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Abstract This paper examines differences in the ability to obtain capital—bank loans and trade credit—between firms, industries, and countries using survey data on European small and medium-sized enterprises (SMEs) from 2009 to 2014. The results show that firm age and firm size are positively linked to SMEs' access to bank loans, but only firm size is positively related to the provision of trade credit. The results also provide empirical support for a complementary rather than a substitutive effect between bank loans and trade credit. Manufacturing SMEs have a significantly higher likelihood of receiving bank loans and trade credit than non-manufacturing SMEs. We find differences across countries in terms of the relevance of firm age and firm size for obtaining capital. In addition, we point at specific country-level variables that explain why obtaining credit is easier in some countries. We perform additional analyses to confirm our baseline results and provide directions for future research.

Keywords Bank loans · Trade credit · Information asymmetry · SMEs

JEL classifications E44 · G32 · G33 · L26

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1 Introduction

Small and medium-sized enterprises (SMEs), which are defined in the current paper as firms with 250 employees at most, depend on regular cash inflows to ensure their survival and growth. It is important to understand the determinants of their access to credit because SMEs create the majority of jobs (De Wit and De Kok 2014) and contribute substantially to the growth of modern economies (Carree and Thurik 2003). Bank financing and trade credit are two major sources of SME finance (Berger and Udell 1998). Because banks are more likely to provide loans to firms with more assets (Cosh et al. 2009), i.e., to larger firms, SMEs are more dependent on alternative forms of financing, such as trade credit (Berger and Udell 1998; Petersen and Rajan 1997). A trade credit is offered by suppliers when there is a delay between the provision of goods and/or services and their actual payment by the SME (Biais and Gollier 1997). Suppliers have various (non-)financial motivations for granting trade credit. Trade credit is a way of stimulating

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sales, for example, by offering more favorable terms with increasing quantities. Trade credit also makes it possible to construct long-term relationships with customers and help them in difficult periods. Furthermore, it allows customers to evaluate the quality of goods before paying and therefore is a signal of high standards (García-Teruel and Martínez-Solano 2010; Klapper et al. 2012). Firms that supply trade credit have been found to be more profitable than non-suppliers (Martínez-Sola et al. 2014).

In an ideal finance marketplace, SMEs with good projects experience no restrictions to gaining access to external finance, whereas SMEs with poor projects are financially restricted. However, when a lender screens a potential borrower, information asymmetries cannot be avoided, because the lender is less informed about the viability of the borrower and its projects than the borrower itself (Jensen and Meckling 1976). Information asymmetries are thought to be particularly strong for small and young firms because of their restricted credit history and track record and their lower ability to provide collateral.

The present study focuses on bank loans and trade credit as two often-used sources of finance for SMEs by examining the SMEs' *direct* experiences with bank loan and trade credit negotiations ("applications").[1] Such direct measures of a firm's access to bank loan and trade credit have generally been unavailable. The central concept is debt capacity, which refers to the ability of a firm to obtain all or part of its demand for debt financing (Cosh et al. 2009; Levenson and Willard 2000; Ang and Smedema 2011).[2] Debt capacity may have several financing sources, such as bank financing and trade credit. Although numerous studies have investigated the determinants of debt capacity in terms of bank loans, evidence for the determinants of obtaining trade credit is much scarcer. We have the following four research aims.

First, we focus on firm size and firm age as relevant firm-level characteristics that determine whether a requested bank loan or trade credit is granted. Debt financing restrictions may be severe for small and young firms, thereby hindering the entrepreneurs' efforts to develop their businesses. It has been argued that trade credit is a good alternative source of finance for SMEs (Diamond 1989; García-Teruel and Martínez-Solano 2010), highlighting the relevance of taking the investigation of trade credit into account in the context of SMEs.

Second, we focus on whether bank financing and trade credit should be considered "complements" or "substitutes" (Giannetti et al. 2011; Agostino and Trivieri 2014). SMEs are inclined to use multiple sources of finance (Moritz et al. 2016). Trade credit can be regarded as a substitute for SMEs that cannot be financed by banks: SMEs that already have access to bank loans are less likely to seek access to trade credit and vice versa (Berger and Udell 1998). Yet, trade credit can also be considered a complement: backing by suppliers is a positive signal for a bank during the screening process of a potential borrower. It may thus reasonably be asked whether trade credit is a positive signal that makes banks less reluctant to lend.

Third, we investigate whether application success (for bank loans or trade credit) depends on the sector in which an SME is active. Previous studies (Hall et al. 2000; Taketa and Udell 2007) suggest that sectors may have a relevant impact on financial choices, and, hence, that industry differences may be present regarding the provision of credit. Indeed, Taketa and Udell (2007) find that the availability of the financing form depends on the industry in which Japanese SMEs are active.

Fourth, we investigate country differences regarding debt capacity. The presence of country differences for the success of application outcomes can be expected for several reasons. For example, Casey and O'Toole (2014) investigate whether financial restrictions for SMEs are more severe in countries that have suffered more profoundly from the crisis, and they find a high degree of heterogeneity across countries. In the present paper, we investigate whether the importance of firm age and firm size for obtaining credit depends on the country, and we determine which country-level variables explain application success.

Our paper contributes to the existing literature in two ways. First, we empirically investigate firm, industry, and country differences in the provision of bank loans and trade credit. We use a proxy for debt capacity based

[1] We define "application" as a situation when a firm enters into negotiation with a bank to obtain a loan or with a supplier to obtain a trade credit. However, trade credit negotiations can be informal or formal, because trade credit is characterized by more informal relationships compared with bank loans.

[2] While in this paper we focus on a firm's access to outside finance, other studies examine other questions related to debt financing. For example, Canton et al. (2013) examine perceived financial flexibility by investigating the expected capacity of a firm to access external financing.

on SMEs' direct experiences with bank loan and trade credit applications. This approach differs from many studies on SMEs' access to finance that tend to concentrate on bank loans alone. Second, we unravel the linkage between bank loan and trade credit applications to determine whether bank lending and trade credit are complements or substitutes. To our knowledge, no empirical study conducted in Europe has yet compared these two forms of financing based on application decision outcomes. For this purpose, we make use of multiple observations for an SME across years.

Our analysis is based on 12 waves (2009–2014) of the SME Access to Finance survey carried out on behalf of the European Commission. We underline the importance of distinguishing between bank loans and trade credit. Our results reveal that firm size and firm age are relevant variables to explain why European SMEs obtain bank loans, whereas only firm size is relevant for trade credit, with the largest firms having a higher probability of receiving trade credit. Regarding the dependency between the two sources of finance, we find that bank financing and trade credit are complementary rather than substitutive. We also find differences in loan application success depending on the sector in which an SME is active. That is, SMEs in the manufacturing industry have a significantly higher probability of receiving the requested bank loan or trade credit than SMEs in non-manufacturing sectors. In terms of country differences, we find heterogeneity across countries in terms of the importance of firm age and firm size, and we point at specific country-level variables that are important for obtaining credit.

The paper is organized as follows. Section 2 provides a review of the literature. In Sect. 3, the data, variables, and methodology are presented. The main results and additional analyses are presented in Sect. 4. Concluding remarks follow in Sect. 5.

2 Literature review and hypothesis development

As stated by Jensen and Meckling (1976), in any lending situation, information held by the lender and borrower is asymmetric. Information asymmetry refers to the situation where insiders (the SMEs) are better informed about themselves than outsiders such as banks, suppliers, investors, and shareholders. Adverse selection may result from information asymmetries, and it indicates that lenders find it difficult to distinguish good borrowers from bad borrowers.[3] Credit screening is the process by which a lender tries to obtain information about the borrower's quality, which is indicated, for example, by liquidity or leverage ratios, in order to reduce information asymmetries. Yet, insiders often have no incentive to provide information to outsiders. Credit screening therefore provides an imperfect image of a firm's solvability, because certain aspects, such as its long-term strategy, future business development, and the quality of managers or products, do not appear in a purely financial analysis. SMEs may then be subject to financing restrictions, in which case SMEs with good projects may be denied access to finance or are charged high interest rates (Sharpe 1990).

