How judicial efficiency impacts trade credit and doubtful receivables

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Abstract

Judicial efficiency has been widely identified as a factor that has an impact on credit markets and firms' financial decisions. In this paper, we study the relationship between judicial efficiency and trade credit granted by firms to their customers, as well as how the judicial system influences the proportion of those credits that are deemed 'doubtful'. We test our assumption by analysing a sample of 1526 listed, 'non-financial' firms located in countries in the eurozone, during the period 2011–2021. The proxies of judicial efficiency are the length of judicial proceedings and rule of law, obtained from the World Bank's 'Doing Business' and the World Bank Governance Indicators (WGI) databases, respectively. The empirical findings confirm our hypotheses that efficient justice allows for increased supplier confidence when extending financing to their customers and reduces doubtful trade credit.

Keywords Judicial efficiency · Trade credit [granted] · Doubtful trade credit · Accounts receivable · Eurozone

JEL Classification G32 · K40

1 Introduction

Trade credit is defined as an arrangement between firms and their customers to postpone payment. Its importance stems from its contribution to the economy and, according to the International Monetary Fund (2019), it is the main channel of global trade financing. In the European Union, trade credit contributes 30% to GDP

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(Canto-Cuevas et al., 2019). However, there are differences in the use of trade credit between European countries (Demirgüç-Kunt & Maksimovic, 2001; García-Teruel & Martínez-Solano, 2010a; Rajan & Zingales, 1995;). The aim of this paper is to establish whether these differences may be partially due to the functioning of the judiciary. The positive impact of strong and efficient institutions on business activities is broadly known (Bradley & Klein, 2016; Thornton et al., 2011). Nevertheless, their relationship with the use of trade credit remains unexplored.

The possible impact of judicial efficiency on trade credit is rooted the nature of trade credit transactions. Credit sale, like any other credit operation, implies the establishment of payment conditions and, hence, tacitly occurs in a contract between supplier and customer. At the same time, the seller takes on the risk of customers defaulting (Adams et al., 1992). The problems derived from this financial link between firms (called the 'trade credit channel') have been studied at both macro and micro level. At macro level, the relationship between the trade credit channel and propagation of liquidity shocks in the economy has been analysed (e.g., Battiston et al., 2007; Boissay, 2006; Costello, 2020; Kiyotaki & Moore, 1997). At micro level, "trade credit default is a channel of transmission of financial disruptions from firm to firm" (Mateos-Planas & Seccia, 2021, p.1). In this sense, some works have shown how trade debtor failures are associated with an increase in financial distress (or bankruptcy risks) for the trade creditors involved (e.g., Adikhanova et al., 2022; Boissay & Gropp, 2013; Jacobson & Schedvin, 2015).

Having taken those aspects into consideration, the judiciary should provide a guarantee regarding the fulfilment of the conditions between creditor and debtor. Following this logic, it is reasonable to deduce that the absence of efficient contract enforcement could lead to opportunistic behaviour affecting the debtor's intention to fulfil the payment conditions by the agreed date. This may increase the level of legal risk for the creditor and, in turn, could result in a reduction of credit granted to customers (Li et al., 2018). Thus, the presence of legal protection adds to the confidence of economic agents such as investors, creditors, financial entities and firms when they act as 'funding suppliers' (Demirgüç-Kunt & Maksimovic, 2001; Fabbri & Menichini, 2010; La Porta et al., 1998). While there are studies on the impact of efficient judicial enforcement on banking credit, the evidence with respect to trade credit is scarce.

Trade credit can be viewed from two perspectives. On the one hand, firms can obtain funds from their suppliers and, on the other, they can grant credit to their customers through deferred payments. In trade credit operations, the risk of debt default affects suppliers in particular; efficient judicial systems allow this risk to be reduced. To our knowledge, only two papers (Johnson et al., 2002; Li et al., 2018) have analysed the impact of institutional environment on trade credit offered to customers. Both papers focus on the level of trade credit provision. Our study aims to complete the literature by analysing the relationship between not only judicial efficiency and trade credit granted, or trade receivables, but also judicial efficiency and doubtful trade credit.

The relationship between judicial efficiency and trade credit is framed in Law and Finance literature. Studies have shown that varying levels of protection of creditor rights influence investment decisions, business behaviour and the functioning of

the financial markets (Djankov et al., 2001, 2003; La Porta et al, 1997, 1998). In this sense, a weak judicial environment can incentivise, on the one hand, the conservative conduct of creditors regarding credit granted and, on the other, debtors' opportunistic behaviour (Jappelli et al., 2005). The first situation can affect the level of trade receivables and the second, doubtful trade credit. In addition, scarce empirical evidence (Johnson et al., 2002; Li et al., 2018) indicates that in countries with greater judicial efficiency, firms grant a higher volume of trade credit to their customers. Based on these arguments and the previous empirical evidence, our study predicts that judicial efficiency could have a positive effect on trade credit granted. Regarding the relationship between judicial efficiency and doubtful trade credit, as our knowledge, there is no paper focused on this. Thus, based on theoretical arguments, we predict that lower judicial efficiency will increase doubtful trade credit.[1]

To reach our objectives, the research was carried out based on a sample of 1,526 listed, 'non-financial' companies located in the eurozone in the period 2011–2021. We used both quantitative *and* qualitative proxies of judicial efficiency: the duration of judicial processes and *the rule of law*. These were obtained from the World Bank's 'Doing Business' and the World Bank Governance Indicators (WGI) databases, respectively. The results obtained—having been controlled for determinants of trade credit, as well as for different subsamples—show that firms located in countries with greater judicial efficiency extend a higher volume of trade credit to their customers (*accounts receivable*) relative to sales and have a lower rate of *doubtful trade credit*. These results can indicate that greater judicial security with respect to enforcement of conditions in trade contracts increases the level of trade credit granted by firms to their customers and reduces doubtful trade credit.

This study focuses on Europe, which we consider as an interesting study area for the analysis of trade credit behaviour in the context of judicial enforcement. Firstly, there are disparities in the use of trade credit among European countries and differences observed in the levels of judicial efficiency. Secondly, European authorities have expressed their concerns about increasing payment defaults in commercial transactions. This led to the adoption of Directive 2000/35/CE of the European Parliament and of the Council on combating late payment in commercial transactions, later repealed by Directive 2011/7/UE. This directive has been transposed by all the countries of the eurozone, which provides a system of common regulation for these countries, allowing legal efficiency to be isolated.

The present study offers several contributions to the literature. Firstly, it provides evidence for studies on the importance of judicial systems, confirming the transcendental role of judicial efficiency, which stimulates economic development through its impact on business decisions. Secondly, it contributes to trade credit literature, which has hereto mainly focused on the reasons for the use of trade credit and business characteristics, with little attention paid to the external factors affecting the supplier's decision to grant it. As such, it explains the differences in trade credit in

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[1] In addition to judicial efficiency, which refers to a formal institution, other studies have focused on the incidence of informal institutions in trade credit. Thus, the role of the social trust (Wu et al., 2014), religiosity (Chen et al., 2020), and cultural values (Ghoul & Zheng, 2016) has been analyzed.

the context of European countries identified in previous studies, specifically those by García-Teruel and Martínez-Solano (2010a), Grau and Reig (2018), Mättö and Niskanen (2019), which do not account for institutional factors related to judicial efficiency. Thirdly, from the perspective of the trade credit provider, while the risk of loss arising from delay or non-payment on the part of the debtor has been analysed (e.g., Adikhanova et al., 2022; Boissay & Gropp, 2013; Jacobson & Schedvin, 2015), to our knowledge, no study has considered the role of judicial efficiency in influencing the level of doubtful trade credit. Thus, the present study also contributes to the understanding of the impact of judicial institutions on trade credit granted by businesses to customers and on doubtful trade credit.

