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Reduced cross-border lending and financing costs of SMEs

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ABSTRACT

This paper investigates how the withdrawal of banks from their cross-border business impacted the borrowing costs of European firms since the crisis. We combine aggregate information on total and cross-border credit with firm-level survey data for the period 2010–2014. We find that the decline in cross-border lending led to a deterioration in the borrowing conditions of small firms. In countries with more pronounced reductions in cross-border credit inflows, the likelihood of a rise in firms' external financing costs increased. This result is mainly driven by the interbank channel, which plays a crucial role in transmitting shocks to the real sector across borders.

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1. Introduction

This study aims at contributing to a better understanding of the impact of changes in international credit market integration on the real economy. Previous literature shows that financial integration alleviates the financing constraints of firms (e.g. Harris et al., 1994; Gallego and Loayza, 2001), with some studies finding that small firms can especially benefit from credit market liberalization (Gelos and Werner, 2002; Laeven, 2002). Given that the global financial crisis led to a considerable retrenchment in international capital flows, our goal is to investigate how the reduction in cross-border bank lending affected the access to finance for small and medium-sized enterprises (SMEs) in the euro area.

We contribute to the literature by analyzing the implications of credit market fragmentation for SMEs within the euro area, while other studies focus on developing or emerging economies. In contrast to previous studies, the question we ask here is whether the drop in foreign lending since the crisis has increased borrowing costs for firms. Indeed, our regression results indicate that firms in countries that experienced sharper reductions in cross-border credit inflows were more likely to see their credit costs rise. When comparing the importance of credit inflows to banks and to non-banks for this effect, we find that it is mainly the fragmentation of the interbank credit market that drives the negative link between cross-border credit and credit costs of SMEs in the euro area.

Several studies show that credit markets have become more fragmented since the crisis (Cetorelli and Goldberg, 2011; Bruno and Shin, 2014; Milesi-Ferretti and Tille, 2011; Lane, 2013, 2014a,b;Bremus and Fratzscher, 2015), and that the decline
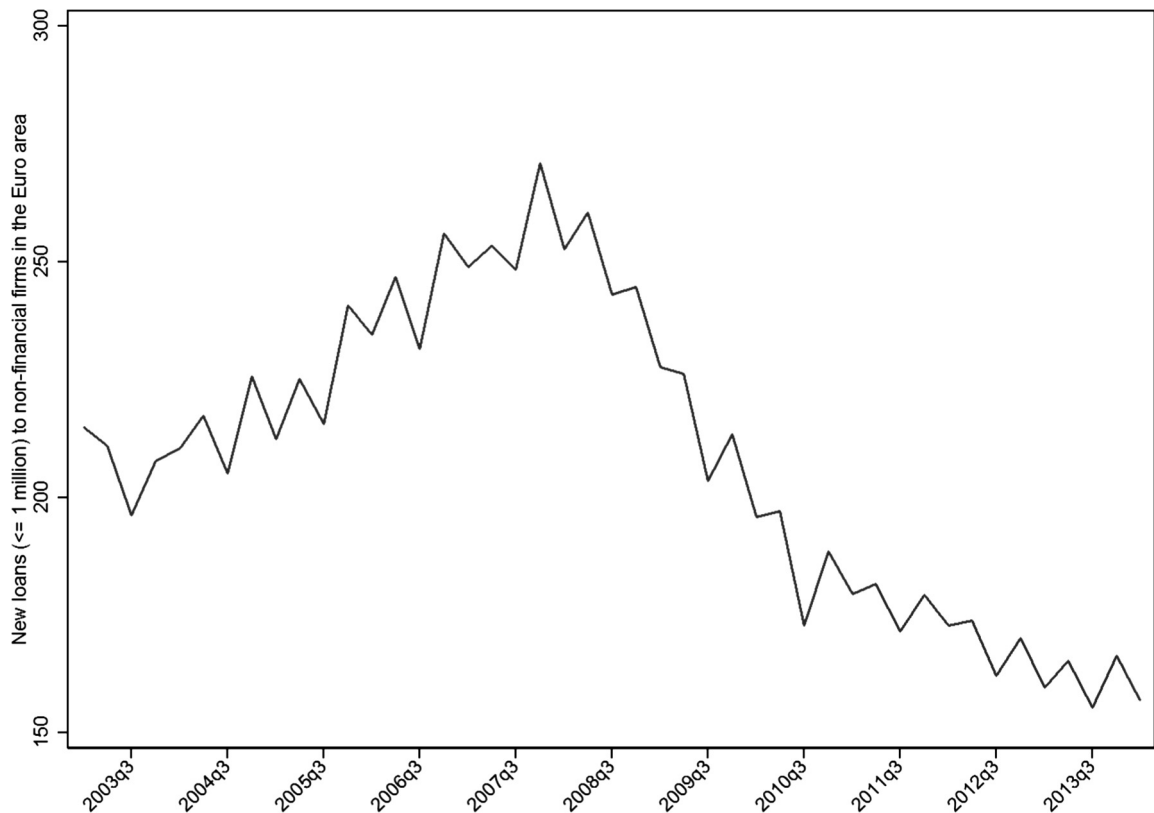