2.1 Firm size and age as determinants of bank financing and trade credit

The literature has shown that firm age and firm size are important determinants of debt access for SMEs. Young firms experience more problems due to information asymmetries than older firms, because they have a less successful track record than older firms due to their limited accounting history (Diamond 1989; Canton et al. 2013). Large firms have more diversified project portfolios and are therefore less risky (Rajan and Zingales 1995). Small or young firms may also have less collateral (e.g., fewer tangible assets or capital) to guarantee that they will be able to repay their debts. Acquiring information about a debtor's quality is a learning process as well, as shown in particular by Rajan (1992) in her comparison between informed and arm's length debt.[4] Outsiders may therefore be less likely to receive positive signals on the quality of young SMEs than insiders. Furthermore, financing restrictions for SMEs should be more severe during crisis periods. Holmstrom and Tirole (1997) propose a model in which firms with different levels of initial capital ask for funding. They take into account different types of macroeconomic shocks, such as credit crunches, and show that firms with lower levels of initial capital are hit more seriously by such global financial restrictions. SMEs in

[3] Moral hazard issues occur after the transaction when the agent wants to maximize its own benefits at the expense of the principal (e.g., diverting the funds to bad projects).

[4] Arm's length financing refers to a situation in which the investor has no other information than public information and a poor capacity to renegotiate a debt contract (e.g., a bondholder).

particular, having less capital, are predicted to be more weakened by such shocks.

Hyytinen and Pajarinen (2008) empirically investigate how a firm's size and age relate to information asymmetries. These authors find an inverse link between a firm's information opacity (measured from bank ratings) and its age. Interestingly, Hyytinen and Pajarinen (2008) find no link between information opacity and firm size. In contrast, Canton et al. (2013) study perceived bank loan accessibility and show that small and young SMEs perceive more difficulties to obtain bank loans than larger and older SMEs. Levenson and Willard (2000) study credit line accessibility from financial institutions in the USA in the late 1980s. They observe that 6.36% of the SMEs in their sample are unable to obtain financing and 4.22% choose not even to apply because they anticipate a denial decision. They also show that restricted firms are the smallest ones, confirming the positive link between firm size and loan accessibility. Robb (2002) confirms that in the USA, younger firms have a higher probability of being denied when they apply for a bank loan than older firms. Freel et al. (2012) report results in the UK suggesting that discouraged firms are smaller or lack close relationships with banks or service firms. Chakravarty and Xiang (2013) also show that older firms are more likely to apply for debt financing in developing countries and that strong relationships with the banking system reinforce this link.

Similar to banks' screening processes, the provision of trade credit is influenced by information asymmetries and one may expect that firms' age and size also affect this type of financing. To our knowledge, few papers have zoomed in on firm size and firm age as determinants of trade credit. García-Teruel and Martínez-Solano (2010) focus on the determinants of trade credit using data from seven European countries, and find that granted trade credit represents, on average, 22% of total assets. They find positive relationships between firm size and firm age on the one hand and the trade credit received by SMEs on the other.

Distinguishing between two firm-level determinants (firm age and firm size) and two forms of capital (bank financing and trade credit) results in the following four hypotheses:

Hypothesis 1a Firm age is positively related to application success for bank financing.

Hypothesis 1b Firm size is positively related to application success for bank financing.

Hypothesis 1c Firm age is positively related to application success for trade credit.

Hypothesis 1d Firm size is positively related to application success for trade credit.

2.2 Trade credit versus bank financing

The literature has shown that SMEs may more easily signal their quality to suppliers of trade credit (Biais and Gollier 1997) than to banks that use a screening process. Mian and Smith (1994) mention the example of the regular visits of a manufacturer's sales representative to its customers. In addition, inputs (e.g., transacted goods) represent strong collateral in trade credit transactions: they represent more value for a supplier than for a bank because the former "… can repossess the merchandise and resell it on more favorable terms" (Mian and Smith 1994, p. 76). Burkart and Ellingsen (2004, p. 570) highlight a main difference between cash and inputs considering the risk of diversion, where diversion is defined as "… any use of resources which does not maximize the lenders' expected returns." They argue that customers represent less risk for suppliers than for banks, since it is less easy for customers to divert inputs than cash: inputs are used for current activities and are a good collateral of the transaction. This implies that firms that apply for trade credit should be less subject to credit constraints. Also, information asymmetries and problems of adverse selection and moral hazard are less severe for trade credit applications than for bank loan applications (García-Teruel and Martínez-Solano 2010). Trade credit suppliers have been found to be less rigid in their liquidation policies than banks (Huyghebaert and Van de Gucht 2007).

What is the relationship between bank loan and trade credit applications? Empirically, Petersen and Rajan (1997) document that 70% of US SMEs provide trade credit to their customers and show that better-quality firms in the USA obtain more trade credit. However, trade credit is expensive and is therefore used more intensively by firms that have restricted access to bank financing. In contrast, Giannetti et al. (2011) show that US firms receive trade credit at low cost. Giannetti et al. (2011) also prove that trade credit and bank lending are more likely to be complements than substitutes. Receiving

trade credit can be considered a positive signal that makes banks less reluctant to lend. Biais and Gollier (1997, p. 905) theoretically show that, as suppliers obtain better information on the borrowers' quality, the granting of trade credit proves that they accept bearing the default risk of the buyer and that "… it has good information about the latter." Banks may then simply observe the access to trade credit to reduce their own information asymmetry. Casey and O'Toole (2014) show with European data that firms that are credit rationed are 9% more likely to use trade credit. However, contrary to our approach, they only consider the current usage of trade credit and not the application outcome. Agostino and Trivieri (2014) show that banks in Italy take trade credit information into account when they make lending decisions, also suggesting a complementary rather than a substitutive mechanism between the two sources of finance. In particular, they show that the positive effect of trade credit financing on obtaining bank financing is all the more important, as the relationships with banks are younger.

Our second hypothesis is:

> Hypothesis 2 Application success for trade credit is positively related to application success for bank financing.

2.3 Role of industries and institutions

The industry of the firms in particular, in the face of similar prevailing circumstances, may have a relevant influence on financing choices (Harris and Raviv 1991; Mian and Smith 1992). Hall et al. (2000) use UK data to show that capital structure determinants are driven by the firm's sector of activity. Previous studies, without distinguishing between different types of debt, generally focus on the relationship between sectors and leverage ratios (Van Der Wijst and Thurik 1993; Jordan et al. 1998). These studies find that firms in manufacturing sectors that typically have a greater concentration of tangible assets (e.g., higher liquidation value), have better access to debt financing. Yet, only a few papers investigate the relationship between industry and bank financing. La Rocca et al. (2010) find that firms in manufacturing sectors use more bank loan financing and obtain long-term debt more easily, due to lower information asymmetries.

Some papers show that trade credit terms are determined by sectors (Ng et al. 1999; Klapper et al. 2012). Giannetti et al. (2011) also find an influence of suppliers' sectors on the amount of accounts receivable. They further differentiate between the type of goods produced and show that suppliers of differentiated products (unlike standardized ones) have larger accounts receivable, suggesting that the nature of the inputs influences suppliers' trade credit policies. It is more difficult to break the relationship or to divert these inputs when the suppliers offer unique products. Taketa and Udell (2007) analyze SMEs in manufacturing and non-manufacturing sectors and show that sector determines an SME's probability of obtaining the required finance. Psillaki and Eleftheriou (2015) further confirm that firms in traditional or manufacturing sectors obtain trade credit more easily than firms in non-manufacturing industries. In manufacturing industries processing basic raw materials, it is easier to repossess and resale the inputs; then, firms belonging to this sector may have easier access to external financing. It should be observed that the importance of age, size, and the application success of the alternative form of financing is lower due to the reduced information asymmetries in the manufacturing sector (Mian and Smith 1992; Psillaki and Eleftheriou 2015).

Because of the described benefits of being active in the manufacturing sector, we formulate a hypothesis about differences in the probability of obtaining finance between manufacturing and non-manufacturing industries (hypothesis 3). We also hypothesize that information symmetries are less of a concern for manufacturing SMEs such that the positive relationship between age/size and application success is expected to be negatively moderated by sector (manufacturing versus non-manufacturing; hypothesis 4). Similarly, we expect the positive relationship between application success for trade credit and bank financing to be negatively moderated by the manufacturing sector (hypothesis 5).

