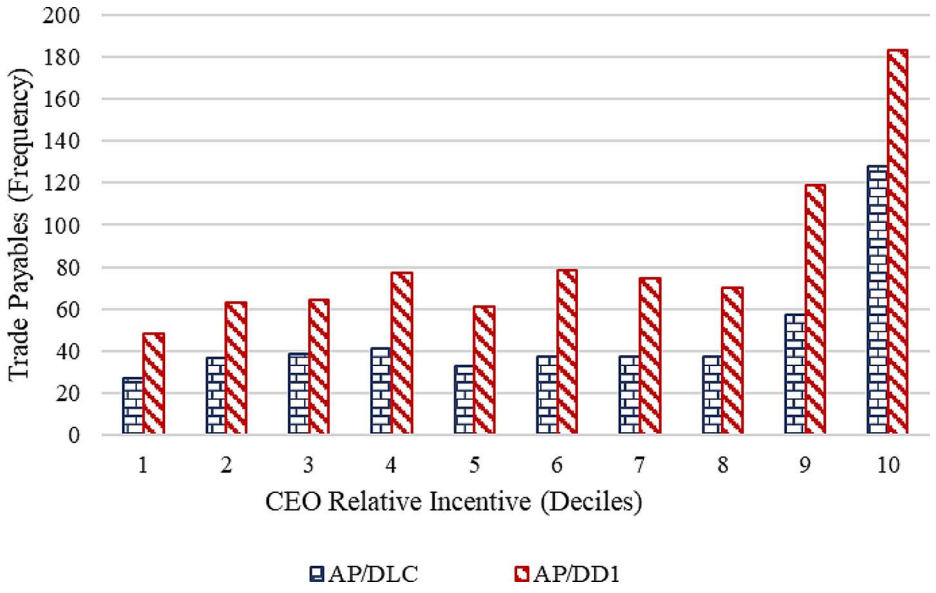

Fig. 2 Trade payables and CEO relative incentive

like components in executive compensation are effective in mitigating manager and trade creditor-related agency issues.

4.2 Test of H1

4.2.1 Association between inside debt and trade credit

Table 4 presents the multivariate regression results obtained using Eq. (1). For this main analysis, we consider only the control variables which have been identified to have a significant influence on trade credit in the univariate analysis, i.e., *Firm Size*, *Leverage*, *Cash Holdings*, *Profitability*, *MTB*, *PPE* and *Market Share*. Firstly, in the regression showing the effect of CEO inside debt on *AP/DLC* (i.e., trade credit versus formal short-term debt), we observe positive and statistically significant coefficients on *CEO Relative Leverage* (Column 2) and *CEO Relative Incentive* (Column 4). This suggests that CEO inside debt increases accounts payable relative to formal short-term debt (i.e., short-term credit by banks and financial institutions). Subsequently, in the regressions on *AP/DD1* (i.e., trade credit versus the long-term debt maturing in one year), both *CEO Relative Leverage* (Column 3) and *CEO Relative Incentive* (Column 5) have positive and significant coefficients at the 1% significance level. This suggests that CEO inside debt also increases accounts payable relative to long-term debt maturing in one year. Put together, these findings suggest that CEO inside debt has a positive impact on the supply of trade credit.

In terms of magnitude, a 1% increase in *CEO Relative Leverage* is associated with about 0.26% increase in *AP/DLC*, whereas a 1% increase in *CEO Relative Incentive* is associated with about 0.307% increase in *AP/DLC*. For *AP/DD1*, a 1% increase in *CEO Relative Leverage* is associated with a 0.298% increase in *AP/DD1*, whereas a 1% increase in

Table 4 Baseline multivariate regression models

Variable	AP/DLC	AP/DD1	AP/DLC	AP/DD1
(1)	(2)	(3)	(4)	(5)
CEO Relative Leverage	**0.260*****	**0.298*****		
	(5.585)	(6.277)		
CEO Relative Incentive			**0.307*****	**0.335*****
			(6.250)	(6.705)
Firm Size	−0.083**	−0.026	−0.073*	−0.017
	(−2.160)	(−0.717)	(−1.907)	(−0.456)
Leverage	−2.312***	−2.407***	−2.263***	−2.384***
	(−8.579)	(−9.636)	(−8.400)	(−9.530)
Cash Holdings	−0.046	0.014	−0.047	0.014
	(−1.229)	(0.390)	(−1.269)	(0.411)
Profitability	−0.428	−1.064***	−0.475	−1.099***
	(−1.098)	(−2.819)	(−1.219)	(−2.924)
MTB	−1.345***	−1.256***	−1.336***	−1.247***
	(−5.114)	(−4.612)	(−5.103)	(−4.597)
PPE	−0.342	−0.599**	−0.354	−0.613**
	(−1.269)	(−2.325)	(−1.316)	(−2.376)
Market Share	−1.099	0.089	−1.191	0.034
	(−0.806)	(0.064)	(−0.873)	(0.025)
Constant	3.100***	3.142***	3.022***	3.075***
	(7.485)	(7.210)	(7.262)	(6.999)
Industry Dummy	Y	Y	Y	Y
Year Dummy	Y	Y	Y	Y
Adj.R^2	0.197	0.229	0.199	0.230
Obs.	9233	8664	9233	8664