Fig. 1. New loans to non-financial companies. This figure plots new loans granted to non-financial companies (in billion USD). The data are available from the MFI Interest Rate Statistics by the ECB. *q* denotes quarters.

in cross-border bank lending is particularly pronounced and persistent in the euro area. According to Wehinger (2013), SMEs are particularly affected by financial fragmentation.[3] Overall, in the euro area, new bank credit to small firms declined by nearly 40 percent between 2008 and the beginning of 2014 (Fig. 1), with SMEs reporting deteriorating credit availability in many euro area countries (Fig. 2). Regarding SMEs' costs of funding, although average loan rates for firms have decreased since 2012, the spreads between loan rates for small and large loans have increased significantly (Fig. 3), especially in those countries hit hardest by the crisis.

Owing to the fact that firms in the euro area are highly dependent on bank financing, tight credit market conditions can importantly limit their access to external finance. As SMEs make up for more than 98 percent of non-financial firms in the EU, about 60 percent of gross value added, and nearly 70 percent of employment, their credit conditions play an important role for investment, innovation, and growth in the euro area.

Combining firm-level with macroeconomic data, we run probit regressions to test different channels through which credit market fragmentation affects the financing constraints of SMEs. External financing costs are measured using micro-level data from the *Survey on Access to Finance of Enterprises in the Euro Area* (SAFE). The SAFE data contain information on borrowing conditions and business characteristics of European SMEs. Aggregate credit data come from the *International Banking Statistics* and from the *Statistics on Credit to the Private Sector* provided by the Bank for International Settlements.

The data reveal that access to finance was, indeed, among the most pressing problems for SMEs in the euro area in the aftermath of the crisis (Fig. 4). However, there are pronounced differences across countries. Not surprisingly, access to finance is particularly problematic in the periphery countries. In contrast, only about six percent of German firms listed access to finance as their most pressing problem at the end of 2013. These differences across countries potentially point to a strong fragmentation of credit markets in the euro area, with capital not necessarily flowing to where it can be employed most fruitfully. Our regression analysis examines this issue in more detail by looking at the impact of changes in cross-border credit flows on firms' financing costs.

Credit market segmentation can affect firms' access to finance through different channels. First, a decline in credit inflows from abroad can increase financing costs because of reduced direct cross-border lending to firms (at arms-length or through