> Hypothesis 3 Being active in the manufacturing sector is positively related to application success for bank financing and trade credit.
>
> Hypothesis 4 Being active in the manufacturing sector negatively moderates the positive relationships between firm age and firm size, and application success for bank financing and trade credit.
>
> Hypothesis 5 Being active in the manufacturing sector negatively moderates the positive

relationship between application success for trade credit and application success for bank financing.

Macroeconomic factors have been demonstrated to determine SME financing choices (e.g., Demirgüç-Kunt and Maksimovic 2001). The financial restrictions of SMEs are also influenced by the quality of the institutions available in a country. Canton et al. (2013) show that SMEs in countries with a higher concentration of the banking sector find it easier to obtain bank financing. Demirgüç-Kunt and Maksimovic (2001) study trade credit in 39 countries. They show that a strong banking system is associated with a higher availability of trade credit, whereas the quality of the legal system reinforces the use of bank debt relative to trade credit.

The studies in the literature have also analyzed SME financing restrictions within the context of the recent financial crisis that began in 2007. Psillaki and Eleftheriou (2015) compare trade credit and bank financing in a sample of French SMEs before and during the financial crisis. Their study only considers bank loans repayable within 1 year rather than long-term loans, and they focus only on certain industries. They show that bank financing acts more as a complement than as a substitute for trade credit for some sectors and that this effect is stronger during a financial crisis. Casey and O'Toole (2014) discuss cross-country differences in the importance of financial constraints and the propensity to use alternative sources of finance when firms are constrained. According to these authors SMEs from "distressed countries" did not suffer from more stringent financing restrictions than SMEs that are active in countries not severely hit by the crisis. At the same time, SMEs in these distressed countries are more likely to apply for alternative financing. Taketa and Udell (2007) demonstrate that during the Japanese banking crisis, trade credit and bank financing are more complementary than substitutive.

In the present paper, we investigate whether country-level variables influence the relationship between firm age and firm size on the one hand, and application success on the other. Also, we determine which country-level variables are related to an SME's application success for bank loans and trade credit. Because there is a lack of earlier literature on these topics, we do not formulate hypotheses here.

3 Data, methodology, and variable definitions

3.1 Dataset

The dataset (Survey on the Access to Finance of Enterprises (SAFE)) enables a study of the determinants of SMEs' debt capacity in a multi-country context. The data are collected using fixed telephone lines, and respondents are the owner, financial manager/director, or chief financial officer. The SAFE survey has been conducted in various waves since 2009 on behalf of the Directorate General for Enterprise and Industry of the European Commission, in cooperation with the European Central Bank. Our analysis considers 12 waves over the period January 2009–September 2014. The original dataset covers 72,849 firm-wave observations for 11 countries: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, and Portugal. In total, 26% of the observations in this dataset reflect applications for debt financing, and 19% reflect applications for trade credit financing in the 6 months prior to the interview. The sample we use in the baseline regression analyses consists of applying firms only (16,687 firm-wave observations in case of bank loans and 11,562 firm-wave observations in case of trade credit).[5] A subset of firms has been followed over time for a consecutive number of time periods; this sample is used for our analysis of the interrelationship between the two sources of finance.

3.2 Methodology

We proceed with the following baseline binary probit model to test hypotheses 1a to 1d, which relate SMEs' debt capacity to firm age, firm size, and several control variables:

$$\Pr(application\ \ success)_{ijt} = \Phi\left(X_{ijt}\beta + \rho_j + \tau_t\right) \quad (1)$$

where we use a specification for bank loans and a specification for trade credit. Furthermore, Φ is the cumulative normal distribution, and the subscript i denotes the firm, j denotes the country, and t denotes

[5] These samples are a bit smaller than one would expect on the basis of the numbers presented above. This is related to the fact that the question on application success (see below) was not answered or because of missing values for the control variables.

Table 1 Application (success) information for bank financing and trade credit for each country

Country	SMEs that applied for bank financing	Application success for bank financing (as % of SMEs that applied)	SMEs that applied for trade credit	Application success for trade credit (as % of SMEs that applied)
Austria	902	0.833	366	0.842
Belgium	1159	0.792	427	0.696
Estonia	2130	0.540	663	0.597
Finland	3207	0.835	3025	0.888
France	679	0.806	554	0.661
Germany	3181	0.817	858	0.846
Greece	1078	0.387	1212	0.394
Ireland	564	0.489	1185	0.647
Italy	3225	0.633	2642	0.722
Netherlands	503	0.467	378	0.513
Portugal	859	0.638	708	0.675
Total	17,487	0.674	12,018	0.654

Note: These data refer to the entire sample of firms that have applied for bank loans and/or for trade credit financing

the wave. β is $Kx1$ and X_{ijt} is the ijtth firm observation on K explanatory variables (including firm age and firm size and control variables; see below for an overview of the variables). We also include country dummy variables (ρ_j), time dummy variables (τ_t), and industry controls in all regressions. To ease interpretation and enhance comparability across variables and specifications, we report marginal effects (at the means of the variables). In some model specifications, we replace the country dummy variables with specific country-level variables (see below).

We extend Eq. 1 to test hypothesis 2 by adding a variable measuring an SME's success in applying for trade credit in the bank loan specification. Similarly, we add a variable measuring an SME's success in applying for bank loans in the trade credit specification. These two application success variables (to test hypothesis 2) are defined by the outcomes observed in the previous wave. Information about application (success) for the previous wave is available for a subset of SMEs which enables us to link application success in the previous period to application success in the current period.

To test hypotheses 3, we focus on the estimates of the marginal effects for a variable reflecting the manufacturing sector (value 1 for manufacturing, and value 0 for all non-manufacturing sectors). Hypothesis 4 is tested by adding interaction terms between the manufacturing sector and firm age/size. Hypothesis 5 is tested by adding an interaction term between the manufacturing sector and lagged application success.

3.3 Variable definitions

In line with the earlier literature (e.g., Biais and Gollier 1997; Burkart and Ellingsen 2004), we consider the determinants of application success for bank loans and for trade credit separately. That is, the first dependent variable focuses on bank loans (*application success bank financing*), whereas the second dependent variable focuses on trade credit (*application success trade credit*). We focus on the following question about the successfulness of an SME's application for bank financing and trade credit: "If you applied for and tried to negotiate for this type of financing over the past 6 months, did you receive all the financing you requested, did you receive only part of the financing you requested, or did you receive it only at unacceptable costs or terms and conditions so you did not take it, or did you receive nothing at all?" Both variables take a value of 1 if the answer is "applied and got everything" or "applied but only got part of it," and a value of 0 if the answer is "applied but refused because cost too high" or "applied but was rejected."

Table 1 presents the acceptance rates for bank financing and trade credit financing, defined as the percentage of successful requests (applied and got everything and applied but only got part of it versus all requests). The mean acceptance rate was approximately 67.4% for SMEs that applied for bank financing and 65.4% for SMEs that applied for trade credit financing.

The vector X_{ijt} of Eq. 1 contains firm age, firm size, and the firm-level control variables. Dummy variables capture the impact of firm age: *age < 2* is a dummy variable equal to 1 if the firm was founded fewer than 2 years ago (used as the reference category in our analyses); *age 2–5* is equal to 1 if the firm age is between 2 and 5 years; *age 6–10* is equal to 1 if the firm age is between 6 and 10 years; *age > 10* equals 1 if the firm is older than 10 years.

For firm size, the following variables are included: *employees 1–9* takes a value of 1 for micro firms with 1–9 employees (used as the reference category in our analyses); *employees 10–49* takes a value of 1 for small firms with 10–49 employees; and *employees 50–249* takes a value of 1 for medium-sized firms with 50–249 employees.[6]

We include a set of control variables in the regressions. First, we include profit growth to capture the impact of the firm's performance on application success. The variable *profit growth* takes a value of 1 if a firm's profit has increased over the past 6 months (Casey and O'Toole 2014), and 0 otherwise. To capture *ownership*, we use dummy variables for each type of ownership. We distinguish among: (a) public shareholders, (b) family or entrepreneurs, (c) other firms, (d) venture capital firms/individual investors, (e) single ownership, and (f) another type of ownership. Previous studies find that ownership structure has an impact on access to bank loans (Canton et al. 2013) and trade credit (Psillaki and Eleftheriou 2015). To control for the industry in our baseline model, we distinguish among four industries: manufacturing, construction, trade, and services (note that for hypotheses 3–5, the non-manufacturing sectors will be merged into one category).[7] We also control for wave effects by including dummy variables.