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). *t*-statistics are in parentheses. This table reports regression coefficients (β) of the multivariate OLS regressions of trade payable variables on CEO inside debt and the controls. The sample period ranges from the year 2007 to 2022. Columns 2 and 4 report regression coefficients (β) of the multivariate OLS regressions of *AP/DLC* on *CEO Relative Leverage* and *CEO Relative Incentive* respectively. Columns 3 and 5 report regression coefficients (β) of the multivariate OLS regressions of *AP/DD1* on *CEO Relative Leverage* and *CEO Relative Incentive* respectively. Industry fixed effects are based on Fama-French 49 industries. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Appendix B

CEO Relative Incentive is associated with about 0.335% increase in *AP/DD1*. Overall, our empirical findings strongly support *Hypothesis 1* that there is a positive association between CEO inside debt and the supply of trade credit.

As information asymmetry hampers the supply of trade credit (Wu et al. 2014; Liu et al. 2016), our findings suggest that aligning CEOs' leverage with that of the firm not only deters risk transfer from equity holders to debtholders (Edmans and Liu 2011) but also eases supplier information concerns, leading to increased provision of trade credit. Additionally, as CEO inside debt curtails excessive risk-taking (Cassell et al. 2012) and reduces default risk (Sundaram and Yermack 2007), our results also suggest that the incentive alignment effect of CEO inside debt ensures that the credit risk of suppliers is lowered, thus resulting in a higher supply of trade credit to firms. Most importantly, in the absence of formal contracts or collateral to protect suppliers' claims which exposes suppliers to greater risk than bankers (Garcia-Appendini and Montoriol-Garriga 2020), our findings suggest that CEO inside debt

compensates for the absence of these formal protection mechanisms. Overall, we find that a higher commitment through inside debt from CEOs signifies a deeper personal investment, instilling a sense of confidence and assurance among trade credit suppliers.

4.2.2 Mitigating endogeneity concerns

Endogeneity due to omitted variables and reverse causality could result in biased coefficients and inefficient standard errors of estimated regression coefficients. We address these concerns to establish the robustness of our findings as follows:

Additional Control Variables

To ensure that our regression results presented in Table 4 are not influenced by endogeneity arising due to time-varying omitted control variables (Roberts and Whited 2013), we re-estimate the baseline regression models with additional control variables found insignificant in the univariate regression analysis, i.e., *R&D, ROA, Cash Flow, Capex, Sales Growth, CEO Age, and CEO Tenure*. The regression results with these additional controls are presented in Table 5. The coefficients on *CEO Relative Leverage* and *CEO Relative Incentive* remain positive and statistically significant, thus confirming the robustness of our main results. The economic significance of our results also remains unchanged by the inclusion of these additional control variables, reinforcing that CEO inside debt is a significant predictor of trade credit.

Firm-fixed effects regression model

While the inclusion of additional controls addresses omitted variable bias arising from time-varying factors, it does not address bias arising from the omission of firm-specific attributes that do not vary with time. To address this concern, Roberts and Whited (2013) recommend the adoption of a firm-fixed effects panel regression model. For this, we first run the Hausman test and confirm that fixed effects are appropriate. Then, we re-estimate the regression models presented in Table 4 by supplementing firm-fixed effects to the baseline regression model in Eq. (1). The results are presented in Table 6. Similar to the main results reported in Table 4, the coefficients of all variables of interest, *CEO Relative Leverage* and *CEO Relative Incentive*, are statistically significant with positive signs.[8] This confirms that our findings do not suffer from endogeneity arising due to omitted time-invariant firm-specific factors.

Instrumental variables regression

Though our findings strongly support the notion that the CEO inside debt sends a strong signal to trade creditors regarding the commitment of CEOs toward debtholders (Edmans and Liu 2011), it could be possible that firms having low levels of trade credit could include debt-like components in executive compensation to access higher credit amounts from their suppliers. To mitigate this reverse causality issue, we adopt an instrumental variable (IV) approach which can effectively address endogeneity arising from reverse causality.

As executive compensation practices vary substantially between industries (Murphy 1999), we use the industry-year mean of *CEO Relative Leverage* and *CEO Relative Incentive* as instrumental variables (Cassell et al. 2012; Erkan and Nguyen 2021). We then perform a Two-Stage-Least-Squares (2SLS) regression analysis, the results of which are

[8] In economic terms, we find that a 1% percentage increase in *CEO Relative Leverage* is associated with about 0.375% increase in *AP/DLC* and 0.338% increase in *AP/DD1*, whereas a 1% increase in *CEO Relative Incentive* is associated with 0.417% increase in *AP/DLC* and 0.364% increase in *AP/DD1*.