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[3] Reasons for the borrowing limits faced by small firms include their opaqueness and, hence, the larger information asymmetries between banks and small firms compared to larger and listed firms for which hard information is readily available.
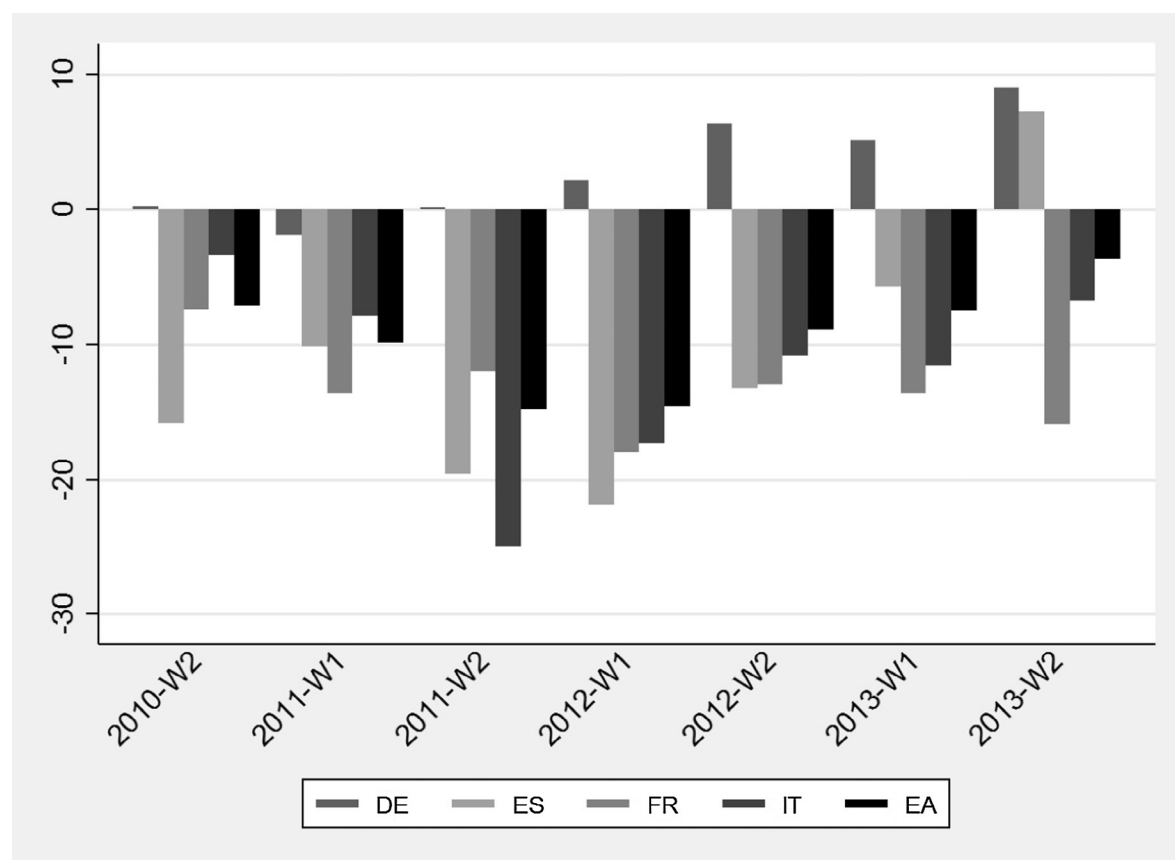
Fig. 2. Change in the availability of bank loans for SMEs This figure plots the net weighted percentage of responses (increased availability minus decreased availability). The data are available from SAFE by the ECB. *W* denotes the waves of the survey. While 'wave 1' (W1) of each survey year covers the second and third quarter of that year, 'wave 2' (W2) captures the fourth quarter of the year and the first quarter of the following year. Therefore, our sample covers the period 2010Q4–2014Q1 (i.e. 2010W2–2013W2).

foreign affiliates). As shown by firm-level survey-data from the EFIGE project for seven European countries,[4] on average, about eight percent of SMEs used foreign bank credit in 2008/09. However, there is a considerable degree of heterogeneity across countries. Whereas nearly 15 percent of French SMEs used services by foreign banks, less than five percent of German SMEs did so.

Second - even if individual firms do not have a direct relationship with foreign banks - a decrease in foreign credit inflows has indirect effects on the firm's financing conditions through its impact on the domestic credit market. On the one hand, contestability and, hence, competitive pressures in the domestic banking sector decrease due to fragmentation, with potentially adverse effects on the retail credit market. Consequently, banks may charge higher lending rates to their clients (Bremus, 2015; de Blas and Russ, 2013). On the other hand, credit market fragmentation can reduce domestic lending if the (wholesale) funding conditions of domestic banks deteriorate (Feyen et al., 2014; Brei, 2007) as cross-border interbank credit becomes scarce. For the case of Turkey, Baskaya et al. (2017) find a positive link between the credit supply of domestic banks that have a higher share of wholesale liabilities and capital inflows. Based on micro-data for a set of euro area banks, De Haan et al. (2017) find that loan rates increase and lending volumes fall in response to a wholesale funding shock, especially in those countries most hit by the European sovereign debt crisis. Hence, wholesale and interbank funding seems to be an important transmission channel of global credit cycles.