Data on country-specific variables are taken from the World Bank website for the years 2008 to 2013 (the country-specific variables are measured 1 year prior to the actual wave of the survey). First, following Demirgüç-Kunt and Maksimovic (2001), we consider the growth rate of gross domestic product (*GDP growth*) because firms in fast-growing economies may be more in need of credit than firms in non-expanding economies. We also use variables to measure financial development and the size of the real sector that previous studies have found to predict the use of external finance (Demirgüç-Kunt and Maksimovic 2001). Furthermore, we consider two proxies for the development of the financial system that may influence a firm's capacity to access external capital. We use domestic credit provided to the private sector as a percentage of GDP (*Ln(domestic credit)*) and the number of commercial bank branches per 100,000 adults (*Ln(bank branches)*). Finally, to measure the size of the real sector, we use the ratio of trade to GDP (*trade*) and the variable *inflation* to control for price distortions.

4 Results

A correlation matrix for the firm-level independent and control variables is provided in Table 2. The low correlations between variables generate no serious concerns with regard to multicollinearity. Table 2 also presents descriptive statistics for the entire sample of firms that applied for bank and trade credit financing.

4.1 Main results

Models 1 and 2 of Table 3 present the baseline results with *application success bank financing* and *application success trade credit* as the dependent variables, respectively. There are notable differences in the determinants of application success for each type of financing. When we consider model 1, we observe that firm age and firm size are significantly and positively related to the probability of application success for bank financing. Hence, older and larger SMEs are significantly more likely to receive the requested bank loan than younger and smaller SMEs. Specifically, the impact of firm age is significant and positive for SMEs that have been in existence for at least 6 years. Concerning firm size, firms with at least ten employees have a significantly higher probability of retrieving their requested bank loan than micro firms (one to nine employees). In particular, the differences in application success for bank finance are significant and more marked for firms having more than 50 employees versus micro firms (the probability of receiving the requested bank loan is 8 percentage points higher for firms with between 50 and 249 employees than for firms with between 1 and 9 employees).

[6] We do not include a continuous specification for age and employees because such a continuous measure is not available for each wave.

[7] Several previous studies include tangibility in examining financial decisions, but this variable was not available. Gompers (1995) shows that tangibility and industry sector are correlated. This implies that industry variables can also be a proxy for the agency problems arising in a firm.

Table 2 Descriptive statistics and correlation matrix

	Obs.	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Firm age < 2	17,054	0.021	0.144	1.000									
2. Firm age 2–5	17,054	0.061	0.240	−0.039*	1.000								
3. Firm age 6–10	17,054	0.129	0.335	−0.058*	−0.110*	1.000							
4. Firm age > 10	17,054	0.789	0.408	−0.264*	−0.504*	−0.736*	1.000						
5. Employees 1–9	17,487	0.284	0.451	0.080*	0.115*	0.108*	−0.185*	1.000					
6. Employees 10–49	17,487	0.384	0.486	−0.042*	−0.044*	−0.035*	0.069*	−0.597*	1.000				
7. Employees 50–249	17,487	0.333	0.471	−0.044*	−0.080*	−0.083*	0.132*	−0.464*	−0.433*	1.000			
8. Profit growth	17,150	0.235	0.424	0.023*	0.030*	0.021*	−0.044*	−0.078*	0.013*	0.073*	1.000		
9. Own: public shareholders	17,437	0.026	0.159	−0.003	0.000	−0.000	0.001	−0.086*	−0.008*	0.105*	0.020*	1.000	
10.Own: family/entrepreneurs	17,437	0.593	0.491	−0.043*	−0.056*	−0.054*	0.093*	−0.094*	0.083*	0.014*	−0.041*	−0.193*	1.000
11. Own: other firms	17,437	0.101	0.301	0.006	0.008*	0.021*	−0.024*	−0.146*	0.000	0.164*	0.038*	−0.061*	−0.369*
12.Own: venture capital firms	17,437	0.011	0.104	−0.003	0.012*	0.007	−0.012*	−0.052*	−0.003	0.062*	0.016*	−0.019*	−0.113*
13. Own: person	17,437	0.253	0.435	0.048*	0.056*	0.045*	−0.087*	0.260*	−0.085*	−0.198*	0.007	−0.116*	−0.701*
14. Own: others	17,437	0.016	0.127	−0.007*	−0.009*	−0.002	0.010*	−0.051*	−0.006	0.063*	0.006	−0.025*	−0.151*
15. Sector: manufacturing	17,487	0.299	0.458	−0.035*	−0.047*	−0.073*	0.101*	−0.231*	0.031*	0.225*	0.037*	0.022*	0.070*
16. Sector: construction	17,487	0.113	0.317	−0.012*	−0.006	−0.002	0.009*	−0.001	0.037*	−0.040*	−0.037*	−0.016*	0.007*
17. Sector: trade	17,487	0.263	0.440	0.013*	0.012*	−0.005	−0.008*	0.144*	−0.017*	−0.143*	−0.035*	−0.015*	0.011*
18. Sector: services	17,487	0.325	0.468	0.027*	0.034*	0.072*	−0.089*	0.074*	−0.036*	−0.043*	0.023*	0.005	−0.078*
19. GDP growth	17,487	−0.668	3.923	0.017*	−0.017*	−0.003	0.007	−0.011*	−0.003	0.016*	0.038*	−0.031*	−0.039*
20. Ln (domestic credit)	17,487	4.513	0.207	−0.006	−0.017*	0.007*	0.006	0.024*	0.002	−0.029*	−0.038*	0.015*	0.083*
21. Ln (bank branches)	17,487	3.243	0.593	−0.033*	0.004	0.006	0.004	0.039*	0.009*	−0.053*	−0.088*	0.029*	0.143*
22. Trade	17,487	1.695	4.933	0.028*	−0.003	−0.016*	0.006	−0.011*	0.004	0.007*	0.114*	−0.013*	−0.077*
23. Inflation	17,487	1.743	1.558	0.004	0.033*	0.003	−0.024*	−0.034*	−0.007	0.045*	0.033*	−0.016*	−0.073*

	11	12	13	14	15	16	17	18	19	20	21	22	23
11. Own: other firms	1.000												
12.Own: venture capital firms	−0.036*	1.000											
13. Own: person	−0.221*	−0.068*	1.000										
14. Own: others	−0.048*	−0.015*	−0.091*	1.000									
15. Sector: manufacturing	0.054*	0.022*	−0.126*	−0.002	1.000								
16. Sector: construction	−0.027*	−0.017*	0.026*	−0.019*	−0.202*	1.000							
17. Sector: trade	−0.053*	−0.018*	0.043*	−0.034*	−0.353*	−0.218*	1.000						
18. Sector: services	0.018*	0.009*	0.055*	0.045*	−0.435*	−0.269*	−0.469*	1.000					
19. GDP growth	0.018*	−0.003	0.043*	−0.000	0.003	0.008*	−0.053*	0.042*	1.000				
20. Ln (domestic credit)	−0.059*	−0.015*	−0.054*	0.003	−0.020*	−0.010*	0.053*	−0.024*	−0.269*	1.000			
21. Ln (bank branches)	−0.064*	−0.012*	−0.121*	−0.002	0.065*	−0.014*	0.021*	−0.068*	−0.196*	0.221*	1.000		
22. Trade	0.004	0.011*	0.078*	0.018*	−0.027*	−0.009*	−0.017**	0.046*	0.191*	0.022*	−0.304*	1.000	
23. Inflation	0.016*	−0.001	0.076*	−0.003	0.011*	0.008*	−0.070*	0.049*	0.145*	−0.235*	−0.256*	−0.115*	1.000

Notes: For the description of the variables, see Sect. 3. We estimate these correlations using the entire sample of firms that have applied for bank loans and/or for trade credit financing

*5%—level of significance

These results are consistent with the first two hypotheses (1a and 1b). Overall, the results suggest that banks consider an "age threshold" when they screen firms. Both firm size variables have significant coefficients in our bank loan specification.

In contrast, the trade credit model (model 2; application success trade credit) reveals a significant and positive impact only for firm size (SMEs with at least 50 employees). Hypothesis 1c is not supported whereas hypothesis 1d is partially supported. These results are in line with García-Teruel and Martínez-Solano (2010), who find a significant impact of firm size on received trade credit.[8]

To investigate hypothesis 2, we examine the link between success in obtaining one source of finance and a previous success in obtaining the alternative source of finance.