Table 5 Multivariate regression models with additional control variables

Variable	AP/DLC	AP/DD1	AP/DLC	AP/DD1
(1)	(2)	(3)	(4)	(5)
CEO Relative Leverage	**0.257*****	**0.291*****		
	(5.555)	(6.156)		
CEO Relative Incentive			**0.306*****	**0.329*****
			(6.253)	(6.634)
Firm Size	–0.046	0.013	–0.036	0.023
	(−1.166)	(0.347)	(−0.909)	(0.608)
Leverage	–2.453***	–2.548***	–2.402***	–2.521***
	(−9.138)	(−9.990)	(−8.945)	(−9.859)
Cash Holdings	–0.248	–0.862**	–0.299	–0.901**
	(−0.635)	(−2.232)	(−0.765)	(−2.342)
Profitability	–2.035***	–2.115***	–2.032***	–2.116***
	(−5.112)	(−5.197)	(−5.128)	(−5.223)
MTB	–4.211***	–2.643*	–4.271***	–2.672*
	(−3.095)	(−1.839)	(−3.171)	(−1.869)
PPE	–0.405	–0.764**	–0.425	–0.784**
	(−1.284)	(−2.509)	(−1.347)	(−2.572)
Market Share	–2.006	–0.934	–2.113	–1.008
	(−1.448)	(−0.679)	(−1.524)	(−0.732)
R&D	–0.005	–0.001	–0.005	–0.001
	(−1.076)	(−0.187)	(−1.076)	(−0.180)
ROA	2.808***	3.312***	2.812***	3.341***
	(3.573)	(4.277)	(3.598)	(4.334)
Cash Flow	–1.823***	–1.233***	–1.801***	–1.213**
	(−3.862)	(−2.583)	(−3.821)	(−2.546)
CAPEX	0.168	0.723	0.204	0.735
	(0.148)	(0.605)	(0.179)	(0.615)
Sales Growth	0.188*	–0.058	0.174	–0.074
	(1.657)	(−0.529)	(1.538)	(−0.669)
CEO Age	–0.112	–0.142	–0.141	–0.163
	(−0.317)	(−0.394)	(−0.400)	(−0.455)
CEO Tenure	–0.044	–0.015	–0.045	–0.017
	(−0.888)	(−0.307)	(−0.928)	(−0.351)
Constant	3.261**	3.333**	3.300**	3.352**
	(2.260)	(2.260)	(2.290)	(2.276)
Industry Dummy	Y	Y	Y	Y
Year Dummy	Y	Y	Y	Y
Adj. R^2	0.206	0.235	0.208	0.237
Obs.	8892	8340	8892	8340

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). *t*-statistics are in parentheses. This table reports regression coefficients (β) of the multivariate OLS regressions of trade payable variables on CEO inside debt and the controls. The sample period ranges from the year 2007 to 2022. Columns 2 and 4 report regression coefficients (β) of the multivariate OLS regressions of *AP/DLC* on *CEO Relative Leverage* and *CEO Relative Incentive* respectively. Columns 3 and 5 report regression coefficients (β) of the multivariate OLS regressions of *AP/DD1* on *CEO Relative Leverage* and *CEO Relative Incentive* respectively. Industry fixed effects are based on Fama-French 49 industries. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Appendix B

Table 6 Baseline multivariate regression models with firm fixed effects

Variable	AP/DLC	AP/DD1	AP/DLC	AP/DD1
(1)	(2)	(3)	(4)	(5)
CEO Relative	**0.375*****	**0.338*****		
	(9.034)	(7.428)		
CEO Relative Incentive			**0.417*****	**0.364*****
			(9.444)	(7.536)
Firm Size	−0.276***	−0.346***	−0.271***	−0.341***
	(−3.447)	(−4.167)	(−3.388)	(−4.112)
Leverage	−1.627***	−1.818***	−1.605***	−1.815***
	(−7.484)	(−7.825)	(−7.391)	(−7.814)
Cash Holdings	−0.059	−0.024	−0.061	−0.024
	(−1.441)	(−0.540)	(−1.498)	(−0.554)
Profitability	−0.185	−0.812**	−0.191	−0.813**
	(−0.507)	(−2.027)	(−0.524)	(−2.034)
MTB	−0.181	−0.095	−0.181	−0.097
	(−1.008)	(−0.540)	(−1.002)	(−0.550)
PPE	−1.803***	−1.273***	−1.764***	−1.242***
	(−4.175)	(−2.841)	(−4.088)	(−2.779)
Market Share	0.238	0.951	0.196	0.945
	(0.111)	(0.418)	(0.092)	(0.415)
Constant	4.622***	5.905***	4.584***	5.879***
	(6.634)	(8.128)	(6.591)	(8.104)
Firm Dummy	Y	Y	Y	Y
Year Dummy	Y	Y	Y	Y
R^2	0.089	0.108	0.091	0.108
Obs.	9233	8664	9233	8664

