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Bank Loan Application Success of Innovative and Non-Innovative SMEs

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Abstract. The investigation of the determinants of access to finance is relevant because restricted loan accessibility could hinder firm growth. This paper focuses on small- and medium-sized enterprises (SMEs) and whether their requested loan is granted by the bank. Financial data for SMEs in 29 European countries are used (four waves of the Survey on the Access to Finance of Enterprises during 2009-2014) to test the relationship between innovative behavior and loan application success. The contribution of the present study is that a distinction is made between product, process, and organizational innovation. Also, cross-national evidence on the link between innovation and loan turndown is provided while existing studies usually focus on a single country. The results indicate that SMEs that adopt innovations are less likely to receive the requested loan than SMEs that do not adopt innovations, and this holds for all three types of innovation. Additional analyses reveal the robustness of the results across various firm age and firm size categories, and the majority of countries.

Keywords: credit constraints, SMEs, process innovation, product innovation, organizational innovation.

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1. Introduction

This paper focuses on the success of bank loan applications among innovative and non-innovative small- and medium-sized enterprises (SMEs; firms with a maximum of 250 employees). It is well known that SMEs are particularly vulnerable to the restricted provision of external capital such as bank loans because of their smallness and opaqueness, which increase the information asymmetries between lenders (banks) and borrowers (SMEs). Focusing on the determining factors of access to finance as in the present paper is relevant because restricted access could hinder firm growth or firm performance (Beck et al. 2006,

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2008; Parker and Van Praag 2006; Mach, 2014). Our focus on innovation is an unsurprising one given that innovation is thought to be an important contributor to economic growth (Audretsch and Chowdhury, 2011), for example through its positive relationship with firm performance (Rosenbusch et al. 2011). It is known that significant fractions of SMEs are involved in various innovation activities such as process, product, or organizational innovation (Lee et al., 2010). Also, innovative SMEs are likely to be the most promising SMEs for the economy; at the same time they are also more in need of external finance than non-innovative SMEs (Freel, 1999; Lee et al., 2015). In sum, it is important to know whether innovative and non-innovative SMEs differ in terms of the success of their bank loan applications.

The present paper's key concept is bank loan application success, and it follows the relatively large set of studies that investigates the properties of firms that obtain none (or all) of the funding for which they applied (Levenson and Willard 2000; Blanchflower et al. 2003; Storey 2004; Cavalluzzo and Wolken 2005; Kim 2006; Orser et al. 2006; Fraser, 2014). A wide range of firm-level factors have been put forward in these – mostly single-country – studies that may explain bank loan application success or loan denial; these factors include financial (growth) indicators, firm age, firm size, ownership structure, and sector orientation, which will all be included as control variables in the empirical analysis. Prior studies in the area of loan application success have generally overlooked our main variable of interest, innovativeness. The international character of our database increases the paper's potential to draw uniform conclusions about the influence of different types of innovation on loan application success as opposed to conclusions that are restricted by the specifics of a single country. A distinction is made between product, process, and organizational innovation. We hypothesize that SMEs that adopt innovations convey a riskier image to banks compared to SMEs that do not adopt innovations, which has negative consequences for the bank loan application success of these innovative SMEs.

To test our hypotheses, several waves of the Survey on the Access to Finance of Enterprises (SAFE) from the European Commission (EC) and the European Central Bank (ECB) are used. Four waves are merged for the present purpose (2009, 2011, 2013 and 2014) that contain innovation-specific information. The combined dataset contains objective information on loan application success and additional financial information for SMEs in 29 European countries. A sample of about 7,500 SMEs applying for bank loans is used to assess the importance of innovation for loan application success, while controlling for relevant firm-specific factors including firm age, size, past growth, growth expectations, ownership structure, and sector orientation. A merit of our dataset is that the data have been collected during periods of economic upturn and downturn, during which banks apply different lending conditions. Especially in periods of

economic downturn firms resort to bank loans to finance their business (Ono and Uesugi, 2014), but rejection rates also tend to increase (Fraser, 2014).

The results indicate that innovative SMEs have a lower probability of receiving the requested loan than non-innovative SMEs, and that this significant negative relationship between innovation and loan application success is validated for product innovation, process innovation, and organizational innovation. There are substantial differences across countries but in the majority of countries a significant negative relationship between innovation and loan application success is found. The link between innovation and loan turndown is robust across several firm age and firm size groups.

The present paper is structured as follows. First, it provides an overview of the relevant literature and proposes hypotheses about the relationship between innovative behavior and loan application success. Next, the data are presented, and the subsequent section presents the results and discusses several extensions of the analysis. The final section concludes and notes certain limitations of the present analysis and suggestions for future research.