The paper is structured as follows. Section 2 describes the theoretical arguments that explain the relationship between judicial efficiency and granted and doubtful trade credit. Section 3 addresses the methodological aspects. Section 4 presents the empirical results. Finally, Sect. 5 puts forward the discussion, along with the main conclusions and implications of the study.

2 Judicial efficiency and trade credit. Theoretical considerations and empirical evidence

A commercial transaction that involves a credit-based sale is a mercantile contract that defines the conditions that must be adhered to, as well as the applicable jurisdiction in the event of default. As such, while trade credit increases sales and improves customer-debtor relations (e.g., Box et al., 2018; Cuñat, 2007; Wilner, 2000), it also exposes suppliers to the absorption of costs[2] and default risk (Adams et al., 1992). Therefore, during the establishment of a trade agreement, the supplier (creditor) must have a degree of certainty that when a payment is not completed in line with the contract, its conditions will be legally enforced. At the same time, the customer (debtor) must receive the product on time, according to the established conditions. Consequently, the decision regarding whether to grant trade credit, as well as the profits stemming from these operations may depend on whether the credit supplier can rely on the judiciary to resolve payment disputes (Li et al., 2018).

A contract between a buyer and a seller is an agreement on the 'exchange of property rights' with respect to economic goods. The need for an appropriate definition and the crucial role of 'assignment of property rights' has been demonstrated by researchers in the framework of law and in the economics literature. Consequently, the latter has shown that legal protection and the level of procedural formalism in courts differ according to their legal origin, and that a legal system is among the main drivers of financial market development and economic growth (Djankov et al., 2001, 2003; La Porta et al., 1997, 1998). However, in addition to the content of the legislation, its efficient implementation by judicial institutions is also important. Therefore, in parallel to studies focusing on the impact of laws and their content,

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[2] Administrative costs from granting credit and supervision and transaction costs due to the conversion of accounts receivable in cash (Emery, 1984; Sartoris and Hill, 1981).

the effect of their efficient implementation is examined (Greif et al., 1994; Mora-Sanguinetti, 2013; Shah et al., 2017).

The logic of the relationship between trade credit and judicial efficiency primarily requires understanding that trade credit transactions are credit sale contracts involving the risk of incompliance with the established conditions. Parts of this risk can be addressed via contractual provisions. Nevertheless, contracts are inherently incomplete, and hence it is impossible to mitigate these risks in full (Grossman & Hart, 1986; Hart & Moore, 1999). This is due to the presence of transaction costs derived from different stages of commercial transactions, as well as the asymmetric information in the market. Asymmetric information implies that parties involved in an economic transaction will have limited access to information, or that one party will possess greater material knowledge than the other (Wang et al., 2018). This in turn prevents both parties from considering all potential future courses of action (Hart, 1995). In addition, the existence of asymmetric information preventing the anticipation of future actions on the part of economic agents increases the problem of 'moral hazard' (Stiglitz & Weiss, 1981). On the one hand, at the time of formalising a contract, the debtor can conceal the true level of risk, as well as their intention with respect to future payments. On the other, once the contract is signed, the creditor may have difficulties monitoring or controlling the debtor's behaviour. Consequently, if there are no mechanisms that alleviate this biased information, the anticipation of these circumstances by the creditor could lead to an increase in the cost of future credit or 'credit rationing' (Pagano & Jappelli, 1993).

Although trade credit is usually unsecured and its repayment enforcement through the courts can be problematic (Troya-Martínez, 2017), undoubtedly, one of the mechanisms aimed at mitigating the above-mentioned problems and increasing confidence are judicial institutions (Dary & James, 2020). Since lenders do not have full information on borrowers and contracts are incomplete, the presence of a third party responsible for the legislation and its enforcement is central to credit transactions. In the absence of an efficient judiciary, the gains from defaulting may outweigh the cost of sanctions, leading solvent borrowers to adopt a strategic default (Jappelli et al., 2005). The implication is that creditors will be exposed to opportunistic behaviour on the part of the debtors, which can lead to higher default rates, ultimately increasing costs for the creditor (Arena, 2018). However, a default on a loan does not necessarily need to be strategic.[3] A borrower may be unable to repay the debt because of insolvency problems. In any case, the problems with the financial link between creditor and debtor through trade credit (the trade credit channel) can have significant consequences at the macro-economic level, related to liquidity shocks (Battiston et al., 2007; Boissay, 2006; Costello, 2020; Kiyotaki & Moore, 1997), and at the microeconomic level because trade debtor failures may cause an increase in financial distress (bankruptcy risks) for the trade creditors involved (Adikhanova et al., 2022; Bossay and Gropp, 2013; Jacobson & Schedvin, 2015).

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[3] Additionally, both parties (creditor and debtor) have an interest in meeting the payments, because for both of them trade credit represents a kind of insurance to survive in their businesses (Cuñat 2007; Troya-Martínez, 2017; Wilner, 2000).

Whatever the situation, the key role of judicial institutions is to frame opportunistic behaviour when the borrower fails to repay the debt and enforce contracts. On this basis, we can conclude that the efficient functioning of the justice system may affect the creditors' decision to grant trade credit as well as its terms and, at the same time, the debtors' conduct in relation to trade debts incurred.

Previous research investigating judicial efficiency and external financing has focused on the relationship between judicial efficiency and bank financing (e.g., Bae & Goyal, 2009; Božović, 2021; Fabbri, 2010; Jappelli et al., 2005), leaving trade credit in the background. A possible explanation for the scarcity of research in this direction is the fact that trade credit depends on factors that are more difficult to measure, such as trade relations between the supplier and the customer, or the marketing strategy of the business. In addition, trade credit is often considered informal, although it is worth noting that a trade agreement is a legal contract subject to the jurisdiction of the area, which deflects some of its informal features.

Amongst the scarce empirical studies that have analysed the incidence of judicial efficiency on trade credit granted are investigations by Johnson et al. (2002) and Li et al. (2018). Johnson et al. (2002), using a survey carried out in post-communist countries, indicate that 58% of the firms sampled have been involved in a commercial dispute. In addition, 87% of entrepreneurs in Romania, 73% in Poland and 55% in Ukraine consider that the intervention of the courts in trade disputes between creditors and debtors is a good solution. The result of this study, which is based on entrepreneurs' perceptions and experience of judicial enforcement, indicate that the efficient functioning of the courts is crucial, especially for new commercial relations. Judicial efficiency strengthens confidence in contracts and increases firms' willingness to extend trade credit to new customers, which in turn lowers their entry barriers to the market. Similarly, Li et al. (2018) carried out a study of 68 emerging economies using a subjective measure of judicial efficiency. They found that the improvement of judicial efficiency increases goods sold on credit by 3.5% and that the impact of legal systems is more substantial in more developed countries.

Both previous works use a variable related to the amount of trade credit, which is more closely related to the effect that judicial efficiency may have on the creditor's ability to grant more deferrals to its customers. However, a greater use of trade credit can increase default rates (Box et al., 2018; Machokoto et al., 2022; Wang et al., 2018). Therefore, in order to judge the extent to which the behaviour of debtors is also affected by judicial efficiency, it is necessary to consider doubtful trade credit as well. However, to our knowledge, no paper has analysed this second relationship.

In summary, greater efficiency in the application of the law, on the one hand, provides more security to the creditor regarding the probability of quick recovery in case of default and, on the other hand, reduces opportunistic debtor conduct. Thus, we propose the two following hypotheses:

H1 Greater judicial efficiency will increase the amount of trade credit granted by providers to their customers.

H2 Greater judicial efficiency will reduce doubtful trade credit.