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). *t*-statistics are in parentheses. This table reports regression coefficients (β) of the multivariate OLS regressions of trade payable variables on CEO inside debt and the controls. The sample period ranges from the year 2007 to 2022. Columns 2 and 4 report regression coefficients (β) of the multivariate OLS regressions of *AP/DLC* on *CEO Relative Leverage* and *CEO Relative Incentive* respectively. Columns 3 and 5 report regression coefficients (β) of the multivariate OLS regressions of *AP/DD1* on *CEO Relative Leverage* and *CEO Relative Incentive* respectively. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Appendix B

reported in Tables 7 and 8. Table 7 reports the regression results of 2SLS models of *AP/DLC* and *AP/DD1* and *CEO Relative Leverage*. In Column 2, the first stage of the 2SLS regression model, the original variable *CEO Relative Leverage* is regressed on industry-year mean *CEO Relative Leverage* (IV) and the results indicate that there is a strong relationship between *CEO Relative Leverage* and the IV. In columns 3 and 4, *AP/DLC* and *AP/DD1* are regressed on the predicted value obtained from the first stage regression. The coefficients of instrumented *CEO Relative Leverage* remain significant and positive. Both, *Cragg-Donald Wald F-stat.* and *Kleibergen-Paap Wald F-stat.*, for weak instruments are large, indicating the validity of the IV. Similarly, Table 8 reports the regression results of 2SLS models of *AP/DLC* and *AP/DD1* and *CEO Relative Incentive*. Again, the results are similar to our main results reported in Table 4. Together, these results confirm that our main findings are robust to potential endogeneity arising due to reverse causality.

Table 7 Instrumental variable regression for CEO relative leverage

Variable	CEO Relative Leverage	AP/DLC	AP/DD1
(1)	(2)	(3)	(4)
Ind CEO Relative Leverage	**0.830*****		
	(12.573)		
Predicted CEO Relative Leverage		**0.490*****	**0.593*****
		(4.263)	(4.886)
Firm Size	–0.056***	–0.070*	–0.010
	(−2.668)	(−1.768)	(−0.256)
Leverage	–1.829***	–1.873***	–1.853***
	(−15.787)	(−5.192)	(−5.333)
Cash Holdings	0.162***	–0.084**	–0.038
	(6.898)	(−2.056)	(−0.961)
Profitability	0.919***	–0.655	–1.342***
	(3.971)	(−1.605)	(−3.468)
MTB	–0.040	–1.337***	–1.243***
	(−0.378)	(−5.065)	(−4.533)
PPE	0.096	–0.366	–0.627**
	(0.748)	(−1.323)	(−2.352)
Market Share	2.604***	–1.671	–0.668
	(3.342)	(−1.170)	(−0.460)
Constant	0.668***	2.882***	2.866***
	(3.671)	(6.467)	(6.149)
Industry dummy	Y	Y	Y
Year dummy	Y	Y	Y
Test for Endogeneity P-value		0.162	0.101
Test for Weak Identification			
–Cragg-Donald Wald F-Stat.		416.816	411.553
–Kleibergen-Paap Wald F-stat.		158.078	148.297
Adj. R^2	0.286	0.187	0.216
Obs.	9233	9233	8664

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). *t*-statistics are in parentheses. This table reports regression coefficients (β) of the 2SLS regressions of trade payable variables on CEO inside debt and the controls. The sample period ranges from the year 2007 to 2022. Column 2 reports regression coefficients (β) of the first stage regressions of *CEO Relative Leverage* on the industry-year mean of *CEO Relative Leverage* (IV). Columns 3 and 4 report regression coefficients (β) of the second-stage regressions of *AP/DLC* and *AP/DD1* on the predicted value obtained from the first stage. Industry fixed effects are based on Fama-French 49 industries. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Appendix B

4.3 Test of H2

4.3.1 Association between inside debt and trade credit: the role of financial constraints

Following the discussions in Sect. 2.4, we proceed to examine whether the positive relationship between CEO inside debt and trade credit is more pronounced in financially constrained firms. For this, we perform regression analysis using Eq. (2), where the coefficient on the interaction term *CEO Leverage×Constraints* indicates whether the relationship between

Table 8 Instrumental variable regression for CEO relative incentive

Variable	CEO Relative Incentive	AP/DLC	AP/DD1
(1)	(2)	(3)	(4)
Ind CEO Relative Incentive	**0.825*****		
	(11.692)		
Predicted CEO Relative Incentive		**0.533*****	**0.629*****
		(4.443)	(4.935)
Firm Size	–0.078***	–0.055	0.006
	(−4.088)	(−1.378)	(0.163)
Leverage	–1.695***	–1.863***	–1.874***
	(−15.759)	(−5.213)	(−5.442)
Cash Holdings	0.140***	–0.079**	–0.031
	(6.357)	(−1.988)	(−0.800)
Profitability	0.926***	–0.697*	–1.377***
	(4.155)	(−1.702)	(−3.555)
R&D	–0.062	–1.323***	–1.228***
	(−0.633)	(−5.048)	(−4.513)
PPE	0.123	–0.384	–0.650**
	(1.036)	(−1.388)	(−2.434)
Market Share	2.500***	–1.733	–0.685
	(3.481)	(−1.216)	(−0.474)
Constant	0.842***	2.785***	2.771***
	(4.992)	(6.137)	(5.805)
Industry dummy	Y	Y	Y
Year dummy	Y	Y	Y
Test for Endogeneity P-value		0.256	0.178
Test for Weak Identification			
–Cragg-Donald Wald F-Stat.		428.917	423.676
–Kleibergen-Paap Wald F-stat.		136.701	127.067
Adj. R^2	0.286	0.191	0.219
Obs.	9233	9233	8664

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). *t*-statistics are in parentheses. This table reports regression coefficients (β) of the 2SLS regressions of trade payable variables on CEO inside debt and the controls. The sample period ranges from the year 2007 to 2022. Column 2 reports regression coefficients (β) of the first stage regressions of *CEO Relative Incentive* on the industry-year mean of *CEO Relative Incentive* (IV). Columns 3 and 4 report regression coefficients (β) of the second-stage regressions of *AP/DLC* and *AP/DD1* on the predicted value obtained from the first stage. Industry fixed effects are based on Fama-French 49 industries. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Appendix B

CEO inside debt and trade credit is more pronounced in financially constrained firms. The regression results are presented in Table 9. Panel A presents the results with *AP/DLC* as the dependent variable and Panel B presents the results with *AP/DD1* as the dependent variable. In both panels, financial constraints are measured using the *SA Index, WW Index* and *Non-Dividend Payment*.