2. Literature Background

Our main factor of interest refers to the *innovative behavior* of SMEs. Innovation has been argued to be central to entrepreneurship and SMEs. Furthermore, innovative behavior is positively related to firm performance, especially among new ventures (Rosenbusch et al. 2011; Vladimirov, 2016). Indeed, innovative projects are promising projects and may be essential for an SME's survival and growth, but there are also some less positive outcomes related to innovation of which restricted access to finance has been mentioned in earlier literature (see below).

First of all, because innovations entail risky projects and uncertainty about cash-flow and revenue, banks may be reluctant to lend money to firms that adopt innovations (Freel 2007). This problem may be even more pressing among SMEs that have only a small investment scale which makes them more dependent on the innovation with uncertain returns. In addition, the input to the innovation process does not have residual value once the innovation project does not turn out to be successful (Freel, 1999).

Second, SMEs that display innovative behavior tend to have relatively low asset tangibility, which makes it difficult for banks to value these intangible properties (Lee et al., 2010). Innovation induces information asymmetries between lender and borrower (Ortiz-Molina and Penas 2008; Venturelli, 2008), and may therefore negatively impact loan application success.

Third, several proposed methods to mitigate information asymmetry are expected to be less helpful in the context of innovative SMEs. While entrepreneurs may "signal" the quality of their projects to the lender, signaling

will be less effective in the case of innovation because the firm's competitive advantage is at stake such that "new ideas can be copied" (Venturelli, 2008, p. 21). The provision of collateral has also been suggested as a remedy for informational asymmetry between lender and borrower (Steijvers and Voordeckers, 2009). However, innovative firms depend more on intangible assets which complicates the use of collateral when requesting a bank loan (Lee et al., 2015). Similarly, while relationship lending has been proposed to mitigate information asymmetry (Behr et al. 2011; Petersen and Rajan 1994, 1995; Harhoff and Körting 1998; Fraser, 2014) it may be less useful among innovative firms (Venturelli, 2008).

In spite of these theoretical arguments, there is limited empirical evidence on the relationship between SMEs' innovative behavior and their access to bank loans. Freel (2007) uses a sample of 256 small firms in the United Kingdom that applied for bank loans. For these firms, the proportion of loans successfully applied for is known. Using several proxies for innovative behavior, the author finds that the most innovative firms – both in terms of process and product innovation – are less successful in obtaining bank loans than the least innovative firms (see also Freel, 1999). There is some evidence, however, that "a little innovation may be a good thing" (Freel 2007, p. 32). Using a large sample of SMEs in, again, the United Kingdom (with data from 2007/2008, 2010, and 2012) Lee et al. (2015) find that innovating SMEs are also less likely to access the required external funding than non-innovating SMEs. These authors use a measure of product innovation, and is similar to the one used in the present study.

Mina et al. (2013) use a combined sample of firms from the United Kingdom and the United States, and use measures of product, process, and organizational innovation, as well as an input measure for innovation (R&D expenditures). The authors do no find a significant relationship between any of these innovation measures and the probability of obtaining the requested finance in the United Kingdom, but in the United States the following results are found. Contrary to our expectations expressed below, these authors find that product and process innovation are positively related to the probability of obtaining finance whereas organizational innovation is negatively related to this probability. The authors link this higher responsiveness to innovation in the United States compared to the United Kingdom to "different levels of risk-aversion specific to innovation or to different (perceived) average quality of innovation." (Mina et al., 2013; p. 889).

There has also been evidence of higher costs of borrowing for innovative firms. In a sample consisting of SMEs in the United Kingdom, Rostamkalaei and Freel (2016) find that for firms that grow through innovation, borrowing is more expensive than for firms that grow without innovation. All in all, we expect that innovative SMEs are less likely to receive the requested bank loan than non-innovative SMEs, which leads to the following hypotheses (while distinguishing between product, process, and organizational innovation):

H1a: SMEs that introduce product innovations are less likely to receive the requested bank loan than SMEs that do not introduce product innovations.

H1b: SMEs that adopt process innovations are less likely to receive the requested bank loan than SMEs that do not adopt process innovations.

H1c: SMEs that adopt organizational innovations are less likely to receive the requested bank loan than SMEs that do not adopt organizational innovations.

The problems of uncertainty and information asymmetries are likely to be most severe for innovations that are most directly linked to the projects undertaken by the firm. Therefore, the riskiness of the projects is expected to be lower for process innovations than for product innovations. It is more likely for process innovations than product innovations to transmit a positive signal to banks because process innovations are usually targeted at cost minimization with only minor product differentiation involved (Freel, 1999). While cost minimization could be argued to be an element of process innovation, this is not the case for organizational innovation with costs involved due to "complex changes in the division of labor" (Mina et al., 2013, p. 888).

We therefore expect the negative influence of innovative behavior on loan application success to be less severe for process innovation than for product and organizational innovation:

H2a: SMEs that adopt process innovations are more likely to receive the requested bank loan than SMEs that introduce product innovations.