3 Empirical design

3.1 Sample and data sources

The sample was obtained from the Osiris database, which contains the financial and stock market data of listed firms at the international level. We accounted for 'non-financial', active firms with positive total assets and shareholder equity located in 19 countries of the eurozone in the period 2010–2021. The study uses consolidated financial statements available for all years of the period 2010–2021. Following these criteria, we obtained an initial panel of 1636 companies. The year 2010 was used to calculate the 'lagged values' of variables. Therefore, the study period begins in 2011. Given that Latvia and Lithuania joined the Eurozone in 2014 and 2015, respectively, we excluded them form the sample. It was also considered appropriate to eliminate observations where no data was available for the variables used in the study and those that contained errors, such as negative sales or 'accounts receivable' values. Similarly, regarding the dependent variable, and given that receivables included in current assets for more than one year can represent an error in the data, we have eliminated firms with a 'trade credit granted ratio' greater than one. Likewise, we have dropped the observations with a 'doubtful trade credit ratio' higher than one. Since the study targets listed companies, we have excluded firms with a turnover of less than two million euros or less than two million euros on their balance sheet (micro-firms). Additionally, following criterion used by Chen et al. (2016), we decided to keep countries with more than 50 observations during the analysed period in the sample. This led to the exclusion of Slovakia, ultimately reducing the sample to 16 eurozone countries. As a result, the final sample is an unbalanced data panel of 1526 firms and 15,230 observations for the period 2011–2021. This sample represents, on average, 74% of the stock market capitalization of the countries considered, ranging from 60% of Spain and 95% of Ireland.[4] Furthermore, the importance of the stock market in relation to GDP varies greatly between countries. Thus, Germany, France, Belgium, the Netherlands, Luxembourg, Slovenia and Spain present values of between 60 and 85%, these being the countries where the vast majority of the firms in the sample are concentrated. The rest of the countries shows figures lower than 40%.[5] Data on the judicial efficiency was obtained from the World Bank's Doing Business database and 'rule of law' from World Bank's Worldwide Governance Indicator database (WGI).

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[4] These figures are undervalued because the World Bank statistics include financial companies, while they have been excluded in the work sample.

[5] Data computed from information obtained from the World Bank website: https://data.worldbank.org/indicator/CM.MKT.LCAP.CD?name_desc=false. Furthermore, we want to highlight that DB capitalization data includes financial companies, so these percentages of representativeness of our sample could be undervalued, since our sample does not include this type of company.

3.2 Variables

Dependent variable. Following the stated hypotheses, the first dependent variable of interest is the volume of trade credit granted to customers, measured as the ratio of accounts receivable to total sales (*TC_granted*). This is the most common measure of trade credit granted used in the literature (e.g., García-Teruel & Martínez-Solano, 2010b; Grau & Reig, 2014, 2018; Li et al., 2018; Lin & Chou, 2015; Nguyen & Nguyen, 2022; Oh & Kim, 2016; Petersen & Rajan, 1997; Wu et al., 2014). The second dependent variable is doubtful trade credit, which is measured as the ratio of *doubtful accounts receivable* to *accounts receivable (Doubtful_TC)* (Esilä, 2015; Mateos-Planas & Seccia, 2021). Given that some of the 'doubtful debtors' may come from sales made in previous years, we considered it more appropriate to relativize this item in terms of accounts receivable, since this item accumulates all sales pending collection. In terms of robustness, we consider doubtful trade receivables over sales (Adilkhanova et al., 2022; Esilä, 2015) and over total assets (Nguyen & Nguyen, 2022).

Explanatory Variable. The key explanatory variable of the study is *judicial efficiency*. Among the various indicators used in literature, we consider the length of judicial proceedings (*Duration*) and *rule of law*. The duration approximates the quantitative dimension while rule of law indicator is the qualitative one. The two indicators were obtained from databases held by the World Bank. Data regarding the time required to enforce contracts was taken from the World Bank's 'Doing Business' Database, and the 'rule of law index' was taken from the World Bank's Governance Indicators (WGI). These databases contain data that allows the large geographical area and period of our study to be covered. 'Duration' is the time taken to resolve a commercial dispute and has an inverse meaning. As such, a longer trial duration represents lower judicial efficiency. Following the 'Doing Business' methodology, time is registered in calendar days, starting from the moment when the seller files a lawsuit in court until payment. This does not only account for the days when actions take place, but also considers waiting periods. The time is an average duration of three different stages: (1) filing and service; (2) trial and judgment; and (3) enforcement.[6] According to the WGI definition, 'rule of law' "captures perceptions to the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence". The value of the indicator ranges from − 2.5 to 2.5, with higher values corresponding to better outcomes in regards to rule of law.[7] Therefore, it is expected that the more efficient the *rule of law* in the country, the more security creditors will have regarding the future performance of contracts.

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[6] For details on Doing Business methodology see the website: https://archive.doingbusiness.org/en/methodology/enforcing-contracts.

[7] Detailed documentation of the WGI, and full access to the underlying source data available at: https://databank.worldbank.org/metadataglossary/worldwide-governance-indicators/series/RL.EST. See also Kaufmann et al. (2010).

Among previous studies that used trial duration as a judicial efficiency proxy are Bae and Goyal (2009), Galli et al. (2017), Shah et al. (2017) and Moro et al. (2018). Likewise, among the studies that have used rule of law are Chui et al. (2016), Meng and Yin (2019) or Alvarez-Botas and González (2021). All these studies analyse the incidence of judicial efficiency on bank debt or the cost of debt; none have considered the incidence of judicial efficiency on trade credit.[8]

Control Variables. To identify the control variables that can affect the commercial credit granted, we reference Petersen and Rajan (1997), considered the seminal study in the financial literature. In addition, we take into account other more recent works, among which are Molina and Preve (2009), García-Teruel and Martínez-Solano (2010a, 2010b), Cheung and Pok (2019) and Chen et al. (2020). For the determinants of doubtful accounts receivable, we focused on the studies by Esilä (2015), Nguyen and Nguyen (2022) and Adilkhanova et al. (2022), which analyse both trade credit granted and doubtful account receivables and consider the same control variables for both. According to these studies, we have considered the following variables: *firm's size*, *age*, *profitability*, *leverage*, *liquidity* and *sales growth*.

Size. Larger firms have better access to financial markets to fund receivables (Cheung & Pok, 2019; Petersen & Rajan, 1997). However, Long et al. (1993) predict that smaller firms will extend more trade credit to their customers because, in this way, they can signal their quality. Thus, the expected relationship between size and trade receivables is not clear (García-Teruel & Martinez-Solano,). Extending trade credit to riskier customers could represent one of the means to accomplish increased sales and gain market share. However, the benefits from trade credit relationships with riskier customers would be smaller for larger and older companies. Therefore, larger and older firms would be expected to build relationships with more trustworthy and creditworthy customers, which would result in lower doubtful trade credit (Esilä, 2015). *Size* is measured by the natural logarithm of total assets (e.g., Chen et al., 2020; García-Teruel & Martínez-Solano, 2010a; Ngyen and Nguyen, 2022; Petersen & Rajan, 1997).

Age. Similar to size, the relationship between age and trade credit granted is not clear. On the one hand, older firms have greater access to external financing than younger ones and are therefore willing to grant more credit to their customers (Petersen & Rajan, 1997). On the other hand, it may be assumed that older companies, which are supposed to have a better reputation than younger ones, do not need to grant more credit to their clients since they are better established (García-Teruel & Martínez-Solano, 2010a). Regarding doubtful trade credit, it is possible that older firms will have experience and knowledge that allow them to better select and manage their clients, reducing the probability of 'doubtful clients'. *Age* is the number of years in the company's lifespan (Cheung & Pok, 2019; Esilä, 2015; Nguyen & Nguyen, 2022).

Leverage and liquidity. Studies investigating the determinants of trade credit suggest that firms with greater access to external financing also extend more trade credit

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[8] The only studies that have looked at judicial efficiency and trade credit (Johnson, 2002; Li et al., 2018), have used survey-based measures of efficiency, not published indicators.

to their customers, thereby creating a redistribution channel within the economy (e.g., Molina & Preve, 2009). Jackson and Liu (2010) suggest that the size of the allowance for doubtful receivables is likely to be affected by the company's liquidity and solvency. Following Esilä (2015), we expect these leverage and liquidity variables to be positively related to both the trade receivables and the doubtful trade credit. Leverage is measured as the ratio between total debts and total assets (Cheung & Pok, 2019; Chen et al., 2020; Esilä, 2015; Molina & Preve, 2009). Liquidity is proxied by the current assets and current liabilities ratio (Esilä, 2015).