Based on contingency tables and statistical tests for independence (Appendix 1 and Appendix 2), we find a general dependency between bank loan and trade credit application success for a subsample of firms that applied for both types of financing. SMEs that applied for and obtained one type of financing also applied for and obtained the alternative type of financing. At the same time, firms that failed to obtain one type of financing were unsuccessful in obtaining the alternative type of financing.

We use a binary probit model to empirically investigate the relationship between the two types of financing, and we focus on the subsample of SMEs that applied for both types of finance in consecutive waves. Models 3 and 4 of Table 3 present these results. It turns out that trade credit application success in the previous period significantly and positively predicts bank loan application success in the current period (model 3). Also, bank loan application success in the previous period significantly and positively predicts trade credit application success in the current period (model 4). Hence, creditors consider previous application success in assessing a current application. It seems that by reducing the sample of firms to only those that had been involved in both types of access to external finance, one form of financing is affected by the other. These results confirm hypothesis 2 on the complementary effect between trade credit and bank financing application success.

In the last four models of Table 3, we add country variables to the regression specifications to control for specific macroeconomic conditions. Specifically, we find that GDP growth is significantly and positively associated with the probability of obtaining bank financing and trade credit. The first proxy for financial development, Ln(domestic credit), is significantly and positively related to the probability of obtaining bank financing. The second proxy, Ln(bank branches), is significantly and positively associated with the probability of obtaining trade credit. Globally, this finding implies that countries with an efficient financial system are, on average, characterized by a favorable financial environment for SMEs. Finally, trade and inflation play a significant role for trade credit application success rather than bank loan application success.

Hypotheses 3, 4, and 5 are tested in Table 4. Columns 1 and 2 of Table 4 replace the industry dummies from Table 3 with a manufacturing versus non-manufacturing dummy variable. Overall, we find that firms in the manufacturing industry have a significantly higher probability of obtaining external financing, confirming hypothesis 3. Following Taketa and Udell (2007), Table 4 adds interaction terms between the manufacturing sector on the one hand, and firm age (columns 3 and 4), firm size (columns 3 and 4) and lagged application success (columns 5 and 6) on the other hand. The results show the importance of the manufacturing sector in shaping the magnitude of the baseline relationships. The relationship between firm age and an SME's application success for bank financing and trade credit is negatively moderated by the manufacturing industry.[9] For firm size, we do not find a moderation

[8] However, our empirical focus is different because García-Teruel and Martínez-Solano (2010) consider the level of trade credit rather than direct experiences with bank loan and trade credit applications.

[9] Additional Wald tests in column 3 of Table 4 reveal that the sum of the coefficients of the age dummy variables and the interaction terms lead to non-significance for age 6–10 and age > 10, and a significant negative coefficient for age 2–5 (p value < 0.10). For trade credit (Column 4) we find significant negative coefficients for age 2–5, age 6–10, and non-significance for age > 10. In sum, there is some evidence that younger SMEs in the manufacturing sector have a higher likelihood of obtaining credit than older SMEs. To further check the robustness of our findings, we provide an analysis by partitioning the sample of firms into non-manufacturing and manufacturing firms. We find that the relationships between firm age/size and application outcomes are weaker in the manufacturing sector than in the non-manufacturing sectors. For reasons of brevity, these results are not tabulated but are available upon request.

Table 3 Binary probit regressions with application success as the dependent variable (marginal effects are shown)

	(1) Application success bank financing	(2) Application success trade credit	(3) Application success bank financing	(4) Application success trade credit	(5) Application success bank financing	(6) Application success trade credit	(7) Application success bank financing	(8) Application success trade credit
Previous application success trade credit			0.273*** (0.012)				0.286*** (0.010)	
Previous application success bank financing				0.224*** (0.025)				0.228*** (0.023)
Firm age								
2–5	− 0.0124 (0.018)	− 0.0359 (0.042)	− 0.0390 (0.145)	− 0.0741 (0.103)	0.0647 (0.127)	− 0.0464 (0.042)	− 0.0484 (0.154)	− 0.0380 (0.096)
6–10	0.0346** (0.014)	− 0.0203 (0.040)	− 0.0456 (0.154)	− 0.132 (0.118)	− 0.0324 (0.041)	− 0.0356 (0.040)	− 0.0703 (0.167)	− 0.134 (0.116)
> 10	0.0857*** (0.025)	0.0152 (0.038)	− 0.0275 (0.152)	− 0.101 (0.113)	0.0831** (0.039)	0.0037 (0.039)	− 0.0427 (0.167)	− 0.104 (0.112)
Employees								
10–49	0.0555*** (0.015)	0.0020 (0.011)	0.0466 (0.037)	0.0455 (0.031)	0.0671*** (0.012)	0.0022 (0.011)	0.0537 (0.039)	0.0420 (0.033)
50–249	0.0755*** (0.024)	0.0224* (0.012)	0.0951*** (0.033)	0.0711*** (0.024)	0.0858*** (0.023)	0.0236* (0.012)	0.102*** (0.035)	0.0701** (0.027)
Profit growth	0.0659*** (0.008)	0.0628*** (0.010)	0.0485** (0.022)	0.0430 (0.028)	0.0923*** (0.015)	0.0789*** (0.010)	0.0544*** (0.020)	0.0505 (0.031)
Ownership								
Public shareholders	0.0303 (0.029)	0.0344 (0.027)	− 0.0468 (0.060)	0.0547 (0.050)	− 0.0504 (0.039)	− 0.005 (0.028)	− 0.106** (0.046)	0.0238 (0.052)
Family/entrepreneurs	0.0364*** (0.010)	0.0230** (0.011)	− 0.0038 (0.025)	0.0614 (0.038)	0.0007 (0.020)	0.0085 (0.011)	− 0.0249 (0.018)	0.0521 (0.034)
Other firms	0.0506*** (0.017)	0.0376** (0.017)	− 0.0120 (0.038)	0.123*** (0.026)	0.0224 (0.028)	0.0338** (0.016)	− 0.0144 (0.036)	0.119*** (0.028)
Venture capital firms	− 0.0199 (0.027)	− 0.0664 (0.044)	− 0.0843 (0.138)	0.0858 (0.079)	− 0.0566** (0.026)	− 0.0889* (0.046)	− 0.0902 (0.151)	0.0854 (0.079)
Other	0.0522** (0.021)	− 0.0208 (0.041)	0.0599 (0.071)	− 0.254*** (0.089)	0.0427** (0.020)	− 0.0319 (0.042)	0.0392 (0.067)	− 0.246*** (0.091)
Sector								
Manufacturing	− 0.0002 (0.010)	− 0.00398 (0.012)	0.0896*** (0.019)	− 0.0116 (0.021)	− 8.80e−05 (0.009)	− 0.0010 (0.011)	0.0946*** (0.023)	− 0.009 (0.019)
Construction	− 0.0428** (0.018)	− 0.0460*** (0.015)	0.0452* (0.025)	− 0.0315 (0.036)	− 0.0446** (0.019)	− 0.0430*** (0.015)	0.0638** (0.025)	− 0.0220 (0.033)
Trade	0.00264 (0.010)	0.0223* (0.012)	0.0711*** (0.023)	0.0236 (0.016)	− 0.0152 (0.014)	0.0046 (0.011)	0.0696*** (0.025)	0.0236 (0.016)
Country variables								
GDP growth					0.0152** (0.007)	0.0244*** (0.002)	0.0223*** (0.005)	0.0206*** (0.004)
Ln(domestic credit)					0.185* (0.095)	− 0.0369 (0.028)	− 0.0443 (0.072)	0.0748 (0.049)
Ln(bank branches)					0.014 (0.063)	0.0811*** (0.008)	− 0.0008 (0.028)	0.0748*** (0.012)
Trade					0.0037 (0.006)	0.0020** (0.001)	0.0006 (0.004)	0.0034 (0.002)
Inflation					0.0111 (0.015)	0.0195*** (0.003)	0.0093 (0.019)	0.0301** (0.012)
Country dummies	Yes	Yes	Yes	Yes	No	No	No	No
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,687	11,562	1775	1745	16,687	11,562	1775	1745
Log likelihood	− 9638	− 7017	− 1054	− 1041	− 10.131	− 7216	− 1076	− 1051
McFadden's R^2	0.087	0.061	0.133	0.100	0.085	0.065	0.115	0.092
McKelvey and Zavoina R^2	0.169	0.128	0.252	0.200	0.159	0.129	0.220	0.179

Notes: For the description of the variables, see Sect. 3. Marginal effects calculated at the means are presented. Robust clustered (by country) standard errors are between parentheses. Reference categories: age, < 2; employees, 1–9; ownership, single person, sector, services

*10%, **5%, ***1%levels of significance

effect for either type of financing; hence, hypothesis 4 is partially supported. We do not find significant coefficients of the interaction terms between the manufacturing dummy and application success in obtaining the alternative form of financing. Thus, hypothesis 5 is not supported. In sum, our sector-specific analysis highlights the role of industries in the context of application success: in the manufacturing sector, suppliers consider the value of the inputs delivered to be strong collateral (Biais and Gollier 1997; Mian and Smith 1992 and Mian and Smith 1994).