H2b: SMEs that adopt process innovations are more likely to receive the requested bank loan than SMEs that adopt organizational innovations.

3. Data

To test the relationship between innovative behavior and loan application success, information from the EC/ECB SAFE among SMEs (2009, 2011, 2013, 2014) is used. In total, 56,213 telephone interviews were conducted across 38 countries, including 53,451 interviews in the EU-28 and 2,762 interviews in selected non-EU countries.[2] In some countries and in some years, interviews with companies employing more than 250 employees were not conducted. As a consequence, we will restrict our analyses to micro (1-9 employees), small (10-49 employees), and medium-sized firms (50-249 employees) and exclude firms with more than 250 employees from our estimation sample. We include only

2. The non-EU countries are Albania, Iceland, Israel, Liechtenstein, Macedonia, Montenegro, Norway, Serbia, Switzerland, and Turkey.

countries in our final sample in which interviews were conducted in each year.[3] We use a subsample of SMEs that have applied for a bank loan in the past six months and for which information on all control variables and the three innovation variables is available, resulting in an estimation sample of 7,460 SMEs in 29 countries (the EU-28 and Iceland).

The 2009 wave of our dataset was carried out by Gallup; the 2011, 2013, and 2014 waves were carried out by IPSOS MORI. The interviews were conducted by telephone using CATI. Only in the 2009 survey there was an option to participate through an internet questionnaire or on paper, via fax. The person interviewed in each company was a top level executive (general manager, financial director or chief accountant). Dun & Bradstreet provided the sampling list of eligible firms. The survey excludes firms that are active in agriculture, public administration, and financial services. Post-sampling weights (based on firm size and economic activity) are used for our descriptive analysis.[4]

3.1. Dependent and Independent Variables

It is known whether the SMEs have applied for a bank loan within the previous six months before the interview took place. Bank loans refer to new applications or renewals and exclude overdrafts and credit lines. For SMEs that have applied for a bank loan, the application success is known. That is, the SMEs indicate whether they have received all the financing they requested (the dependent variable *application success* receives a value of 1), some of the financing (value 0) or none of the financing (also a value of 0). An application could also be pending at the time of data collection, or a bank loan could have been refused by the SME because of unacceptable costs or terms and conditions. Both cases will not be taken into account in our analyses.

Our independent variables are measured as follows. *Product innovation* equals 1 if the SME has introduced a new or significantly improved product or service to the market during the 12 months prior to the interview and 0 otherwise. *Process innovation* equals 1 if the SME has adopted a new or significantly improved production process or method and/or a new way of selling their goods or services during the previous 12 months and 0 otherwise. And *organizational innovation* equals 1 if the SME has adopted a new organization of management during the previous 12 months and 0 otherwise.

An overview of the dependent variable *application success*, the independent variables, and the control variables that will be used in our multivariate analysis is provided in table 1. The set of control variables includes firm age, firm size,

3. This way, Albania, Switzerland, Israel, Liechtenstein, Montenegro, Macedonia, Norway, Serbia, and Turkey are excluded.

4. More information about the survey and sampling methodology can be found here: https://www.ecb.europa.eu/stats/money/surveys/sme/html/index.en.html.

ownership structure, past firm growth, firm growth expectations, and sector orientation. Wave dummies are included to control for year-specific influences. Dummy variables are included for the countries to control for country-specific influences (the corresponding results are not displayed in the output tables but are available upon request from the author; country-specific results are obtained in an additional analysis in section 4).

Table 1: Names and definitions of dependent, independent, and control variables.

Variable name	Categories
Dependent variable	
Application success	Received all financing (value 1) versus received some/ no financing (value 0)
Independent variables	
Product innovation	1 if introduction of new/significantly improved product/service to the market during the past 12 months, 0 otherwise
Process innovation	1 if adoption of new/significantly improved production process or method, and/or new way of selling goods/services during the past 12 months, 0 otherwise
Organizational innovation	1 if adoption of new organization of management during the past 12 months, 0 otherwise
Control variables	
Firm age	Less than 2 years (reference) 2-5 years 5-10 years More than 10 years
Firm size	1-9 employees (reference) 10-49 employees 50-249 employees
Ownership structure	Public shareholders Family/entrepreneurs Business groups/other firms Venture capital firms/business angels Single owner (reference) Other
Growth past 6 months	Decrease of turnover Turnover remained unchanged (reference) Increase of turnover
Expected growth next 3 years	Decrease of turnover Turnover will remain unchanged (reference) Increase of turnover
Sector	Construction Industry Trade Services (reference)
Wave	2009 (reference) 2011 2013 2014