Profitability. Petersen and Rajan (1997) state that firms in trouble may use the extension of credit to attempt to maintain their sales. In a similar vein, [temporarily] unprofitable firms may resort to an extension of trade credit to risky clients in an attempt to restore their sales and profits. Thus, we expect a negative relationship between profitability and trade credit granted, as well as with doubtful trade credit. We use *profit margin* (Ebit/sales) and *return on assets* (*ROA*) (Ebit/total assets) for trade receivables and doubtful trade credit, respectively. Several authors have used this variable to explain trade receivables (e.g., García-Teruel & Martínez-Solano, 2010a, 2010b; Molina & Preve, 2009; Petersen & Rajan, 1997). Likewise, the few studies that have analysed doubtful receivables have also considered these variables (Cheung & Pok, 2019; Chen et al., 2020; Esilä, 2015; Nguyen & Nguyen, 2022).

Sales growth. Firms may use their trade credit policy in order to stimulate their sales. On the other hand, when sales grow, it is likely that companies will try to reduce their accounts receivable. Following García-Teruel and Martínez-Solano (2010b), we would expect a negative relationship between sales growth, trade credit granted and doubtful trade credit. The variable *Sales growth* is computed as the variation rate in sales between two consecutive years (Abdulla et al., 2020; García-Teruel & Martínez-Solano, 2010a).

Industry. The type of activity carried out by companies significantly affects trade credit policies due to differences in production cycles (García-Teruel & Martínez-Solano, 2010a). Previous studies show that trade credit transactions are usual in industrial firms (e.g., Bastos & Pindado, 2007). Therefore, in this paper, we have considered a dummy variable equal to 1 if the company is industrial and 0 otherwise. However, this variable is time invariant, so it is not possible to include it directly in the panel models estimated with fixed effects. An alternative way of solving this problem is to create the interaction between this dummy and the dummies for the years (e.g., Álvarez-Botas & González, 2021). Thus, the industry-year interaction is equal to 1 in each year when the firm belongs to an industrial sector and zero otherwise. In addition, the dummies for the years have also been considered (Li et al., 2018; Nguyen & Nguyen, 2022).

In addition to firm-level control variables, the macroeconomic conditions may affect the use of accounts receivable, although it is not clear what the expected relationship is between the business cycle and the trade credit granted by firms (García-Teruel & Martínez-Solano, 2010a, 2010b). These authors assert that, on the one hand, a deterioration in macroeconomic conditions may reduce the ability of companies to generate cash flow and limit bank financing. On the other hand, the existence of credit restrictions can restrict the possibility of providers financing their clients. In the first case, there would be an increase in accounts receivable while, in

the second, they would decrease. Following the cited authors, the GDP is supposed to control for the macroeconomic conditions. Specifically, we include the GDP per capita (Chen et al., 2020). Table 7 of the Appendix contains a list with the description of the variables.

3.3 Empirical model

We estimate the relationship between trade credit granted and judicial efficiency using a panel data model. This method allows us to control for unobservable heterogeneity as it provides more than one cross-section, data reducing bias from the presence of individual effects (Hsiao, 1985). The baseline model is as follows:

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\begin{aligned}
Trade\ credit_{i,t} = {} & \beta_0 + \beta_1 Judicial_{Efficiency\,i,t-1} + \beta_2 Size_{i,t} + \beta_3 Age_{i,t} \\
& + \beta_4\, Profitability_{i,t-1} + \beta_5 Leverage_{i,t-1} + \beta_6 Liquidity_{i,t-1} + \beta_7 Salesgrowth_{i,t} \\
& + \beta_8 GDPpercapita_{i,t} + \beta_{9-20} Year_t + \beta_{21-31} Industry\_year_t + \mu_i + \varepsilon_{i,t}
\end{aligned}
$$

According to the two hypotheses, the dependent variable (trade credit) is the *trade credit granted* or *doubtful trade credit*. Likewise, *judicial efficiency* is a proxy for *duration* or *rule of law*. To alleviate the effect of outliers, we 'winsorised' some explanatory variables, *profitability, liquidity and Sales growth,* at 1% and 99%. Moreover, to avoid the potential endogeneity between the dependent and firm-level independent variables, they are lagged by one year. Likewise, the proxies of judicial efficiency are also lagged one year to avoid endogeneity with the GDP. In the model, μ_i controls for the firm's unobservable characteristics and $\varepsilon_{i,t}$ is the error term.

In order to use the most suitable model, we employed the Hausman (1978) test, which differentiates between fixed effects models and random effects models in a panel data analysis. The results suggest that it is appropriate to use a fixed effects model. To control for the possible problems of endogeneity, we estimated parameters through the Generalized Method of Moments (GMM). We use an extension of the Arellano and Bond (1991), proposed by Arellano and Bover (1995) and Blundell and Bond (1998), in the robustness analysis. All estimation is computed with the Stata14 econometric package.

4 Results

4.1 Descriptive analysis

The sample distribution presented in Table 1 differs by country, with the predominance of French and German firms (nearly 51%), followed by those from Italy, Greece, Finland, Belgium, Spain and the Netherlands, which all account for about 36% of the sample. The eight remaining countries jointly represent less than 13%. Given that the sample is composed of listed firms, the distribution may be affected by size and development in the stock exchange. Regarding the sectorial distribution of the sample, in Table 1, we can see the importance of industrial firms, which account for 47% of all of the observations, followed by firms from the information

Table 1 Sample distribution by country and sector. 2011–2021

Country	N of observ.	% over total	Industry	N of observ.	% over total
Austria	461	3.03	Agriculture	491	3.22
Belgium	782	5.13	Industry	7126	46.79
Cyprus	343	2.25	Water, gas and electricity	607	3.99
Estonia	140	0.92	Construction	507	3.33
Finland	892	5.86	Trade	1084	7.12
France	4159	27.31	Transport	540	3.55
Germany	3612	23.72	Hospitality	266	1.74
Greece	1088	7.14	Information and communication	2301	15.11
Ireland	302	1.98	Real estate activities	893	5.86
Italy	1235	8.11	Professional services	815	5.35
Luxembourg	265	1.74	Other services	601	3.95
Malta	108	0.71			
Netherlands	687	4.51			
Portugal	309	2.03			
Slovenia	82	0.54			
Spain	765	5.02			
Total	15,230	100	Total	15,230	100

and communication sector (15%). The lowest number of observations belong to the hospitality (1.74%) and agriculture (3.22%) sectors.

Table 2 shows descriptive statistics of trade credit granted and doubtful trade credit, by country.

An average level of trade credit granted in the eurozone is about 18%, although it differs between countries. A certain geographical pattern can be observed. Credit granted to customers is highest in Southern European countries, including Greece (28%), Italy (26%), Portugal (21%) and Spain (22%), and lowest in Estonia (7%), Malta (9%), Luxembourg (11%), Austria and the Netherlands (13%). Regarding doubtful trade credit, the average for the whole sample is close to 5%, although it ranges from the 1% in Finland to 15% in Greece. The countries with the highest rate of doubtful receivables are Greece (15%), Portugal (12%) and Cyprus (10%).

Table 3 shows descriptive statistics of the judicial efficiency variables by country. The overall average length (*Duration*) of judicial proceedings is 1.84 years and ranges from 0.88 years in Luxembourg to 3.84 years in Greece. This shows that the functioning of the courts in Europe varies significantly between countries.