Finally, we investigate differences at the country level. Therefore, Table 5 shows the marginal effects of firm age and firm size for the 11 countries. Control variables as in Table 3 are also included. Clearly, there is large heterogeneity in terms of the importance of firm age and firm size for application success. These country-by-country results appear to be in line with earlier analyses in the European economic environment (Casey and O'Toole 2014) that find strong heterogeneity across countries. In particular, for bank financing (Table 5 (bank financing)), the marginal effects of firm age are statistically significant mainly in German legal-origin countries such as Austria, Estonia, and Germany. Firm size is important for bank loan application success in seven out of 11 countries. Concerning trade credit (Table 5 (trade credit)), an impact of firm age is generally absent while for firm size we find a significant impact for Belgium, Greece, Italy, and the Netherlands.[10]

4.2 Additional analyses

Sample selection and discouraged borrowers Models 1 and 2 in Table 6 show the results for binary probit models with sample selection that consist of an outcome equation (*application success*) and a selection equation (applying or not).[11] For model identification, it is necessary to include a variable that is correlated with the decision to apply, but not for application success. We use the variable *D_subsidiaries*, which takes a value of 1 if a firm claims to be "part of a profit-oriented enterprise (e.g., a subsidiary or branch) *not* making autonomous financial decisions," and 0 otherwise. For subsidiary firms, we expect a low probability of applying for external financing, which is verified in a single equation probit model with the decision to apply as the dependent variable. We also find that this variable is not significantly associated with an SME's access to external finance. Importantly, the coefficients for the outcome equation (application success)[12] are in line with our previous results. In addition, we find that the error terms of both equations in the sample selection model are not significantly correlated (p values > 0.10 for both dependent variables). Hence, selection does not seem to be a concern in our case.

To further check the robustness of our findings, we take into account discouraged borrowers. Kon and Storey (2003) develop a theory that predicts that good *and* bad borrowers can become discouraged due to information asymmetry and application costs. Empirical studies have examined discouragement in the case of bank loan applications (Levenson and Willard 2000; Han et al. 2009; Freel et al. 2012; Chakravarty and Xiang 2013). To assess the role of discouragement, we use the definition of Freel et al. (2012, p. 400): "… firms that chose not to apply for fear of rejection". According to this definition, we re-estimate models 1 and 2 of Table 6 and consider the fact that SMEs that did not apply because of a fear of rejection. This implies that in the selection equation, the dependent variable has a value of 1 if the firm applied for external financing and 0 if the firm did not apply because of a fear of rejection (these are the discouraged borrowers). Models 3 and 4 in Table 6 show the results. Overall, qualitatively similar results are found.

Ordered probit model Appendix 3 (models 1 and 2) shows the results of ordered probit regressions to account for the ordered nature of our dependent variables. The dependent variable in this case takes a value of 3 if the firm received all financing

[10] In a further analysis, we also consider the relationship between the two types of financing for each country. The results (which are not reported) confirm a positive relation between bank loans and trade credit financing. Too few observations in the panel data were available for each country. This implies that, to obtain an estimate of the relationship, we run a simple regression model with the response variable y as one type of financing and the predictor variable x as the other type of financing in the previous period.

[11] The related survey question on the decision to apply was as follows: "For each of the following ways of financing, could you please indicate whether you applied for them over the past 6 months, or if you did not apply because you thought you would be rejected, because you had sufficient internal funds, or you did not apply for other reasons?"

[12] For brevity, the results for the selection equation (applied yes/no) are not tabulated but are available upon request.

(100%), a value of 2 if it received most financing (75–99%), a value of 1 if it received some financing (1–74%) and a value of 0 if it received no financing (0%). The coefficients we obtain for firm age and firm size confirm our previous results. We find that, where significant, the coefficients are positive, underlining that the very small (one to nine employees) and very young (age < 2) firms are less able to obtain debt financing.

Firm size We also consider a different measure of firm size. We re-perform our analysis in Appendix 3 (models 3 and 4) using annual turnover instead of the number of employees (distinguishing between *turnover < 2 million euros*, *Turnover 2–10* million euros, and *Turnover 11–50* million euros). The findings are qualitatively similar to the results of models 1 and 2 in Table 3.

Application decision and current usage of bank and trade credit We applied an additional analysis to check the relationship between the decision to apply for bank financing and its current usage and between the decision to apply for trade credit and its current usage. Each of these variables of current usage is binary and takes the value of 1 if the firm used it in the past 6 months and 0 otherwise. Significant results are found for variables that measure the current usage of debt financing. Firms that are experienced with the use of bank and trade credit are more likely to ask for financing. Specifically, we find that firms that are experienced with bank loans are 21.8% more likely to ask for bank financing and that firms that are experienced with trade credit are 31.2% more likely to ask for trade credit. The results are statistically significant at the 1% level (complete tables are available upon request). This implies that recent lending experiences can "boost" future access to external financing.

5 Discussion and conclusion

We use the SAFE database (2009–2014) from the European Commission, which includes financial data for SMEs (fewer than 250 employees). We analyze outcomes of SME applications for bank loans and trade credit. Bank loans are the largest source of finance among SMEs (Petersen and Rajan 1994). At the same time, SMEs are dependent on alternative sources of finance, such as trade credit, given their restricted track record and reputation (Berger and Udell 1998; Petersen and Rajan 1997).

There are two major outcomes of the present study. First, we find that the probabilities of receiving trade credit or a bank loan have different determinants. Second, we demonstrate the dependency between the two sources of finance.

Regarding the determinants of receiving a bank loan and trade credit, we find that older and larger SMEs are more likely to receive bank financing, while the results are less convincing for trade credit. That is, firm age is unrelated to the probability of receiving trade credit, and for firm size, there is no significant difference in the probability of receiving trade credit for the smallest firms (less than ten employees) and those between 10 and 49 employees. A relatively small marginal effect is found for the largest SMEs. Our results suggest a different screening process between the two financing options. The relationships with suppliers of credit and information asymmetries play a more substantial role for bank loans than for trade credit. Future research should reveal whether this is indeed the case by using continuous measures of firm age and firm size and measures of information asymmetries (Hyytinen and Pajarinen 2008).

We also add to the literature in terms of the interrelationship between sources of finance. Our results confirm that trade credit and bank financing are complementary rather than substitutive. That is, in our specification, we take account of an SME's successful application for bank finance in the past when using application success for trade credit as the dependent variable. At the same time, a successful application for trade credit in the past was added to the model with application success for bank finance as the dependent variable. We find a significant positive coefficient for the lagged variable in either case, which points to a complementarity effect between the two sources of finance. In other words, a successful application for either source of finance is beneficial for an SME's chance of receiving the other source of finance. The provision of finance through either source can be seen as a signal lenders use when deciding whether or not to grant financing (Giannetti et al. 2011; Psillaki and Eleftheriou 2015; Agostino and Trivieri 2014).