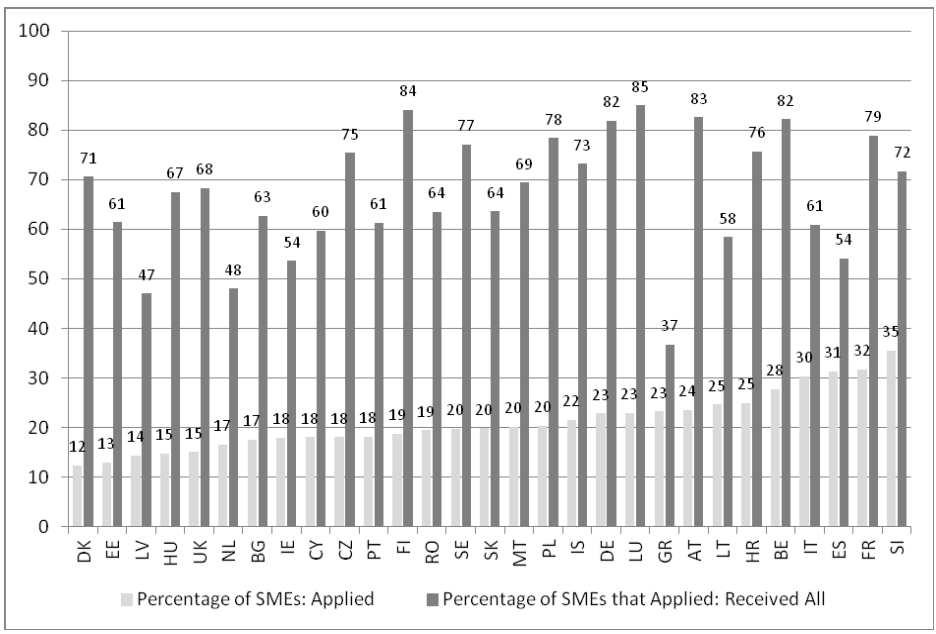
Source: EC/ECB SAFE survey, 2009, 2011, 2013, 2014.

4. Results

4.1. Univariate Analysis

It proves to be the case that 23.9 percent of all SMEs included in the sample have applied for a bank loan during the six months prior to the interview. The majority of SMEs received the funding they requested, that is, 68.6 percent (weighted average). An overview of the application rates for each country is provided in figure 1. The fraction of SMEs that received all requested funding is also displayed. Note that the countries are sorted on the basis of the percentage of SMEs that applied for a bank loan. It appears from figure 1 that there exists much less heterogeneity across countries for the application rates than for the success rates of these bank loan applications.

Figure 1: Application and success rates (received 100 percent of requested loan) for each country.



Source: EC/ECB SAFE survey, 2009, 2011, 2013, 2014. Weighted percentages are shown.
Abbreviations are as follows: Denmark=DK; Estonia=EE; Latvia=LV; Hungary=HU; United Kingdom=UK; Netherlands=NL; Bulgaria=BG; Ireland=IE; Cyprus=CY; Czech Republic=CZ; Portugal=PT; Finland=FI; Romania=RO; Sweden=SE; Slovakia=SK; Malta= MT; Poland=PL; Iceland=IS; Germany=DE; Luxembourg=LU; Greece=GR; Austria=AT; Lithuania=LT; Croatia=HR; Belgium=BE; Italy=IT; Spain=ES; France=FR; Slovenia=SI.

Table 2 displays the distributions of the application and acceptance rates for our innovation variables together with the prevalence rates of the various categories. Although SMEs that introduce/adopt innovations are more likely to apply for bank loans than SMEs without innovative behavior, the application success rates of SMEs that introduce/adopt innovations are lower than SMEs without innovative behavior. This observation is according to our expectations.

A correlation matrix is shown in Table 3.

Table 2: Application and success rates (received 100 percent of requested loan) for innovative and non-innovative SMEs.

	Percentage of SMEs: Applied	**Percentage of SMEs that applied: Received 100% of requested loan**	**Prevalence rate (percent)**
Innovative behavior			
Product innovation	26	66	33
No product innovation	22	70	67
Process innovation	27	64	39
No process innovation	21	72	61
Organizational innovation	29	63	24
No organizational innovation	22	71	76

Source: EC/ECB SAFE survey, 2009, 2011, 2013, 2014. Weighted percentages are shown.