Our estimation results indicate, first, that SMEs in countries experiencing stronger reductions in cross-border bank lending are more likely to face increasing loan rates. This relationship is meaningful both statistically and economically. Second, the negative link between cross-border credit growth and financing costs of SMEs seems to be driven primarily by the interbank lending channel. The stronger the reduction in cross-border credit to the banking system, the more likely firms are to see their loan rates rise. Yet, the impact of direct cross-border lending from banks to firms is statistically insignificant in our setup.

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[4] Austria, France, Germany, Hungary, Italy, Spain, United Kingdom. For more details, see Altomonte and Aquilante (2012).
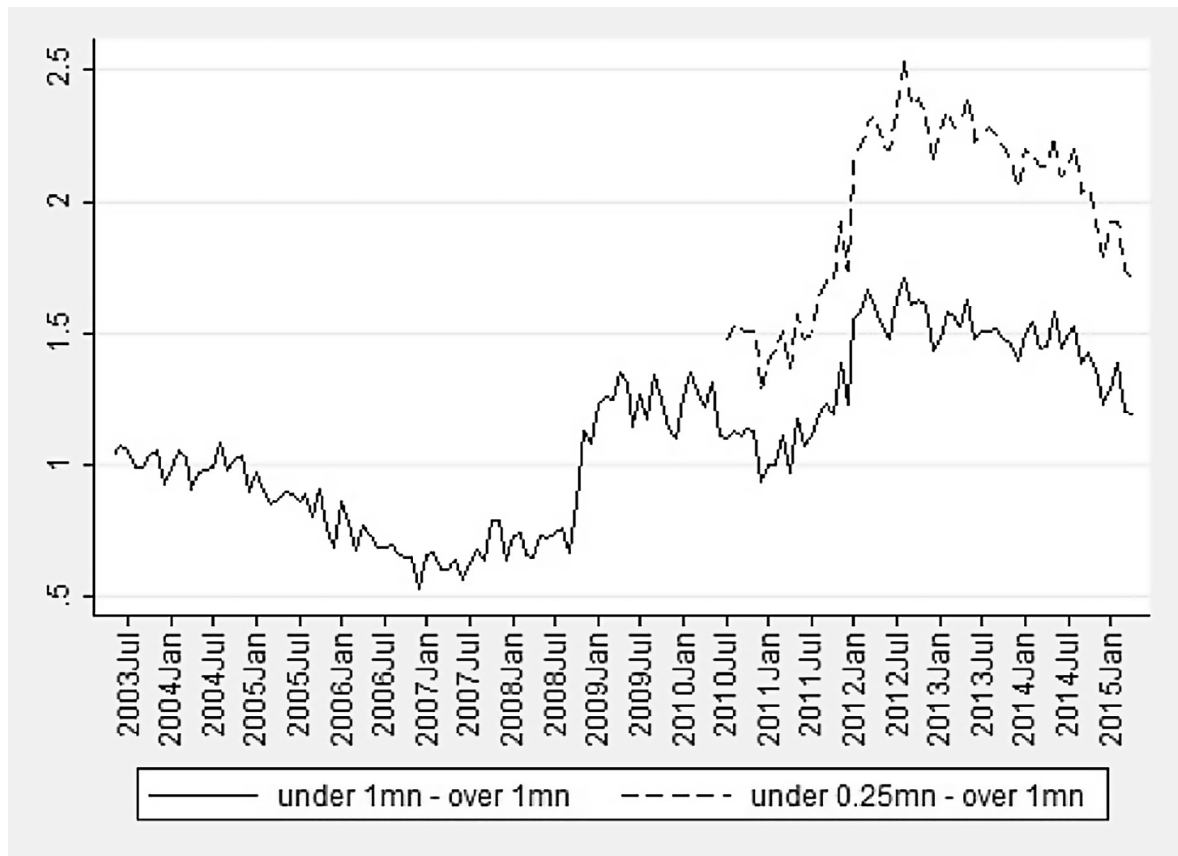
Fig. 3. Loan rate spreads in the euro area. This figure plots the difference between interest rates on small and large loans (percentage points) in the euro area. The data are available from the MFI Interest Rate Statistics by the ECB.