This study also focuses on the determinants of receiving bank loans and trade credit at the industry level and country level. We find that application success is greater

Table 4 Application success, firm age, and firm size

	(1) Application success bank financing	(2) Application success trade credit	(3) Application success bank financing	(4) Application success trade credit	(5) Application success bank financing	(6) Application success trade credit
Previous application success trade credit					0.2890*** (0.036)	
Previous application success bank financing						0.2420*** (0.033)
Manuf. dummy	0.1108** (0.037)	0.1013* (0.060)	0.0908* (0.048)	0.1412** (0.060)	0.1090** (0.040)	0.5180** (0.177)
Manuf. dummy × previous application success trade credit					−0.0399 (0.064)	
Manuf. dummy × previous application success bank financing						−0.0357 (0.045)
Firm age						
2–5	−0.0151 (0.018)	−0.0361 (0.024)	0.0073 (0.015)	−0.0108 (0.039)	0.0366 (0.285)	0.2410 (0.229)
6–10	0.0313 (0.024)	−0.0220 (0.032)	0.0497** (0.020)	0.0140 (0.039)	0.0056 (0.266)	0.180 (0.208)
> 10	0.0826*** (0.026)	0.0160 (0.024)	0.0994*** (0.019)	0.0408 (0.034)	0.0151 (0.251)	0.192 (0.228)
Employees						
10–49	0.0537*** (0.015)	−0.00163 (0.013)	0.0542*** (0.017)	0.0089 (0.013)	0.0295 (0.045)	0.0695*** (0.023)
50–249	0.0736*** (0.024)	0.0172 (0.019)	0.0672** (0.032)	0.0224 (0.022)	0.0597 (0.054)	0.0541* (0.029)
Manuf. dummy × firm age 2–5			−0.1160** (0.058)	−0.118* (0.067)	−0.173 (0.427)	−0.547** (0.269)
Manuf. dummy × firm age 6–10			−0.1070* (0.059)	−0.1600** (0.059)	−0.1030 (0.424)	−0.5380* (0.298)
Manuf. dummy × firm age > 10			−0.1030** (0.049)	−0.1250** (0.061)	−0.0754 (0.399)	−0.4780* (0.268)
Manuf. dummy × employees 10–49			0.0050 (0.019)	−0.0305 (0.020)	0.0799 (0.064)	−0.0815 (0.088)
Manuf. dummy × employees 50–249			0.0238 (0.035)	−0.0128 (0.017)	0.114 (0.091)	0.0076 (0.084)
Profit growth	0.0673*** (0.008)	0.0642*** (0.010)	0.0656*** (0.008)	0.0625*** (0.009)	0.0463** (0.023)	0.0414 (0.029)
Ownership						
Public shareholders	0.0318 (0.029)	0.0358 (0.033)	0.0302 (0.029)	0.0338 (0.034)	−0.0459 (0.062)	0.0523 (0.048)
Family/entrepreneurs	0.0368*** (0.010)	0.0234** (0.009)	0.0365*** (0.010)	0.0229** (0.009)	−0.00551 (0.026)	0.0633* (0.037)
Other firms	0.0514*** (0.017)	0.0391** (0.016)	0.0501*** (0.017)	0.0377** (0.016)	−0.0147 (0.039)	0.125*** (0.027)
Venture capital firms	−0.0165 (0.027)	−0.0620* (0.034)	−0.0198 (0.026)	−0.0642* (0.034)	−0.0873 (0.139)	0.102 (0.070)
Other	0.0541** (0.021)	−0.0193 (0.030)	0.0529** (0.021)	−0.0214 (0.031)	0.0553 (0.073)	−0.2550*** (0.088)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,687	11,562	16,687	11,562	1775	1745
Log likelihood	−10,565	−7474	−9636	−7014	−1052	−1037
McFadden's R^2	0.087	0.060	0.088	0.062	0.135	0.103
McKelvey and Zavoina R^2	0.168	0.125	0.170	0.128	0.255	0.206

Notes: Manufacturing versus non-manufacturing SMEs (marginal effects are shown). For the description of the variables, see Sect. 3. Marginal effects calculated at the means are presented. Robust clustered (by country) standard errors are between parentheses. Reference categories: age, < 2; employees, 1–9; ownership, single person

*10%, **5%, ***1%—levels of significance

Table 5 Application success, firm age, and firm size across countries (marginal effects are shown)

Country	Firm age at 2–5	Firm age at 6–10	Firm age at > 10	Employees 10–49	Employees 50–249	Obs	McFadden's R^2
Bank financing							
Austria	0.028	0.204**	0.146*	− 0.003	0.042	824	0.054
Belgium	0.022	0.007	0.044	0.092***	0.081**	1113	0.084
Estonia	0.015	0.119*	0.142**	0.106***	0.141***	1940	0.073
Finland	0.012	− 0.015	0.028	0.020	0.028	3095	0.051
France	0.134*	− 0.190	− 0.155	0.109	− 0.065	656	0.062
Germany	0.022	0.014	0.102**	0.074***	0.133***	3040	0.058
Greece	− 0.302	− 0.272	− 0.169	− 0.003	0.105**	1056	0.045
Ireland	− 0.100	0.007	0.031	0.057	0.050	546	0.061
Italy	− 0.042	0.016	0.042	0.051**	0.056**	3093	0.066
Netherlands	− 0.105	0.025	0.091	0.187***	0.267***	486	0.110
Portugal	− 0.267	− 0.136	− 0.142	0.074*	− 0.005	833	0.069
Trade credit							
Austria	0.041	0.036	0.055	− 0.029	0.066	318	0.105
Belgium	0.268	0.088	0.163	0.112**	0.194***	417	0.069
Estonia	− 0.022	0.013	0.068	0.028	0.021	587	0.100
Finland	0.002	− 0.012	0.019	0.006	0.023	2922	0.045
France	0.064	0.191	0.225	− 0.001	0.019	522	0.131
Germany	0.012	0.026	− 0.009	0.014	0.016	814	0.043
Greece	− 0.234	0.263*	− 0.163	0.027	0.129***	1198	0.046
Ireland	− 0.131	0.013	0.032	− 0.044	0.061	1150	0.055
Italy	− 0.037	0.021	0.028	0.042*	0.039**	2521	0.065
Netherlands	0.159	0.017	0.170	0.117*	0.201***	368	0.067
Portugal	0.057	0.044	0.030	0.070	− 0.033	687	0.049

Notes: For the description of the variables, see Sect. 3. Marginal effects calculated at the means are presented. All of the other variables and controls (not tabulated), included in Table 3, are enclosed. Reference categories: age, < 2; employees, 1–9; ownership, single person; sector, services

*10%, **5%, ***1%—levels of significance

for SMEs in the manufacturing sector compared with SMEs in the other sectors, and that firm age and firm size have less profound impacts on application outcomes in the manufacturing sector than in non-manufacturing sectors. Regarding differences across countries, we find the following. While a significant relationship between firm age and access to bank loans is found in our main sample, a country-specific analysis reveals statistical significance in a few countries only. Despite the relatively small and varying sample sizes across countries, we believe this is an indication of heterogeneity across countries in terms of the importance of firm age and firm size for application success for bank loans and trade credit. These findings are consistent with recent cross-country empirical studies (Casey and O'Toole 2014). Finally, our analysis reveals different country-level determinants of bank loan and trade credit application success.

In addition to the possible avenues for future research described above, further empirical analysis, with the inclusion of credit scores or ratings, should reveal whether it is indeed the case that only good creditors are granted access to additional amounts of credit. Such research could also include objective financial indicators of SMEs that were unavailable for the present study. For example, we included a subjective measure of profit growth in our analyses, whereas previous research pointed to profit or assets as being important in lending decisions. Another limitation is the restricted size of the panel dataset. With more waves becoming available in the coming years, it will be possible to analyze the dynamics of SME