Table 3: Correlation matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
1. Application succes	1.00																				
2. Product innovation	**-0.03**	1.00																			
3. Process innovation	**-0.07**	**0.38**	1.00																		
4. Organizational innovation	**-0.07**	**0.12**	**0.24**	1.00																	
5. Firm age	**0.10**	-0.02	**-0.03**	**-0.03**	1.00																
6. Firm size	**0.14**	**0.04**	-0.02	**0.06**	**0.23**	1.00															
7. Public shareholders	**-0.02**	0.00	**-0.03**	0.01	0.01	**0.07**	1.00														
8. Family/entrepreneurs	0.02	**0.05**	0.01	0.00	**0.07**	**0.04**	**-0.23**	1.00													
9. Business groups/other firms	**0.04**	-0.01	-0.02	**0.03**	-0.01	**0.14**	**-0.07**	**-0.38**	1.00												
10. Venture capital firms/business angels	-0.01	0.00	0.01	0.01	**-0.02**	**0.04**	**-0.02**	**-0.11**	**-0.04**	1.00											
11. Single owner	**-0.05**	**-0.05**	0.01	**-0.02**	**-0.08**	**-0.21**	**-0.12**	**-0.66**	**-0.21**	**-0.06**	1.00										
12. Other ownership structure	**0.05**	0.00	0.00	-0.01	0.02	**0.08**	**-0.03**	**-0.18**	**-0.06**	-0.02	**-0.10**	1.00									
13. Past growth	**0.14**	**0.08**	**0.05**	**0.04**	**-0.06**	**0.14**	**-0.02**	-0.02	0.02	0.01	0.00	**0.03**	1.00								
14. Expected growth	**0.09**	**0.12**	**0.09**	**0.07**	**-0.06**	**0.11**	**0.00**	-0.02	**0.02**	0.01	0.00	0.01	**0.41**	1.00							
15. Construction sector	**0.05**	**0.12**	**0.08**	-0.01	**0.09**	**0.26**	0.00	**0.06**	**0.05**	**0.03**	**-0.11**	-0.01	**0.06**	**0.09**	1.00						
16. Industry sector	**-0.04**	**-0.12**	**-0.07**	-0.02	0.00	0.00	0.00	**-0.03**	-0.01	-0.01	**0.05**	0.00	**-0.05**	**-0.09**	**-0.24**	**1.00**					
17. Trade sector	0.00	**0.02**	**-0.03**	0.00	0.00	**-0.16**	0.00	**0.02**	**-0.04**	**-0.03**	0.02	**-0.03**	**-0.07**	**-0.03**	**-0.40**	**-0.23**	1.00				
18. Services sector	**-0.02**	**-0.06**	0.00	0.02	**-0.08**	**-0.10**	0.00	**-0.06**	0.00	0.00	**0.06**	**0.03**	**0.04**	0.00	**-0.43**	**-0.25**	**-0.41**	**1.00**			
19. 2009	**-0.02**	0.01	0.00	**-0.02**	**-0.08**	**-0.18**	**0.08**	**-0.03**	0.00	0.00	0.00	-0.01	**-0.18**	**-0.11**	**-0.08**	0.01	**0.03**	**0.05**	**1.00**		
20. 2011	0.02	0.01	-0.01	-0.01	0.01	**0.04**	0.01	**0.04**	**0.03**	-0.01	**-0.07**	0.00	**0.07**	-0.01	0.00	0.00	**0.03**	**-0.03**	**-0.23**	**1.00**	
21. 2013	0.01	-0.02	-0.01	0.00	**0.04**	**0.07**	-0.01	0.01	0.01	0.01	-0.01	**-0.02**	**-0.02**	**0.03**	**0.04**	0.00	**-0.02**	**-0.03**	**-0.25**	**-0.41**	**1.00**
22. 2014	-0.02	0.00	**0.02**	**0.02**	0.01	**0.02**	**-0.07**	**-0.02**	**-0.04**	0.00	**0.07**	**0.02**	**0.08**	**0.06**	0.02	-0.02	**-0.03**	**0.02**	**-0.24**	**-0.40**	**-0.43**

Pearson correlation coefficients based on 7,460 observations. Numbers in bold are significant (p-value<0.10). The ordered variables (firm age, firm size, past growth, expected growth) are treated as continuous variables in this table for conciseness. Source: EC/ECB SAFE survey, 2009, 2011, 2013, 2014.

4.2. Multivariate Analysis

We run binary probit regressions to take into account the binary nature of the dependent variable *application success* (value 1=received 100% of the requested loan; value 0=received less than 100% or nothing). The estimated average marginal effects and corresponding standard errors are displayed in table 4.[5]

Model 1 includes the control variables and the product innovation variable, model 2 focuses on process innovation, and model 3 zooms in on organizational innovation. It becomes apparent that the SMEs involved in product innovation have a significantly lower probability of receiving the bank loan than SMEs that are not involved in product innovation (p-value<0.01). A negative marginal effect is also found for process innovation in model 2 (p-value<0.01) and organizational innovation in model 3 (p-value<0.01). Hence, Hypotheses 1a, 1b, and 1c are supported. Our measure of process innovation consists of two items. A more detailed analysis reveals that each measure results in a significant negative marginal effect of innovation: the marginal effect is -0.041 (p-value<0.01) for the adoption of a new or significantly improved production process or method, and -0.077 (p-value<0.01) for the adoption of a new way of selling goods or services during the past 12 months.