Firstly, in Panel A with *AP/DLC* as the dependent variable, we observe positive and statistically significant coefficients for the interaction terms *CEO Relative Leverage×SA Index* and *CEO Relative Incentive×SA Index* (Columns 2 and 4). This indicates that an increase in CEO inside debt leads to a more favourable credit supply when there is an increase in

Table 9 Multivariate regression models with financially constrained effect

Panel A: Multivariate Regression Models for Dependent Variable AP/DLC						
Variable	AP/DLC	AP/DLC	AP/DLC	AP/DLC	AP/DLC	AP/DLC
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CEO Relative Leverage	0.718***	0.736***	0.210***			
	(3.392)	(4.520)	(3.805)			
CEO Relative Incentive				0.719***	0.689***	0.262***
				(3.217)	(3.923)	(4.441)
CEO Relative Leverage × SA Index	**0.104****					
	(2.087)					
CEO Relative Leverage × WW Index		**1.215*****				
		(2.993)				
CEO Relative Incentive × Non_Div			**0.175****			
			(2.208)			
CEO Relative Incentive × SA Index				**0.093***		
				(1.761)		
CEO Relative Incentive × WW Index					**0.984****	
					(2.187)	
CEO Relative Incentive × Non_Div						**0.157***
						(1.904)
SA Index	0.062			0.076		
	(0.947)			(1.199)		
WW Index		2.262*			2.510**	
		(1.803)			(2.004)	
Non_Div			0.029			0.053
			(0.281)			(0.523)
Constant	3.050***	2.653***	2.982***	3.061***	2.690***	2.898***
	(6.277)	(5.995)	(6.951)	(6.392)	(6.108)	(6.717)
Controls	Y	Y	Y	Y	Y	Y
Industry dummy	Y	Y	Y	Y	Y	Y
Year dummy	Y	Y	Y	Y	Y	Y
Adj. R^2	0.200	0.201	0.199	0.203	0.203	0.201
Obs.	9233	9230	9233	9233	9230	9233
Panel B: Multivariate Regression Models for Dependent Variable AP/DD1						
Variable	**AP/DD1**	**AP/DD1**	**AP/DD1**	**AP/DD1**	**AP/DD1**	**AP/DD1**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
CEO Relative Leverage	0.593***	0.676***	0.251***			
	(2.831)	(3.590)	(4.839)			
CEO Relative Incentive				0.642***	0.673***	0.286***
				(2.980)	(3.460)	(5.181)
CEO Relative Leverage × SA Index	**0.068***					
	(1.761)					
CEO Relative Leverage × WW Index		**0.961****				

Table 9 (continued)

Panel B: Multivariate Regression Models for Dependent Variable AP/DD1						
Variable	**AP/DD1**	**AP/DD1**	**AP/DD1**	**AP/DD1**	**AP/DD1**	**AP/DD1**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
		(2.085)				
CEO Relative Incentive × Non_Div			**0.161***			
			(1.889)			
CEO Relative Incentive × SA Index				**0.071***		
				(1.749)		
CEO Relative Incentive × WW Index					**0.873***	
					(1.815)	
CEO Relative Incentive × Non_Div						**0.162***
						(1.836)
SA Index	–0.041			–0.041		
	(−0.634)			(−0.654)		
WW Index		1.662			1.771	
		(1.365)			(1.463)	
Non_Div			0.023			0.032
			(0.231)			(0.317)
Constant	2.905***	2.792***	3.031***	2.856***	2.790***	2.968***
	(5.902)	(5.957)	(6.765)	(5.875)	(5.972)	(6.571)
Industry dummy	Y	Y	Y	Y	Y	Y
Year dummy	Y	Y	Y	Y	Y	Y
Adj. R^2	0.229	0.232	0.231	0.231	0.233	0.232
Obs.	8664	8662	8664	8664	8662	8664

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (two-sided test). *t*-statistics are in parentheses. The sample period ranges from the year 2007 to 2022. Panel A reports regression coefficients (β) of the multivariate OLS regressions of *AP/DLC* on interaction terms of CEO inside debt and financial constraints measures, where a higher *SA Index*, higher *WW Index* and *Non_Div* indicate higher financially constrained firms. Panel B reports regression coefficients (β) of the multivariate OLS regressions of *AP/DD1* on interaction terms of CEO inside debt and financial constraints measures, where higher *SA Index*, higher *WW Index* and *Non_Div* indicate higher financially constrained firms. Industry fixed effects are based on Fama-French 49 industries. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Appendix B

financial constraints, proxied by the *SA Index*. Similarly, we find that the coefficients on the interaction terms *CEO Relative Leverage×WW Index* and *CEO Relative Incentive×WW Index* are positive and significant (Columns 3 and 6), suggesting that CEO inside debt leads to higher levels of trade credit amid an increase in financial constraints proxied by the *WW Index*. Finally, we interpret that CEO inside debt leads to higher levels of trade credit in firms that do not pay dividends, as evidenced by the positive and significant coefficients on *CEO Relative Leverage×Non_Div* and *CEO Relative Incentive×Non_Div* (Columns 4 and 7). We observe similar results in Panel B with *AP/DD1* as the dependent variable.