Regarding the *rule of law index*, the national average for all periods and countries is 1.29, and the values range from 0.32 for Greece to 2.03 for Finland (followed by Austria with 1.85). Moreover, the standard deviation and the minimum/maximum values in Table 3 reveal that there is limited inter-annual variation in both measures of *judicial proceedings* at the 'country' level. Concerning *rule of law*, more time variations are observed, while *duration* is time-invariant in some countries for the period analysed. This is most likely explained by the complexity and time needed for the implementation of judicial reforms.

Table 2 Descriptive statistics of trade credit granted and doubtful by country. 2011–2021

Country	Trade credit granted (%) Account receivables/total sales					Doubtful trade credit (%) Doubtful receivables/account receivables				
	Mean	S.D	Q1	Q2	Q3	Mean	S.D	Q1	Q2	Q3
Austria	13.10	7.71	8.56	12.77	16.88	4.26	9.30	0	0	3.89
Belgium	14.40	12.29	6.51	13.50	19.29	4.38	8.74	0	0.77	4.62
Cyprus	14.34	17.69	0	7.75	20.90	10.40	16.31	0	0.07	17.08
Estonia	6.92	5.25	2.22	6.24	11.50	3.06	7.06	0	0.81	3.12
Finland	13.74	6.94	8.46	13.39	17.87	1.21	3.90	0	0	0.43
France	20.11	15.12	10.41	18.45	27.52	5.60	8.22	0.62	2.90	6.73
Germany	13.28	9.55	6.98	12.72	17.86	2.49	5.84	0	0	2.50
Greece	27.80	23.03	5.97	26.00	42.31	14.64	17.10	0.33	9.61	20.75
Ireland	14.04	7.20	9.99	14.68	18.11	1.63	2.46	0	0.48	2.57
Italy	25.84	14.99	15.71	22.96	32.60	6.29	9.74	0	3.35	8.34
Luxembourg	10.85	10.40	4.55	8.47	14.50	5.42	11.88	0	1.82	4.93
Malta	8.61	9.96	0	7.22	14.49	2.36	8.60	0	0	0
Netherlands	12.64	9.90	5.84	12.53	17.37	4.29	12.52	0	0.90	3.30
Portugal	21.34	17.20	9.97	17.54	28.56	12.17	13.83	0.17	8.70	18.03
Slovenia	15.25	9.00	9.73	16.25	19.28	3.36	7.39	0	0	4.22
Spain	22.13	16.19	11.76	18.94	27.53	7.64	12.21	0	2.88	9.78
Mean	17.77	14.62	8.40	15.34	23.47	5.35	10.11	0	1.42	5.97
Chi2 (KW)	1,794.29***					2,275.63***				

Table 2 presents descriptive statistics for dependent variables used in the analyses.

Variable description in Table 7 of the Appendix. Q1, Q2, Q3: quartiles 1, 2 and 3, respectively.

KW Kruskal Wallis. *, **, ***: significant at 10%, 5% y 1%, respectively.

A comparison between Tables 2 and 3 allows us to observe that countries with the lowest judicial efficiency, like Greece (the lowest), show the highest rates of doubtful receivables, but also the highest ratios of trade credit granted. In comparison, Finland, with the most judicial efficiency, shows the lowest doubtful receivables rate, although the trade credit granted ratio is below the average.

Descriptive statistics of control variables are shown in Table 4. The sample is composed of firms with average (median) annual assets of about 6 million (363 thousand) euros and an average age of 56 years. In average terms, the sample is characterised by firms that are efficient in their business management with an average profit margin of 19.51% and ROA of 10.89%. The average liquidity is of 1.81. Firms in the sample are moderately indebted with average leverage of 55%. The percentage of firm-year observations with positive growth of sales is high (61%). Average GDP per capita is about 35,200 euros.

The analysis of the correlation matrix reveals a significant and negative (positive) relationship between *duration* (rule of law) and both dependent variables, *trade credit granted* and *doubtful trade credit*. Moreover, the correlation between the two judicial efficiency indicators is 0.87. The only coefficient higher than

Table 3 Descriptive statistics of judicial efficiency by country. 2010–2020

Country	Duration (years)					Rule of law index				
	Mean	Median	S.D	Min	Max	Mean	Median	S.D	Min	Max
Austria	1.09	1.09	0.00	1.09	1.09	1.85	1.84	0.04	1.80	1.94
Belgium	1.38	1.38	0.00	1.38	1.38	1.43	1.43	0.06	1.36	1.55
Cyprus	2.56	3.01	0.52	2.01	3.01	0.93	1.04	0.20	0.57	1.22
Estonia	1.22	1.25	0.05	1.16	1.25	1.25	1.24	0.08	1.16	1.37
Finland	1.22	1.33	0.15	1.03	1.33	2.03	2.05	0.06	1.95	2.13
France	1.17	1.22	0.07	1.08	1.22	1.42	1.43	0.05	1.39	1.51
Germany	1.22	1.26	0.14	1.08	1.37	1.66	1.63	0.08	1.55	1.85
Greece	3.84	4.33	0.82	2.63	4.69	0.32	0.32	0.17	0.07	0.59
Ireland	1.71	1.78	0.15	1.41	1.78	1.61	1.72	0.16	1.39	1.77
Italy	3.19	3.25	0.12	3.07	3.32	0.37	0.39	0.08	0.24	0.49
Luxembourg	0.88	0.88	0.00	0.88	0.88	1.81	1.81	0.05	1.78	1.91
Malta	1.38	1.38	0.00	1.38	1.38	1.16	1.15	0.17	0.91	1.42
Netherlands	1.41	1.41	0.00	1.41	1.41	1.84	1.82	0.07	1.75	1.98
Portugal	2.24	2.38	0.16	2.07	2.38	1.09	1.12	0.06	1.00	1.18
Slovenia	3.36	3.48	0.18	3.18	3.53	1.04	1.03	0.04	0.97	1.12
Spain	1.40	1.4	0.01	1.40	1.41	1.03	1.03	0.09	0.90	1.18
Mean	1.84	1.87				1.29	1.27			
Chi2 (KW)	11,287.10[***]					14,158.03[***]				

This table presents descriptive statistics for the explanatory variables. Variable description in Table 7 of the appendix. *KW*: Kruskal Wallis.[*], [**], [***]: significant at 10%, 5% y 1%, respectively.

Source Own elaboration from World Bank's WGI and Doing Business databases.

Table 4 Descriptive statistics of control variables

Variable	Mean	Q1	Q2	Q3	S.D
Size (millions of euro)	5871	0.838	363.47	2,200	0.0002
Age (years)	55.95	23	37	73	49.48
Profit margin$_{t-1}$	0.1951	0.0760	14.3994	0.2566	0.2510
ROA$_{t-1}$	0.1089	0.0537	0.1101	0.1674	0.1082
Leverage$_{t-1}$	0.5567	0.4404	0.5682	0.6883	0.1813
Liquidity$_{t-1}$	1.8157	1.0578	1.4508	2.0727	1.3923
Sales growth	0.0643	− 0.0399	0.0376	0.1202	0.2568
GDP per capita (euro)	35,200	29.220	34,860	39,260	13,006

This table presents descriptive statistics for key variables used in the analyses.

Variable description in Table 7 of the appendix. Q1, Q2, Q3: quartiles 1, 2 and 3, respectively.