While the predicted probability of receiving all requested funding is 68.7 percent, the product innovation variable reduces this probability by 3.4 percentage points. At the same time, we observe that the marginal effects for process and organizational innovation are more negative than for product innovation, that is, 5.8 percentage points and 8.0 percentage points, respectively. Thus, Hypotheses 2a is not supported while Hypothesis 2b is supported.[6]

The results for the control variables are robust across the model specifications. It becomes clear that firm age plays a role here. Older firms (at least 10 years old) are more likely to receive all requested funding than younger firms (up to 10 years old). In addition, firm size is a significant predictor of loan application success, that is, larger SMEs (at least 10 employees) are more likely to receive the requested bank loan than smaller SMEs (up to 10 employees). This finding is supported by replacing the number of employees with a categorical variable measuring the SME's turnover (results are not tabulated: relative to SMEs with an annual turnover of 2 million euros or less, SMEs in higher turnover categories are significantly more likely to receive the requested loan). The important roles for firm age and firm size correspond with the common view that older and larger firms are associated with fewer problems of asymmetric

5. Marginal effects contain information about the increase or decrease of the probability of receiving 100% of the requested bank loan as the result of a one-unit increase of an independent variable while keeping all other variables constant.
6. To test whether the marginal effects of process and organizational innovation are significantly different, a binary probit regression is performed that includes the two innovation variables simultaneously. This analysis indeed reveals a significant difference between the marginal effects of process and organizational innovation (p-value<0.10).

information (Gertler, 1988). The findings are also in line with earlier studies that find more negative perceptions of access to bank loans among young and small SMEs (Canton et al., 2013). Regarding ownership, a significantly higher probability of receiving the requested bank loan is found for multiple ownership by family or entrepreneurs versus single ownership ($p<0.01$). Also, external ownership by business groups or other firms (versus single ownership) significantly increases the probability of application success (p-value<0.05). Our finding for multiple ownership by family or entrepreneurs is in line with Blumberg and Letterie (2008) who show that single ownership increases the probability of bank loan denial compared to multiple ownership using a Dutch sample of new business owners. Indeed, in the case of single ownership, the lending process relies heavily on the characteristics of the owner. Entrepreneurs vary considerably in their honesty and ability, which can be assumed to be two non-observable characteristics, leading to higher chances of information asymmetries between lender and borrower. Furthermore, Schiantarelli and Sembenelli (2000) argue that organizations that belong to business groups or larger firms profit from the close relationships of their ìparent organizationî with banks. Additional evidence based on a sample of Japanese firms finds that firms affiliated with industrial groups have closer relationships with banks than independent firms (Hoshi et al. 1991).[7] Table 4 also reveals that past growth and expected growth are significantly positively related to loan application success. The finding on past growth links with earlier international evidence that firms that grow have more positive opinions about access to finance than firms that do not grow (Canton et al., 2013). For growth orientation, our results are in contrast with earlier evidence based on Canadian SMEs that the loan requests of growth oriented firms were turned down more frequently than the requests of non-growth oriented firms (Riding et al., 2012). Regarding sector orientation, SMEs active in construction and trade have significantly higher probabilities of receiving the requested bank loan than SMEs active in services.

7. There are more advantages of belonging to business groups such as the "(…) financial strength, reputation, geographical and (often) product diversification of the parent company" (Schiantarelli and Sembenelli 2000, p. 176).

Table 4: Binary probit estimation results explaining *application success* (received 100 percent of requested loan=1; received some/no financing=0).

	(1)	(2)	(3)
Product innovation	-0.034***		
	(0.011)		
Process innovation		-0.058***	
		(0.012)	
Organizational innovation			-0.080***
			(0.011)
Firm age: 2-5 years	-0.020	-0.021	-0.022
	(0.053)	(0.052)	(0.051)
Firm age: 5-10 years	0.063	0.063	0.058
	(0.051)	(0.050)	(0.050)
Firm age: >10 years	0.123**	0.122**	0.116**
	(0.051)	(0.050)	(0.049)
Firm size: 10-49 employees	0.051***	0.049***	0.058***
	(0.014)	(0.014)	(0.014)
Firm size: 50-249 employees	0.100***	0.098***	0.107***
	(0.017)	(0.017)	(0.017)
Ownership: Public shareholders	0.013	0.009	0.017
	(0.036)	(0.035)	(0.036)
Ownership: Family/entrepreneurs	0.051***	0.049***	0.050***
	(0.018)	(0.017)	(0.017)
Ownership: Business groups/other	0.058**	0.055**	0.060**
	(0.025)	(0.024)	(0.024)
Ownership: Venture capital firms/ business angels	-0.039	-0.038	-0.039
	(0.054)	(0.055)	(0.054)
Ownership: Other	0.123***	0.120***	0.119***
	(0.034)	(0.033)	(0.035)
Pastgrowth: Decrease	-0.073***	-0.072***	-0.070***
	(0.014)	(0.015)	(0.014)
Past growth: Increase	0.032**	0.033**	0.034**
	(0.015)	(0.015)	(0.016)
Expected growth: Decrease	-0.059***	-0.059***	-0.057***
	(0.022)	(0.021)	(0.021)
Expected growth: Increase	0.000	0.003	0.004
	(0.013)	(0.013)	(0.013)
Sector: Construction	0.030**	0.030**	0.024*
	(0.013)	(0.013)	(0.014)
Sector: Industry	-0.039**	-0.039**	-0.036**
	(0.018)	(0.018)	(0.018)
Sector: Trade	0.050***	0.048***	0.049***
	(0.016)	(0.016)	(0.016)
2011	-0.028	-0.028	-0.027
	(0.027)	(0.026)	(0.026)
2013	-0.039	-0.039	-0.036
	(0.026)	(0.025)	(0.025)
2014	-0.064**	-0.063**	-0.060**
	(0.026)	(0.026)	(0.026)