Table 6 Additional analyses: selection model and discouraged firms

	(1) Selection model	(2) Selection model	(3) Selection model and discouraged firms	(4) Selection model and discouraged firms
	Application success bank financing	Application success trade credit	Application success bank financing	Application success trade credit
Firm age				
2–5	− 0.0009 (0.019)	− 0.0330 (0.023)	0.0016 (0.015)	− 0.0310 (0.027)
6–10	0.0376* (0.022)	− 0.0214 (0.033)	0.0419* (0.022)	0.0167 (0.027)
> 10	0.081*** (0.022)	0.0155 (0.027)	0.0847*** (0.024)	0.0021 (0.024)
Employees				
10–49	0.0405** (0.016)	0.0190 (0.059)	|0.0390** (0.019)	0.0432*** (0.011)
50–249	0.0396* (0.022)	0.0788** (0.036)	0.0534* (0.029)	0.0411*** (0.013)
Profit growth	0.0551*** (0.012)	0.0689*** (0.008)	0.0563*** (0.012)	0.0323* (0.017)
Ownership				
Public shareholders	0.0367 (0.028)	0.0179 (0.082)	0.0226 (0.032)	0.0327 (0.028)
Family/entrepreneurs	0.0299*** (0.010)	0.0299* (0.021)	0.0302** (0.032)	0.0004 (0.006)
Other firms	0.0515*** (0.014)	0.0408** (0.018)	0.0470*** (0.016)	0.0040 (0.017)
Venture capital firms	− 0.0103 (0.023)	− 0.0379* (0.043)	− 0.0193 (0.027)	− 0.0861*** (0.028)
Other	0.0513** (0.017)	− 0.0379 (0.067)	0.0459** (0.022)	− 0.0136 (0.034)
Sector				
Manufacturing	− 0.0055 (0.008)	0.0189 (0.079)	0.0004 (0.009)	− 0.0123 (0.017)
Construction	− 0.0409** (0.017)	− 0.0290 (0.073)	− 0.0418** (0.017)	− 0.0439*** (0.012)
Trade	− 0.0014 (0.007)	0.0432 (0.065)	− 0.0012 (0.009)	0.0004 (0.014)
Country dummies	Yes	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes	Yes
Observations	67,366	62,705	21,539	14,195
Censored observations	50,687	51,148	4860	2638
Uncensored observations	16,679	11,557	16,679	11,557
Wald χ^2 test ($\rho = 0$)	0.235	0.773	0.202	0.312

Notes: For the description of the variables, see Sect. 3. Marginal effects calculated at the means are presented. Robust clustered (by country) standard errors are between parentheses. Reference categories: age, < 2; employees, 1–9; ownership, single person; sector, services

*10%, **5%, ***1%–levels of significance

financing more narrowly and to apply more-advanced panel data techniques.

A clear avenue for further research is the integration of other forms of finance. For example, Cosh et al. (2009) examine the determinants of capital obtained from several forms of financing, such as venture capital, hire purchase or leasing, factoring, and invoice discounting. Moritz et al. (2016) and Masiak et al. (2017) use a cluster analysis approach and identify several SMEs' financing profiles. There are also recent studies that examine the role of crowdfunding (Ahlers et al. 2015; Colombo et al. 2015) and the impact of venture capital finance on a firm's financial structure (Haro-de-Rosario et al. 2016). Further research is also needed to develop better proxies for asymmetric information to improve the analyses of access to debt financing and the role of dynamics in the lending relationship (especially for debt financing). For example, Roberts (2015) shows that the terms of renegotiation (i.e., modifications in the contractual constraints) are an integral part of bank lending that impact the behavior of the contracting parties. This suggests that the dynamics of renegotiation throughout the relationship influence the role of the initial contract terms and, consequently, the initial accessibility to debt financing. Finally, the analysis of potentially differential determinants across several forms of finance can be extended from firm age and firm size to other variables, such as financial indicators or ownership structure.

In sum, our results of the analyses of the application decision outcomes of European SMEs add new insights into their financial restrictions and the way in which multiple sources of finance are used over time. These findings may be useful for policymakers who are committed to encouraging the growth and viability of SMEs. Our results demonstrate the usefulness of financial data collection initiatives over time, and future research can profit from more extensive longitudinal datasets with the inclusion of a wide array of financial sources.

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Appendix 1

Table 7 Contingency table for firms that obtain both trade credit at time *t*-1 and bank financing at time *t*

	Previous application success trade credit = 0	Previous application success trade credit = 1	Total
Application success bank financing = 0	437	358	795
	54.97%	45.03%	100%
	65.03%	31.29%	43.78%
Application success bank financing = 1	235	786	1021
	23.02%	76.98%	100%
	34.97%	68.71%	56.22%
Total	672	1144	1816
	37%	63%	100%
	100%	100%	100%

Pearson chi^2 (1) = 195.75 (Pr = 0.000)

Likelihood-ratio chi^2 (1) = 197.55 (Pr = 0.000)

Cramer's *V* = 0.3283

Fisher's exact = 0.000

1-sided Fisher's exact = 0.000

Notes: The relationship between the two types of financing is analyzed via a contingency table. The tests of statistically significant independence (Pearson's chi^2 (1), likelihood-ratio, Cramer's *V*, Fisher's exact) confirm the existence of a strong coherent link between the two types of financing

Appendix 2

Table 8 Contingency table for firms that obtain both trade credit at time *t* and bank financing at time *t*-1

	Application success trade credit = 0	Application success trade credit = 1	Total
Previous application success bank financing = 0	409	361	770
	53.12%	46.88%	100%
	60.15%	32.46%	42.97%
Previous application success bank financing = 1	271	751	1022
	26.52%	73.48%	100%
	39.85%	67.58%	57.03%
Total	680	1112	1792
	37.95%	62.05%	100%
	100%	100%	100%

Pearson chi^2 (1) = 131.95 (Pr = 0.000)

Likelihood-ratio chi^2 (1) = 132.37 (Pr = 0.000)

Cramer's *V* = 0.2714

Fisher's exact = 0.000

1-sided Fisher's exact = 0.000

Notes: The relationship between the two types of financing is analyzed via a contingency table. The tests of statistically significant independence (Pearson's chi^2 (1), likelihood-ratio, Cramer's *V*, Fisher's exact) confirm the existence of a strong coherent link between the two types of financing

Appendix 3

Table 9 Additional analyses (with application success as the dependent variable)

	(1) Ordered probit Application success bank financing	(2) Ordered probit Application success trade credit	(3) Binary probit (alternative firm size variable) Application success bank financing	(4) Binary probit (alternative firm size variable) Application success trade credit
Firm age				
2–5	− 0.0801 (0.348)	− 0.1406 (0.213)	− 0.0033 (0.019)	− 0.0175 (0.024)
6–10	0.0869 (0.280)	− 0.0906 (0.403)	0.0449* (0.025)	0.0008 (0.033)
> 10	0.2506*** (0.001)	0.0071 (0.946)	0.0943*** (0.026)	0.0288 (0.024)
Employees				
10–49	0.2228*** (0.000)	0.0777*** (0.010)		
50–249	0.3113*** (0.000)	0.1558*** (0.000)		
Turnover				
2–10 M			0.0440* (0.025)	− 0.0092 (0.013)
11–50 M			0.0750*** (0.02)	0.0455*** (0.017)
Profit growth	0.1885*** (0.000)	0.1955*** (0.000)	0.0657*** (0.008)	0.0620*** (0.009)
Ownership				
Public shareholders	0.1387** (0.026)	0.0988 (0.180)	0.0231 (0.0314)	0.0311 (0.034)
Family/entrepreneurs	0.1306*** (0.000)	0.0854*** (0.007)	0.0370*** (0.010)	0.0214** (0.009)
Other firms	0.1534*** (0.000)	0.1291*** (0.006)	0.0480*** (0.018)	0.0333** (0.016)
Venture capital firms	− 0.0450 (0.630)	− 0.1399 (0.197)	− 0.0253 (0.026)	− 0.0741** (0.034)
Other	0.2030** (0.011)	0.0114 (0.912)	0.0514** (0.023)	− 0.0214 (0.032)
Sector				
Manufacturing	− 0.0016 (0.951)	− 0.0102 (0.750)	− 0.0021 (0.011)	− 0.00766 (0.017)
Construction	− 0.1263*** (0.000)	− 0.1410*** (0.001)	− 0.0457*** (0.017)	− 0.0471*** (0.013)
Trade	0.0149 (0.575)	0.0766** (0.018)	− 0.00610 (0.011)	0.0162 (0.014)
Country dummies	Yes	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes	Yes
Observations	16,687	11,562	16,397	11,415
Log likelihood	− 13,289	− 8988	− 9456	− 6916
McFadden's R^2	0.067	0.053	0.088	0.062
McKelvey and Zavoina R^2			0.170	0.130

Notes: For the description of the variables, see Sect. 3. For the binary probit model (models 3 and 4), marginal effects calculated at the means are presented. Robust clustered (by country) standard errors are between parentheses. Reference categories: age, < 2; employees, 1–9; turnover, < 2 million euros; ownership, single person; sector, services

*10%, **5%, ***1%—levels of significance

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