0.5 are between these indicators and GDP per capita (0.51 and 0.54), which is due in part to the fact that they are all obtained at the country level. All correlation coefficients between the remaining variables are lower than 0.25. Moreover, the variance-inflation factors (VIF) for all models range between 1.08 and

Table 5 Judicial efficiency and trade credit

Model	Model 1		Model 2		Model 3		Model 4	
D.V	Trade credit granted		Trade credit granted		Doubtful trade credit		Doubtful trade credit	
	β	t-statistic	β	t-statistic	β	t-statistic	β	t-statistic
$Duration_{t-1}$	−3.0660***	−9.90	–	–	2.5236***	10.73	–	–
Rule of Law$_{t-1}$	–	–	8.4973***	8.73	–	–	−4.6632***	−6.30
Size (log)	1.2059***	5.09	1.2976***	5.48	−0.8518***	−4.77	−0.9543***	−5.34
Age (years)	−0.1750***	−3.59	−13.94***	−2.79	0.1669***	4.57	0.1777**	4.57
Profitabili-ty$_{t-1}$	1.0515**	2.02	0.9365*	1.80	−1.977***	−2.93	−1.6953***	−2.51
Leverage$_{t-1}$	−2.1873**	−2.38	−2.6879***	−2.93	1.4920**	2.14	1.9136***	2.74
Liquidity$_{t-1}$	0.727*	1.75	0.1369*	1.38	0.0877	1.17	0.1193	1.59
Sales growth	−2.8714***	−9.28	−2.9539***	−9.54	−0.8387***	−3.57	−0.7502***	−3.19
GDP per capita(log)	−0.7488*	−1.83	0.0505	0.13	0.3928	1.27	−0.2378	−0.78
Year	Yes		Yes		Yes		Yes	
Industry-year	Yes		Yes		Yes		Yes	
Constant	25.7245***	4.84	−1.788	−0.32	−1.8222	−0.45	15.85***	3.71
No. Observations	15,230		15,230		15,230		15,230	
No. firms	1526		1526		1526		1526	
Adjusted R-squared	0.6897		0.6892		0.6270		0.6250	

This table presents the estimation results of fixed effects panel regressions.

Variable description in Table 7 of the appendix. Profitability is measured by Profit margin in models 1 and 2 and ROA in models 3 and 4. *, **, ***: significant at 10%, 5% and 1%, respectively.

1.67, indicating that there are no problems of multi-collinearity (see Table 8 of the appendix).

4.2 Multivariate analysis

In order to empirically assess the impact of judicial efficiency on trade credit granted to customers and the doubtful trade credit, we applied a panel regression with fixed effects model. We report the results in Table 5. The results of Model 1 indicate that the impact of the length of judicial proceedings *(Duration)* is negative and economically significant at 1%. In Model 2, *Duration* is replaced by *rule of law index*, which is positive and significant at 1%. It is important to recall that this variable has an inverse interpretation of judicial efficiency, while rule of law is a direct proxy of judicial efficiency. Therefore, a longer duration for dispute resolution represents lower efficiency, thus reducing trade credit granted. On the contrary, a higher value for *rule of law* represents a greater degree of efficiency, and this increases trade credit. Therefore, the results obtained are in line with the hypothesis H1, according to which, greater judicial efficiency will increase

the amount of trade credit granted by providers to their customers. Specifically, a one-year increase in duration results in a 3.06% reduction in the volume of granted trade credit, while an increase of one unit of rule of law increases granted trade credit by 8.49%.

With the aim of contrasting the H2 hypothesis, in Models 3 and 4, we replaced the dependent variable for doubtful trade credit. As we can see, the results indicate that *Duration* in Model 3 and *rule of law* in Model 4 have a positive and negative sign, respectively, being significant at 1% in both models. Specifically, a one-year increase in duration represents a 2.52% increase in the volume of trade credit granted, while an increase of one rule-of-law unit reduces the doubtful trade credit by 4.66%. These results may be interpreted in the sense that more judicial efficiency reduces the trade credit default rate and offers support to the H2 hypothesis.

Regarding the control variables, in models 1 and 2, we observed that *size*, *profitability* and *liquidity* show significant and positive signs, while *age, leverage* and *Sales_growth* are significant and negative. Thus, the larger, but less old firms extended more credit to customers. The result regarding *size* supports the argument that larger firms have better access to financial markets to fund receivables (Cheung & Pok, 2019; Petersen & Rajan, 1997). Profitability, liquidity and sales growth show the expected sign. The negative sign of *leverage* is contrary to the expected relationship with the receivables, since greater access to external financing also means that firms can and will extend more trade credit to their customers (Molina & Preve, 2009). This result indicates that firms also use other alternatives to external financing in order to grant more credit.

In models 3 and 4, we observed that all significant control variables, show an inverse sign compared to models 1 and 2. Age and leverage are positive, while size, profitability and sales growth are negative. Contrary to our predictions, older companies have a higher rate of 'doubtful customers' in relation to their accounts receivable. One possible explanation for this result is that these companies place more value on long-term relationships with their customers, which leads them to keep a higher proportion of doubtful customers on their books (who are not necessarily insolvent). Leverage and sales_growth show the predicted signs. Liquidity and GDP per capita are not significant.

Finally, in models 1 and 2, the results regarding the year (untabulated by brevity) indicate that compared to 2011, years 2013 and 2014 are positive and significant, while in 2015 and years from 2018 to 2020 are negative and significant. The interaction *industry-year* is not significant for any year. In models 3 and 4, from 2016 to 2020, there is a significant and negative sign. The interaction 'industry-year' is positive and significant for the period 2013–2019, which indicates that industrial firms had a more doubtful trade credit rate than non-industrial firms during these years.

Robustness analysis

In this section, we provide additional estimations to demonstrate the robustness of the obtained results. The results of the main variables are reported in Table 6. In this table, in panels A and B, the dependent variable is *trade credit granted* and in panels C and D, *doubtful trade credit*. Likewise, in panels A and C, the explanatory variables are *duration* and in panels B and D, *rule of law*.

Table 6 Judicial efficiency and trade credit in the eurozone. Robustness analysis. Panels A and B. Dependent variable: trade credit granted. Panels C and D. Dependent variable: doubtful trade credit

	(1)		(2)		(3)		(4)		(5)		(6)	
	Alternative D.V		Control variable added		Without Germany and France		GMM		Tobit		Multilevel regression	

Panel A. Explanatory variable: Duration. Re-estimation model 1

Model	Model 5A		Model 6A		Model 7A		Model 8A		Model 9A		Model 10A	
	β	t	β	t	β	t	β	z	β	t	β	t
Dur_{t-1}	−0.567***	−2.72	−0.4648***	−2.29	−2.723***	−7.65	−3.370***	−9.31	−0.567***	−2.03	−2.803***	−5.71
AP_assets	–		34.770***	26.94	–		–		–		–	
Control	Yes		Yes		Yes		Yes		Yes		Yes	
Constant	11.087	0.60	4.312	0.24	−20.971	−0.50	−63.362***	−5.72	29.140***	5.77	34.135***	4.53
Observ	15,230		15,230		7459		9150		15,230		15,230	
Firms	1526		1,526		747		1152		1,526		1526	
Adj.R-sq	0.7890		0.7997		0.6853		–		–		–	
Wald Chi2	–		–		–		319.52***		428.26***		339.50***	
AR1	–		–		–		−8.246***		–		–	
AR2	–		–		–		−1.378		–		–	
Sargan test	–		–		–		72.095		–		–	

Panel B. Explanatory variable: Rule of Law. Re-estimation model 2

Model	Model 5B		Model 6B		Model 7B		Model 8B		Model 9B		Model 10B	
ROI_{t-1}	4.278***	6.54	3.4832***	5.45	9.510***	7.73	3.499**	2.20	3.353***	5.49	7.330***	4.89
AP_assets	–		34.497***	26.73	–		–		–		–	
Control	Yes		Yes		Yes		Yes		Yes		Yes	

Table 6 (continued)

Panel B. Explanatory variable: Rule of Law. Re-estimation model 2

Model	Model 5B		Model 6B		Model 7B		Model 8B		Model 9B		Model 10B	
Constant	−7.601	−0.41	−10.871	−0.60	−52.452	−1.25	−49.604	−4.34	25.824***	5.46	12.259	1.63
Observ	15,230		15,230		7459		9150		15,230		15,230	
Firms	1526		1526		747		1152		1526		1526	
Adj.R-sq	0.7896		0.8000		0.6853		–		–		–	
Wald Chi2	–		–		–		314.26***		462.41***		330.63***	
AR1	–		–		–		−8.157***		–		–	
AR2	–		–		–		−1.311		–		–	
Sargan test	–		–		–		74.912		–		–	