The remainder of the paper is structured as follows. In the next section, we discuss how our study is related to previous literature. Section 3 gives a detailed overview of the data employed and the empirical methodology used. Section 4 presents the regression results, and Section 5 concludes.

2. Related literature

Our analysis is related to two main strands of literature. First, we contribute to the literature on external financing constraints of small firms. Several studies use survey information on the perceived and actual financing obstacles reported by firms, e.g. from the World Business Environment Survey (Beck et al., 2006, 2008; Coluzzi et al., 2012), from the Business Environment and Enterprise Performance Survey (BEEPS), or, more recently, from the SAFE.

Using SAFE data for the 2009–2011 period, Ferrando and Mulier (2015) present evidence that less productive, more leveraged, and younger SMEs are more likely to face external financing constraints. The authors argue that the global financial crisis is a good starting point to study external financing constraints, as SMEs in the euro area were likely to experience increased financing obstacles during the post-crisis period. In addition, the subsequent debt crisis in the euro area and the structural changes, especially in the crisis-hit periphery countries, impaired the availability of external financing, especially for the more opaque SMEs. Artola and Genre (2011) use panel data from SAFE for the 2009–2010 period in order to study which firm characteristics affected the access to finance of SMEs during the crisis. Their estimation results reveal that, in particular, young and small firms have experienced credit constraints. In a cross-sectional analysis of 2009, Ferrando and Griesshaber (2011) find that age and ownership are important drivers of perceived financing constraints: older firms and firms owned by shareholders or other firms are less financing constrained. Holton et al. (2014) explore the impact of the crisis on credit supply and demand using SAFE data for 2009–2011 for the EU. They show that banks tightened lending standards, but that credit demand by SMEs was also reduced. Using bank-level data for the Netherlands from the Bank Lending Survey, van der Veer and Hoeberichts (2016) demonstrate that changes in the level of lending standards lead to changes in business lending.