R^2	0.09	0.10	0.10
Observations	7,460	7,460	7,460

*** *p*-value<0.01, ** *p*-value<0.05, * *p*-value<0.10. Average marginal effects are displayed. Standard errors (clustered over country) in parentheses. Country effects are controlled for by means of country dummies. Reference categories: less than 2 years (firm age), 1-9 employees (firm size), single owner (ownership structure), turnover remained unchanged (past growth), turnover will remain unchanged (expected growth), services (sector), 2009 (wave).
R^2 refers to the pseudo R^2 measure of McFadden.

4.3. Extension of Analysis: Moderation Analysis

In this additional analysis we investigate the dependency of the relationship between innovation and access to bank loans on firm age, firm size, and country. For country, for example, this is of particular interest given the fact that earlier studies on the same topic were performed in various countries and resulted in different outcomes (Mina et al., 2013). For firm age and firm size, we may expect that the negative relationships tend to hold for the youngest and smallest SMEs. We include interaction terms between the innovation variables and the moderator variables (age, size, country) and calculate marginal effects for each country and for each age and size class. Table 5 provides a summary of the results.

Although there is cross-country variation, in the majority of countries there is a significant negative relationship between each innovation variable and the probability of receiving the requested loan. Importantly, we find significant negative relationships for the United Kingdom as well, a country that has been the focus in several earlier studies. Regarding age classes, the results were slightly surprising in the sense that no significant relationship was found for the youngest firms. Results for size classes were according to expectations. In line with our general results reported in Table 4, we did not find a significant positive marginal effect for the innovation variables for any single age or size class (see also table 5).

Table 5: Marginal effect of innovation variables depending on country, firm age, and firm size.

Moderator variable	Sign and sigificance of marginal effect	Product innovation	Process innovation	Organizational innovation
Country	Significant positive (p<0.10)	Belgium, Bulgaria, Cyprus, Denmark, Iceland, Latvia, Poland	Cyprus, Denmark, Iceland, Latvia, Luxembourg, Malta, Slovakia	Bulgaria, Hungary, Iceland, Ireland, Latva, Lithuania, Malta, Slovakia, Sweden
	No significant effect (p>0.10)	Estonia, Finland, Malta, Portugal Spain	Croatia, Hungary, Lithuania, Portugal	-
	Significant negative (p<0.10)	Remaining countries (17)	Remaining countries (18)	Remaining countries (20)
Firm age	Significant positive (p<0.10)	-	-	-
	No significant effect (p>0.10)	Less than 2 years	Less than 2 years	Less than 2 years, 2-5 years
	Significant negative (p<0.10)	Remaining age categories (3)	Remaining age categories (3)	Remaining age categories (2)
Firm size	Significant positive (p<0.10)	-	-	-
	No significant effect (p>0.10)	50-249 employees	-	-
	Significant negative (p<0.10)	1-9 employees, 10-49 employees	All size categories	All size categories

4.4. Extension of Analysis: Selection Model

In econometric modeling, one must not discard the selection process that lies behind the outcomes of interest. Inferences that are based on such conditioned processes may lead to incorrect conclusions. In our case, the outcome of interest (loan application success) is a conditioned process and is observed only for SMEs that have applied for a loan. Ideally, one should take into account the selection mechanism by applying a selection model.

As a robustness check, we therefore employ a binary probit model with sample selection consisting of an outcome equation and a selection equation. First, there is a binary variable that indicates whether a firm is selected or not, that is, whether a firm applied for a bank loan. This is the selection equation. Second, there is the binary outcome of interest referring to the dependent variable under investigation, that is, loan application success. This is the outcome equation. The sample selection problem is addressed by modeling the selection and outcome equation jointly (a binary probit model in either case).