Panel C. Explanatory variable: Duration. Re-estimation model 3

Model	Model 5C		Model 6C		Model 7C		Model 8C		Model 9C		Model 10C	
	β	t	B	t	β	t	β	z	β	t	β	t
Dur_{t-1}	0.905***	11.30	2.876***	12.34	2.506***	8.48	0.513***	2.94	3.237***	11.87	2.890***	8.85
Adj._ACP	–		0.032***	18.20	–		–		–		–	
Control	Yes		Yes		Yes		Yes		Yes		Yes	
Constant	−0.0770	−0.13	−2.538	−0.64	−8.333	−1.44	6.742*	1.83	2.333	0.43	−1.682	−0.33
Observ	15,230		15,230		7,459		9,150		15,230		15,230	
Firms	1,526		1,526		747		1,152		1,526		1,526	
Adj.R-sq	0.6428		0.6358		0.6362		–		–		–	
Wald Chi2	–		–		–		1,081.57		519.32***		388.98***	
AR1	–		–		–		−5.323***		–		–	
AR2	–		–		–		0.240		–		–	
Sargan test	–		–		–		61.42		–		–	

Table 6 (continued)

Panel D. Explanatory variable: Rule of Law. Re-estimation model 4

Model	Model 5D		Model 6D		Model 7D		Model 8D		Model 9D		Model 10D	
ROL$_{t-1}$	−1.644***	−6.52	−5.621***	−7.66	−5.621***	−5.49	−0.286*	−1.62	−6.849***	−10.85	−4.979***	−5.62
Adj._ACP	–		0.031***	17.69	–		–		–		–	
Control	Yes		Yes		Yes		Yes		Yes		Yes	
Constant	6.103***	4.19	18.250***	4.32	10.534*	1.69	8.03***	2.59	22.639***	4.50	17.052***	3.53
Observ	15,230		15,230		7,459		9,150		15,230		15,230	
Firms	1526		1526		747		1152		1526		1526	
Adj.R-sq	0.6406		0.6333		0.6340		–		–		–	
Wald Chi2	–		–		–		1,505.37		495.50***		341.48***	
AR1	–		–		–		−5.951***		–		–	
AR2	–		–		–		0.350		–		–	
Sargan test	–		–		–		0.717		–		–	

Judicial efficiency and trade credit in the eurozone. Robustness analysis.

Panel A and B: This table presents the estimation results of fixed effects panel regressions for models 5, 6 and 7, GMM in model 8, Tobit in model 9 and multilevel regression in Model 10. Dependent variable in Models 5A and 5B is receivables/assets. Dur: Duration; ROL: Rule of Law. Variable description in Table 7 of the appendix. *, **, ***: significant at 10%, 5% and 1%, respectively.

Panel C and D: This table presents the estimation results of fixed effects panel regressions for models 5, 6 and 7, GMM in model 8, Tobit in model 9 and multilevel regression in Model 10. Dependent variable in Models 5C and 5D is doubtful account/sales. Dur: Duration; ROL: Rule of Law. Variable description in Table 7 of the appendix. In model 8D the efficiency variable is included as logarithm. *, **, ***: significant at 10%, 5% and 1%, respectively.

Firstly, we replaced the dependent variables for the alternative measures. The results of the re-estimation of the models are shown in column (1), Model 5. Specifically, in Models 5A and 5B, the receivables are relativized by 'assets' instead of 'sales', while in Models 5C and 5D, the doubtful account is divided by 'sales' instead of 'receivables'.[9] The results regarding the explanatory variables are similar in sign and significance to those initially obtained.

Secondly, according to Box et al. (2018), trade payables could be a channel through which firms can provide trade credit. Thus, in Models 6A and 6B, we added accounts payable over total assets (AP_assets) (Nguyen and Nguyen, 2022) as a control variable. The average 'accounts payable' are 0.10 over total assets (standard deviation = 0.08) and range from 0 to 0.83 throughout the sample. In Models 6C and 6D, we added the *adjusted average collection period* (Adj_ ACP) for each sector. In order to obtain this variable, first, we computed the average collection period (ACP) for firms as 'accounts receivable' over 'sales', and then we multiplied this by 360 days (e.g., Molina & Preve, 2009). Considering the ACP for all firms, the average ACP by sector was obtained. Afterwards, the Adj_ ACP of firms was obtained by subtracting the industry ACP. For the whole sample, the average ACP is 9 days, and more than one third of observations have a positive value for Adj_ACP. A higher value for Adj_ACP indicates that the company is offering its customers a sales deferral that is higher than the industry average, so this may attract potentially insolvent customers. Thus, we expected, and got, a positive sign for both variables—AP_assets and Adj_ACP—in the estimation of the respective models. See models 6 (A, B, C, D) in column (2) of Table 6.

Thirdly, following Bussoli and Marino (2018), we estimated Model 7 by removing firms from the two countries with the highest number of observations (Germany and France). The outcome shown in column (3) of Table 6 confirms previous estimations about the variables of interest. Thus, regarding trade credit granted, the sign remains negative for *duration* and positive for *rule of law*. Likewise, with respect to doubtful trade credit, the sign remains positive for *duration* and negative for *rule of law*. In all cases, the coefficients are significant at 1%. This indicates that the initial results are not biased by sample composition.

Fourthly, to deal with possible problems of endogeneity, we estimated the generalised method of moments (GMM), specifically an extension of Arellano and Bond (1991) developed by Arellano and Bover (1995) and Blundell and Bond (1998). These authors proposed a system estimator that uses moment conditions in which lagged differences are used as instruments for the level equation in addition to the moment conditions of lagged levels as instruments for the difference equation. The results shown in column (4) of Table 6 indicate that the impact of *duration* and *rule-of-law* maintain their respective signs and remain significant in all models. In addition, in all models, the Arellano-Bond (AR1 and AR2) tests are significant and non-significant, respectively, which indicate that the errors have auto-correlated at the first differences and not correlated at the level equation. Likewise, the Sargan test is non-significant, which suggest that the instruments are appropriate.

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[9] In addition, we have re-estimated the models with doubtful receivables to total assets (Nguyen and Nguyen, 2022). The results (unreported) are similar.

Fifthly, we have proceeded to re-estimate the models with the Tobit method, in order to control the zeros. This problem is especially relevant in the doubtful trade credit variable, with 40% of zeros, while in the trade credit granted variable, it is only 10%. The results shown in column (5) of Table 6 indicate that the duration and rule of law maintain their sign and significance in all models.

Sixthly, the set of explanatory variables includes variables at firm level and variables at country level (as the proxies of judicial efficiency). Because firms located in the same country share the same environment, they are likely to be more similar to each other than firms operating in other countries. Whit the aim of controlling this issue, we have re-estimated the models using a panel multilevel regression model.[10] The results regarding the interest variables maintain their signs and significance in all models (see column (6) on Table 6).

Seventh, as an alternative to winsorization, we have re-estimated the models by eliminating observations with values lower than the 1st percentile or higher than the 99th percentile of the winsorized variables. The sample is reduced to 14,774 observations, although the results related to the variables of interest (un-reported for brevity) are similar in sign and significance. Therefore, we have verified that winsorization does not affect the results obtained.

Finally, following previous studies showing that trade credit transactions are usual in industrial firms (e.g., Bastos & Pindado, 2007), we estimated the models distinguishing between *industrial* and *non-industrial* firms. The estimation results regarding the explanatory variables (unreported for brevity) remain similar to the initial models in terms of sign and significance.

5 Discussion and conclusion

This study analysed the relationship between judicial efficiency and trade credit granted by listed, 'non-financial' firms located in the eurozone. The positive impact of efficient judicial institutions that promote confidence and security through efficient contract enforcement has been confirmed by previous academic evidence. On this basis, we formulated a hypothesis that predicts a positive relationship between judicial efficiency and trade credit granted by firms to their customers. To test this assumption, we analysed a sample of 1526 non-financial listed firms (15,230 observations) located in the eurozone during the period 2011–2021. As indicators of judicial efficiency, we used the length of judicial proceedings (*Duration*) and *rule of law*, obtained from the World Bank's 'Doing Business' and the World Bank Governance Indicators (WGI) databases, respectively.