In a study relying on the BEEPS data for Eastern Europe and the Caucasus, Beck et al. (2014) present evidence that banks' lending techniques matter for credit constraints of SMEs. They show that relationship lending reduces financing constraints
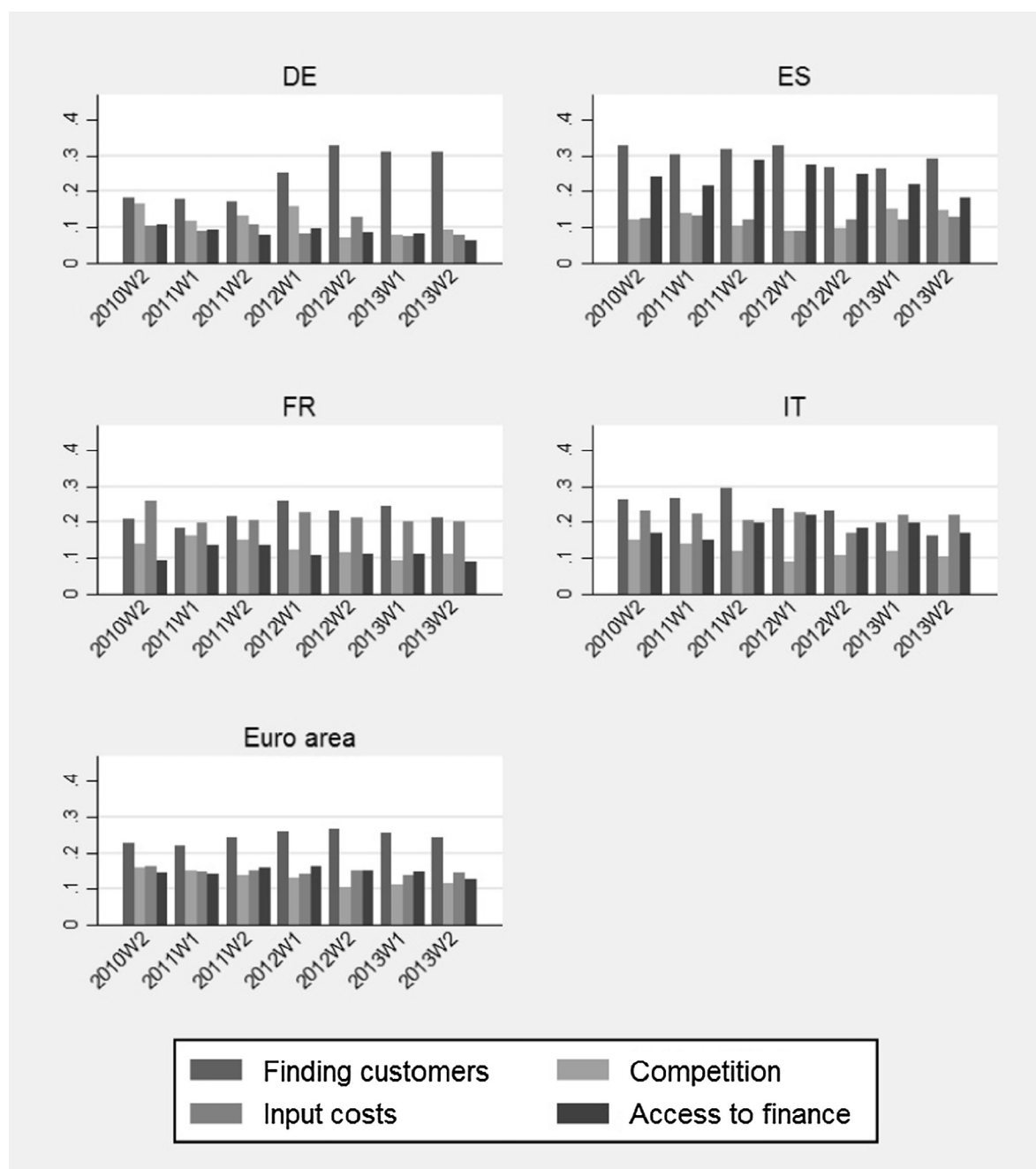
Fig. 4. Firms' most pressing problem. This figure plots the most pressing problem named by firms in SAFE (weighted). The euro area sample includes the 11 countries used in this paper. Representative country-level results are available for France, Germany, Spain, and Italy. *W* denotes the waves of the survey. While 'wave 1' (W1) of each survey year covers the second and third quarter of that year, 'wave 2' (W2) captures the fourth quarter of the year and the first quarter of the following year. Therefore, our sample covers the period 2010Q4–2014Q1 (i.e. 2010W2–2013W2).

in cyclical downturns, but not in booms. Using confidential micro-data on Portuguese banks and firms, Iyer et al. (2014) look at the effect that the drying up of the interbank market had on loan availability for firms. They find that smaller firms especially had problems in accessing finance due to reductions in interbank lending. Furthermore, small firms were not able to substitute banks loans with other sources of finance.

Apart from survey data, a large set of studies exploits firm balance sheet information in order to measure financing constraints by the sensitivity of investment to cash-flow. The idea is that financially constrained firms are more cash-flow sensitive than unconstrained firms. That is, constrained firms must rely more on internal funding (Fazzari and Petersen, 1993).

Yet, cash-flow sensitivity as a measure of financing constraints is criticized (Kaplan and Zingales, 1997, 2000). Following Almeida et al. (2004), several papers alternatively measure firms' financing obstacles by the cash flow sensitivity of cash - a measure more focused on the financial situation of the firm than the cash-flow sensitivity of investment. Based on the cash-flow sensitivity of cash, Baum et al. (2011) find that the financial architecture is important for reducing the financing constraints of small firms: bank-based systems tend to provide better access to finance for SMEs than market-based systems in normal times. However, the authors point out that the results may differ in crisis times. We contribute to this literature by addressing the question of how changes in the degree of credit market integration affect the credit costs of SMEs in the euro area.