These results support our *Hypothesis 2*, emphasizing the significance of the reassurance provided by CEO inside debt to the suppliers of financially constrained firms, where the likelihood of the company defaulting on its payments to suppliers is notably higher. This

suggests that CEO inside debt plays a key role in sustaining financially constrained firms that are typically neglected by formal lending institutions.

5 Additional tests

5.1 Comparison with Hasan et al. (2022)

We acknowledge that our study closely aligns with Hasan et al. (2022), who also explore the relationship between CEO inside debt holdings and trade credit. However, unlike our findings, they conclude that CEO inside debt leads to decreased levels of trade credit. Hence, in this section, we conduct tests to compare and contrast our results with theirs.

Firstly, we noticed differences between the samples of our study and Hasan et al. (2022). While both studies start in 2007, Hasan's ends in 2018, whereas ours goes up to 2022. Hasan et al. (2022) report having 11,868 firm-year observations in their merged (Compustat and ExecuComp) dataset, but this seems doubtful because Hasan et al. (2023), who studied the impact of CEO inside debt on credit ratings, found an initial sample having 23,130 firm-year observations. When we checked the data from 2007 to 2018, we found 24,372 observations, closer to the Hasan et al. (2023) dataset. Our merged dataset, spanning 2007 to 2022, comprises 30,481 observations, similar to Hasan et al. (2023) rather than Hasan et al. (2022). Apart from this initial discrepancy, we followed a similar sampling procedure to Hasan et al. (2022), and eliminated firms belonging to financial and utility industries and those with missing data for computation of the variables in our study. While the process is similar, the number of observations deleted in our study as a result of these two steps is different from Hasan et al. (2022). We deleted about 25% of observations, which is in line with Hasan et al. (2023), compared to only about 10% for Hasan et al. (2022).

Furthermore, our primary variables *AP/DLC* and *AP/DD1* have more missing data compared to the main variable, *AP/TA*, used in Hasan et al. (2022). Consequently, this further reduces the number of observations in our analysis. Additionally, Hasan et al. (2022) do not say anything about addressing firm-year observations where there is zero inside debt.[9] In contrast, we excluded observations with zero inside debt to avoid potential bias, as detailed in Sect. 3.1 (Freund et al. 2018). Assuming Hasan et al. (2022) did not take this step to prevent sample selection bias, we conducted our analysis again, this time including observations with zero CEO inside debt and using a dummy indicator for zero CEO inside debt. The results from this analysis are qualitatively similar to our main findings, indicating a significantly positive relationship between CEO inside debt and our trade credit measures.

Second, to ensure that our findings are not influenced by the selection of control variables differing from those used by Hasan et al. (2022), we repeat the baseline regression analysis using Eq. (1) incorporating control variables identical to theirs. Despite this adjustment, in untabulated results, we still observe a significantly positive relationship between our measures of CEO inside debt and trade credit.

Third, upon comparing the measurement of CEO inside debt, we find that Hasan et al. (2022) employ a similar measure to ours. However, their measure of trade credit differs from ours. They utilize conventional trade credit measures such as accounts payable divided by total assets (*AP/TA*) in their main analysis, and three additional measures (namely, accounts

[9] Firm-years with zero inside debt comprise a significant portion of our sample (11,665/304,841 = 38.27%).

payables divided by cost of goods sold, *AP/COGS*, accounts payables divided by total liabilities, *AP/TL*, and accounts payables divided by purchases, *AP/PURC*) for robustness tests. Subsequently, we replicate their analysis to understand the relationship between their measure of trade credit *AP/TA* and CEO inside debt. Given the potential for multicollinearity among regressors, the sign and statistical significance of the coefficient of CEO inside debt in multivariate regression models may be confounded. Thus, we initially conducted a univariate regression analysis between trade credit and CEO inside debt. This reveals a statistically insignificant relationship between *AP/TA* and CEO inside debt. However, significant negative relationships emerge with the other two measures of trade credit, except *AP/TL*, which is positive and significant.[10] This brings into question the reliability of the association between conventional trade credit indicators and CEO inside debt.

Moving to multivariate regression models, untabulated results show that the relationship between *AP/TA* and CEO inside debt becomes negatively significant in the presence of control variables. This suggests that their results could have been influenced by multicollinearity among the covariates. Additionally, we observe a significant negative relationship between CEO inside debt and trade credit, similar to Hasan et al. (2022), when utilizing the remaining two measures of trade credit, except *AP/TL*. Hasan et al. (2022) propose a demand-side explanation, suggesting that aligning CEO incentives with those of debtholders reduces agency costs stemming from shareholder-debtholder conflicts, thereby facilitating easier access to cheaper credit from formal sources like financial institutions. However, they do not empirically investigate whether higher inside debt inherently leads to increased borrowings from financial institutions.