Our research paper contributes to the literature by focusing on external factors that may affect trade credit, which highlights the need for a deeper analysis of the factors related to the legal institutional environment (Fabbri & Menichini, 2010). The results offer support for the argument that when the judicial system is more efficient, suppliers (creditors) are more confident (Dary & James, 2020) and more likely

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[10] The authors thank to anonymous reviewers their suggestion about the robustness Tobit and Multilevel.

to grant trade credit to their customers (debtors) (Hypothesis 1). At the same time, with a better functioning judicial system, debtors will tend to reduce their opportunistic behaviour and this will lead to a reduction in doubtful trade credit (Hypothesis 2).

Regarding the previous empirical evidence, studies on the impact of judicial efficiency on trade credit granted are scarce. During our research, we encountered the paper of Johnson et al. (2002), who focused on post-communist countries, and Li et al. (2018), who provided evidence for emerging economies. Both authors concluded that firms located in countries with greater judicial efficiency grant more trade credit to their customers. Our results are in line with those of these previous studies and are consistent with previous evidence on the importance of the efficient functioning of justice. However, our study focuses on the eurozone, providing evidence on the impact of judicial efficiency on trade credit in developed countries with similar levels of health and economic well-being and a similar legal context. Moreover, to our knowledge, no study about the incidence of judicial efficiency on doubtful trade credit has been published. The only papers that have analysed doubtful trade credit are Adilkhanova et al. (2022), Esilä (2015), Jackson and Liu (2010) and Nguyen and Nguyen (2022). With the notable exception of the first, all these studies refer to single country, and none considers the institutional context.

Our research contains some limitations related to the available information. First, it would have been interesting to have had quarterly information on the trade credit granted by the firms in our sample. This would have allowed us to mitigate the problem of 'seasonality' in sales, which is specific to certain sectors. Second, to analyse whether the volume of trade credit granted could be affected by the bargaining power of clients, it would have been helpful to have had information regarding important clients and the concentration of sales. The above information was only available for a very limited number of firms. Although it would have allowed for a deeper analysis of the relationship between judicial efficiency and the trade credit granted by the firms in the study, we are confident that these aspects did not bias our results.

Notwithstanding the limitations, the outcome of the study supports the theoretical arguments that the efficient functioning of judicial institutions is a key factor in business decisions, including those relating to the extension of trade credit to customers. In other words, our results corroborate the assumption that a healthy environment for investments and business relations relies on the efficient functioning of justice. Additionally, the fact that our results are similar to those found in other studies on countries with very different characteristics leads to the conclusion that regardless of the level of development, efficient judiciary matters. Therefore, if economic development and growth are to be sustainable, then efficient functioning of judicial institutions is necessary. Finally, our evidence also contributes to the research on trade credit granted by firms located in the eurozone. As such, the majority of studies have focused on SMEs, whereas our investigation is aimed at listed firms.

The outcome of the study also reveals an important link between the functioning of firms and public policies. Trade credit can be an important tool for firms to use in their operational strategy, and it is an interim insurance mechanism (Cuñat, 2007; Wilner, 2000). By granting credit to their customers, firms can manage their current assets and increase sales. At same time, payment default on the part of customers can generate additional costs for credit providers. Consequently, policymakers should invest in the improvement of justice systems, which will ultimately support businesses and help to discourage non-payment. This is particularly important since confidence regarding timely payments can alleviate liquidity problems and, consequently, potential insolvencies.

6 Competing Interests

The authors have no competing interests to declare that are relevant to the content of this article.

Appendix

See Tables 7 and 8

Table 7 Description of variables

Variable	Calculation
Dependent variables	
Trade credit granted (%)	(Accounts receivables/net sales)×100
Doubtful trade credit (%)	(Doubtful receivables/accounts receivables)×100
Explanatory variables	
Duration	Time taken to resolve a dispute in calendar days starting from the moment when the seller files the lawsuit in court until payment. Data is recoded in years
Rule of law	Assesses perceptions of agents' confidence in rules of society, quality of contract enforcement, property rights, police, and courts. The index ranges from −2.5 to 2.5
Control variables	
Size (log)	Natural logarithm of the net sales
Age (years)	Difference between the year of the financial statements and the date of incorporation of the company to the official register
Profit margin	Earnings before interest and taxes/net sales
ROA	Earnings before interest and taxes/total assets
Liquidity	Current assets/current liabilities
Leverage	Total debt/total assets
Sales growth	The sales variation rate in two consecutive years
GPD per capita (log)	GDP of a country divided by its population in a given year
Year	11 dummies corresponding to years 2011 to 2021
Industry-year	11 dummies corresponding to the interaction between dummy industrial firm and year dummies
Other variables included in robustness analysis	
AR_assets	Accounts receivables/total assets
Doubtful_sales	Doubtful receivables/net sales
Doubtful_assets	Doubtful receivables/total assets
AP_assets	Accounting payables/total assets
Adj._ACP	Adjusted sector average collection period (ACP). ACP is computed as accounts receivable over sales, and multiplying this by 360 days. The adjusted average sector is the difference between the ACP of the firm and the average ACP of the sector. The sector is classified from the NACE (see distribution in Table 1)

Sources All accounting data of the firms, as well as the age, year, sector and GDP are extracted from OSIRIS database

Duration are obtained from Doing Business database available at: https://archive.doingbusiness.org/en/data/exploretopics/enforcing-contracts

Rule of law is extracted from World Bank´s WGI database available at: https://databank.worldbank.org/databases/rule-of-law

Table 8 Variance Inflation Factor and correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12
VIF Model 1	–	–	1.49	–	1.22	1.09	1.17	–	1.49	1.46	1.06	1.59
VIF Model 2	–	–	–	1.57	1.21	1.10	1.17	–	1.50	1.46	1.06	1.67
VIF Model 3	–	–	1.49	–	1.17	1.09	–	1.14	1.48	1.45	1.06	1.59
VIF Model 4	–	–	–	1.57	1.17	1.10	–	1.14	1.48	1.45	1.06	1.67
1. Trade credit granted	1.0000											
2. Doubtful trade credit	0.2054***	1.0000										
3. Duration	−0.2219***	0.2597***	1.0000									
4. Rule of law	0.2811***	−0.2697***	−0.8733***	1.0000								
5. Size (log)	−0.1006***	−0.0190***	−0.0810***	0.0738***	1.0000							
6. Age (years)	−0.0922***	−0.0654***	−0.0795***	0.1141***	0.1936***	1.0000						
7. Profit margin	−0.0093	0.0740***	−0.0103	−0.0058***	0.1939***	−0.0397***	1.0000					
8. ROA	−0.0794***	−0.1064***	−0.0655***	0.1006***	0.1082***	0.0522***	0.2653***	1.0000				
9. Leverage	0.0520***	0.0272***	0.0529***	−0.0690***	0.2513***	0.0572***	−0.0413***	−0.0477***	1.0000			
10. Liquidity	−0.0090	−0.0589***	−0.0255***	0.0364	−0.2185***	−0.0383***	−0.0769***	−0.0355***	−0.5409***	1.0000		
11. Sales growth	−0.0506***	−0.0522***	−0.0195***	0.0177**	0.0167**	−0.0422***	−0.0140*	0.0519***	−0.0213***	0.0371***	1.0000	
12. GPD per cap (log)	−0.1975***	−0.2147***	−0.5165***	0.5492	0.1537***	0.0938***	−0.0159**	0.0382***	−0.0273***	0.0244***	0.0161**	1.0000

Variable description in Table 7 of the appendix. *, **, ***: significant at 10%, 5% and 1%, respectively.

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