Parameter identification in selection models is established by means of incorporating exclusion restrictions. That is, the selection equation must contain at least one variable that is not included in the outcome equation. In our application, we use variables that indicate whether the SME has used sources of financing other than bank loans in the past six months. We include two sources: internal funds and trade credit. It is expected that these variables are related to an

SME's behavior in terms of applying for a bank loan but that they are unrelated to the success of these bank loan applications.

The results for the probit regression with sample selection are qualitatively similar to those presented in table 4. A summary is provided in Table 6. The results in table 6 also reveal that innovative SMEs are significantly more likely to apply for bank loans than non-innovative SMEs. Interestingly, the results do not provide evidence of sample selection bias. That is, the correlation coefficient between (the underlying disturbance terms of) both equations is estimated to range from 0.157 to 0.184 for the three model specifications (*p*-value always >0.10). The two "identification variables" have significant coefficients ($p<0.01$; not reported in table 6) in each selection equation.

Table 6: Heckman probit estimation with results explaining loan *application* (selection equation) and *application success* (outcome equation).

	(1)	(2)	(3)
Selection equation			
Product innovation	0.029***		
	(0.005)		
Process innovation		0.043***	
		(0.004)	
Organizational innovation			0.041***
			(0.005)
Outcome equation			
Product innovation	-0.028**		
	(0.014)		
Process innovation		-0.057***	
		(0.013)	
Organizational innovation			-0.077***
			(0.012)
Correlation both equations	0.184	0.170	0.157
	(0.145)	(0.141)	(0.139)

*** *p*-value<0.01, ** *p*-value<0.05, * *p*-value<0.10. Average marginal effects are displayed. Standard errors (clustered over country) in parentheses. Control variables as displayed in table 1 and country dummies are included but coefficients are not reported.

5. Concluding Remarks

The present paper investigated the determinants of SME access to bank loans in a set of European countries using information from the EC/ECB Survey on the Access to Finance (SAFE) of SMEs (2009-2014). Specific attention was devoted to the innovative behavior of SMEs. The probit regressions indicated that SMEs that adopt innovations are significantly less likely to receive the requested bank

loan than the SMEs without such innovative behavior. The results hold for product, process, and organizational innovation alike, and for different firm age and firm size classes. Also in the majority of countries the negative relationship between innovation and application success is confirmed when including interaction terms between the innovation variables and the country dummy variables.

The relationship between loan accessibility and innovative behavior has rarely been tested in previous research. The results in the present paper therefore provide interesting information, as innovation is found to work against SMEs that attempt to acquire bank loans. This result corroborates the findings of Freel (2007) and is highly relevant given that substantial numbers of SMEs adopt either form of innovative behavior in our sample. The exact mechanism behind the underlying dynamics is not investigated here, but one can expect that the riskiness of the projects undertaken and the higher information asymmetries between banks and innovative firms play a role. Innovative SMEs may need to compensate in other areas to diminish the information asymmetries and to convince banks of the feasibility and profitability of their (innovative) projects. It could also be beneficial to resort to alternative sources of finance. Providers of finance other than banks may be better equipped to value innovation projects (Lee et al., 2010). This may also explain the lower probability of access to bank loans of innovative SMEs as found in the present study. There is indeed evidence that innovative SMEs tend to resort to a multitude of sources of finance (Moritz et al., 2016).

A limitation of the present paper is that it focuses on one supply-side factor behind bank lending (i.e., banksí decisions to grant requested bank loans), and hence neglects certain groups of borrowers in the analysis. Firms may, for example, abstain from borrowing money because they are discouraged and fear they will be rejected. Earlier research stressed the relevance of this group of discouraged borrowers and investigated the probability of being discouraged from borrowing money (Han et al., 2009) or the impact of being discouraged on future application probabilities (Xiang et al., 2015). Although a first analysis (results not reported) based on the present dataset already reveals that innovative SMEs are more discouraged to apply for bank loans than non-innovative SMEs, a more rigorous analysis including a number of supply-side and demand-side factors behind bank lending is an interesting path for future research (Canton and Van der Zwan, 2013). In this way, a more complete picture of loan accessibility, viewed from a variety of perspectives related to the supply-side and demand-side factors, will be achieved.

The results do not necessarily mean that banks reject loan offers on the basis of unreasonable grounds. The quality of the (innovative) project is not taken into account in the present research. Further, information about the interest rate charged, the size of the loan, or other non-price aspects of the loan approval are also important components in the loan application procedure to be included in future research (Fraser, 2014). The characteristics of the owner(s), such as

gender, educational attainment, experience in several domains, credit history, and ethnicity (Blanchflower et al., 2003; Cavalluzzo and Wolken, 2005; Cheng, 2015; Fraser, 2009; Smallbone et al., 2003), could be added as well.

In sum, our paper contributes to the knowledge base on the underexplored area of the determinants of bank loan application success. Moreover, we demonstrate the value and richness of the SAFE data base. As such, the present paper may be seen as a call for more research using this data base.

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