Finally, their trade credit measures fail to capture the heightened risk borne by suppliers relative to other secured creditors of the firm, as explained in Sect. 3.2.2. Consequently, based on the negative relationship between CEO inside debt and conventional trade credit measures, it may be inaccurate to conclude that the inclusion of debt-like components in CEO compensation does not assure creditors regarding the increased risk they bear.

5.2 Inclusion of firms with zero-inside debt

In our main multivariate analysis, we have omitted observations with zero inside debt due to inconsistent reporting practices regarding inside debt by companies (Freund et al. 2018). Recognizing that such a filtering process may introduce sample selection bias, we rerun the baseline multivariate regression model using the full sample set, including instances of zero CEO inside debt. The tests conducted, which include observations with zero CEO inside debt, as well as a dummy indicator for zero CEO inside debt, yield results that are qualitatively similar to our main findings. Unreported results indicate a significantly positive relationship between CEO inside debt and our trade credit measures.

5.3 Impact of firm's information environment

Since information asymmetry is a major factor affecting trade credit supply (Wu et al. 2014; Haselmann et al. 2018; Dao et al. 2022), it's crucial to examine whether our primary results

[10] This is not the case with our measures of trade credit (*AP/DLC* and *AP/DD1*) wherein both *CEO Relative Leverage* and *CEO Relative Incentive* have been found to exhibit a statistically significant positive relationship in the univariate regression analysis (See Sect. 4.1).

are influenced by the firm's information environment. For this purpose, we conduct sub-sample analysis focusing on companies characterized by facing both high and low information asymmetry. We gauge this asymmetry using analyst forecast errors and analyst forecast dispersion as proxies (Thomas 2002; Guo and Mota 2021). The sub-samples are categorized according to positional averages, specifically quartiles, terciles, and the median, derived from industry and year-based estimates of analyst forecast errors and analyst forecast dispersion. Untabulated results reveal that information asymmetry does not impact the association between CEO inside debt and the supply of trade credit.

5.4 Impact of regulatory restrictions on withdrawal of deferred compensation

We also perform a Difference-in-Differences analysis by using the final enforcement of the Internal Revenue Code (IRC), Section 409 A in the year 2009, as an exogenous shock to CEO inside debt. Before Section 409 A, deferred compensation plans usually allowed executives to withdraw their deferred compensation at an earlier time for any reason, making deferred compensation less prone to bankruptcy risk. However, the enactment of the said provision discouraged CEOs from making early withdrawals and effectively strengthened the incentives provided by inside debt (Shen and Zhang 2020). We define the year 2009 as the event period. We then define the three years before 2009 (i.e., 2006–2008) as the pre-event period and the three years after 2009 (i.e., 2010–2012) as the post-event period. The *After* dummy is coded as one if a firm-year observation is from the post-event period, and zero if it is from the pre-event period. Our difference-in-differences test sample starts with all the firms that have observations in both pre- and post-event periods. For each firm, we define the change in inside debt, *Δ(CEO Relative Leverage)* or *Δ(CEO Relative Incentive)*, as the mean value of an inside-debt variable during the post-event period minus the mean value of the corresponding variable during the pre-event period. We sort the sample firms into terciles based on the changes in inside debt. We then assign the firms with top-tercile changes in inside debt as treatment firms, while firms with bottom-tercile changes in inside debt are assigned as control firms. Accordingly, the treatment dummy equals one for the firms experiencing top-tercile changes (i.e., greater increases) in inside debt, and zero for the firms with bottom-tercile changes in inside debt. We did not find any significant results indicating that the treatment group (experiencing greater increases in CEO inside debt) undergoes larger increases in trade payables in comparison to short-term debt.

5.5 Subsample analysis of H2

The final additional analysis focuses on examining the impact of financial constraints on the relationship between trade credit and CEO inside debt through a sub-sample analysis. To do this, we identify financially constrained firms by selecting those with *SA Index* or *WW Index* values greater than the cross-sectional industry-year median values (referred to as *HighSAIndex* and *HighWWIndex*), along with non-dividend paying firms (*Non_Div*). We then estimate Eq. (1) across subsets of both financially constrained and unconstrained firms. Our untabulated results reveal that the significantly positive relationship between CEO inside debt and trade credit is more pronounced within the subset of companies facing higher financial constraints compared to those with lower financial constraints. This finding

further supports our hypothesis that the role of CEO inside debt in providing assurance is particularly significant for suppliers in firms dealing with heightened financial constraints.

6 Conclusion

In this study, we have investigated whether trade credit suppliers are more willing to offer trade credit when the CEO's financial leverage closely matches that of the firm. We conduct a panel regression analysis involving publicly traded US companies and find that an increase in the CEO's inside debt corresponds to a greater provision of trade credit. This suggests that CEO inside debt serves as a form of assurance to suppliers regarding their claims, incentivizing them to take on more risk by extending additional credit to these companies. This effect is particularly pronounced in firms facing higher financial constraints, where the risk of default is elevated. This also suggests CEO inside debt plays a key role in sustaining financially constrained firms that are typically neglected by formal lending institutions.

In summary, our findings strongly support the idea that aligning the CEO's incentives with those of debtholders through the inclusion of inside debt in their compensation has a substantial impact on suppliers. Specifically, by examining the proportion of supplier credit relative to bank credit, we confirm that suppliers are more inclined to extend credit when CEO inside debt increases. This is because the presence of inside debt in the CEO's compensation structure helps mitigate the increased risk borne by suppliers. The importance of this confidence-building role played by CEO inside debt is particularly highlighted in financially constrained firms, emphasizing its ability to alleviate suppliers' concerns about payment.

Appendix A

Sample selection procedure.

Procedure	No. of Firm-year Observations	No. of Firms
Compustat Merged with Execucomp	31,481	2,760
Less: Utility Firms	–1,303	
Less: Financial Firms	–6,822	
Less: Missing Values of CEO Inside Debt	–1,291	
Less: Zero CEO Inside Debt	–11,665	
Less: Missing Values of Other Variables	–2,458	
Final No. of Observations	**9,233**	**1,132**

Appendix B

Variable definition

Variable	Description
AP/DLC	The natural logarithm of trade accounts payable divided by the debt in current liabilities.

Variable	Description
AP/DD1	The natural logarithm of trade accounts payable divided by the debt maturing in one year.
CEO Relative Leverage	The natural logarithm of one plus the ratio of CEO inside debt holdings to equity-based holdings scaled by the firm debt-equity ratio (Phan, 2014; Dang and Phan 2016).
CEO Relative Incentive	The natural logarithm of one plus CEO relative incentive is the ratio of the marginal change in the value of CEO inside debt holdings to the marginal change in CEO inside equity holdings given the change in firm value, all scaled by the firm's respective ratio (Phan, 2014; Dang and Phan 2016).
Firm Size	The natural logarithm of a firm's book value of total assets (Petersen and Rajan 1997; Shang 2020; D'Mello and Toscano 2020).
Leverage	The ratio of short-term debt plus long-term debt to book value of total assets (Hansen and Habib, 2019; Shang 2020; D'Mello and Toscano 2020).
Cash Holdings	The ratio of cash and marketable securities to book value of total assets (Petersen and Rajan 1997; Hansen and Habib, 2019; Shang 2020).
Profitability	The operating income before depreciation scaled by total sales (Petersen and Rajan 1997; Chod et al. 2019; Hansen and Habib, 2019).
R&D	The research and development expenses scaled by book value of total asset. R&D is assigned a value of zero if research and development expenses is missing (Kling et al. 2014; Shang 2020; D'Mello and Toscano 2020).
PPE	The ratio of the net value of property, plant, and equipment to the book value of total assets (Chod et al. 2019; Hansen and Habib, 2019; Shang 2020; D'Mello and Toscano 2020).
Market Share	The firm's sales (sale) divided by the total sales of all the firms within the same Fama-French 49 industry (Wilner 2000; Chod et al. 2019).
MTB	Market value of assets divided by the total book value of assets. The market value of assets is defined as the market value of equity minus the book value of equity plus the total book value of assets. The market value of equity is constructed as the close price multiplied by the number of common shares outstanding. The book value of equity is defined as the total book value of assets minus total liabilities plus deferred taxes and investment tax credit. (Petersen and Rajan 1997; Kling et al. 2014; D'Mello and Toscano 2020).
ROA	The operating income before depreciation scaled by the book value of total assets (Shang 2020; D'Mello and Toscano 2020).
Cash Flow	The income before extraordinary items plus depreciation and amortization scaled by the book value of total assets (Love et al. 2007; Shang 2020).
Capex	The ratio of capital expenditures to the book value of total assets (Zhang 2019; Shang 2020).
Sales Growth	Firm's sales in the year t subtract sales in the year t–1, and then scaled by sales in the year t–1 (Petersen and Rajan 1997; Chod et al. 2019; Shang 2020; D'Mello and Toscano 2020).
CEO Age	The natural logarithm of CEO's age (Dang and Phan 2016).
CEO Tenure	The natural logarithm of CEO's tenure (Freund et al. 2021).
SA Index	SA Index is computed as $-0.737 \times \text{Size} + 0.043 \times \text{Size}^2 - 0.040 \times \text{Age}$, where Size is the natural logarithm of inflation-adjusted book assets and Age is the number of years since the firm's accounting data became available in Compustat (Hadlock and Pierce 2010).
WW Index	WW Index is computed as $-0.091 \times$ cash flow ((ib+dp)/at) $-0.062 \times$ dividend dummy $+0.021 \times$ long-term debt (dltt/at) $-0.044 \times$ size (ln(at)) $+0.102 \times$ industry sales growth $-0.035 \times$ sales growth (Whited and Wu 2006).
Non_Div	A dummy variable equal to 1 if the firm paid dividend in a given year and 0 otherwise (Shang 2020).
IndFE	A dummy indicator of Fama-French 49 Industry Classification based on SIC codes of US firms.
YearFE	A dummy indicator for the fiscal year.

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Declarations

Conflict of interest The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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