A second - but smaller - strand of the literature is devoted to the link between cross-border banking and the external financing constraints of small firms. While, among others, Berger et al. (2001) and Mian (2006) show that foreign banks avoid lending to small and opaque firms in developing countries, Clarke et al. (2001, 2005) find that foreign banks lend to small firms in developing and emerging economies at least as much as domestic banks do. Other studies point in the same direction: After financial liberalization, the cash-flow sensitivity of investment was reduced in Chile (Gallego and Loayza, 2001), Indonesia (Harris et al., 1994), and for small firms in Mexico (Gelos and Werner, 2002). Laeven (2002) studies the impact of financial liberalization on firms' access to finance using a panel of 13 developing countries over the 1988–1998 period. After liberalization, small listed firms' investment becomes less sensitive to changes in cash-flow, i.e. firms become less financially constrained. However, large firms become more constrained after liberalization - possibly due to preferential treatment before liberalization. In a similar vein, Forbes (2007) presents evidence that smaller listed companies are more hurt by the introduction of capital controls than larger ones.

Beck et al. (2011) explore bank-level survey evidence from 2006 to analyze to what extent and under which conditions foreign and domestic banks lend to SMEs. Their sample includes 11 large banks operating in advanced economies and 80 large banks operating in developing countries. Against the conventional view that small, domestic banks are more likely to give credit to SMEs, the authors present evidence that foreign banks lend as much to SMEs as domestic banks do. Yet, foreign banks use different lending techniques and organizational structures.

Giannetti and Ongena (2009) study the effects of foreign bank entry on young, small Eastern European firms, both listed and unlisted. Using a linked micro-macro dataset, they find that foreign bank presence fosters firms' use of loans and reduces their cost of debt. However, large firms benefit more from a foreign bank entry than small firms. Based on survey data for a set of Eastern European countries in 2005 and 2008, Popov and Udell (2012) present evidence that, during the crisis, SMEs' financing constraints were affected by the deterioration of their banks' financial health. In addition, they show that the balance sheet weaknesses of foreign parent banks translated into financing obstacles for SMEs.

3. Data and empirical methodology

In order to analyze the effects of the reduction in international bank lending on the financing conditions of SMEs since the crisis, we use a linked micro-macro dataset for 11 euro area countries over the 2010–2014 period. Detailed information on the data used is in Data Appendix.

The linking of micro- to macro-level data in our paper is similar to the setup other studies have chosen. For example, Giannetti and Ongena (2009) explain firm-level growth and firm-level financing conditions by country-level foreign lending, where foreign lending is computed as lending by foreign banks relative to total lending in a given country and year. Baum et al. (2011) investigate how the structure of the financial system (as measured by the activity of stock markets relative to that of banks) affects financial constraints at the firm-level (measured by firms' cash-flow sensitivity of cash). Langfield and Pagano (2016) address the question of how the structure of the entire financial system (bank-based versus market-based) impacts on the risk-taking of individual financial institutions. Hence, in these studies, while the dependent variables are measured at the firm-level, the explanatory variables of interest are the same across firms in each country, as is the case in our analysis here.

The availability of cross-border credit data at the firm-level would be very helpful in order to get a more granular picture. But, to the best of our knowledge, these data are currently not available for the euro area countries in a harmonized form. We consider our analysis as a first step in investigating the question of how the reduction of European credit market integration has affected the financing constraints of SMEs in the euro area.

3.1. Micro-level data

Firm-level information on financial conditions in the euro area is provided by SAFE, from the ECB. The survey covers a wide array of qualitative information on the access to finance for non-financial firms in Europe; predominantly in the euro area. It is representative at the euro-area level, as well as for the four largest countries Germany, France, Italy, and Spain.

SAFE was started in 2009 and is conducted semi-annually. While 'wave 1' (W1) of each survey year covers the second and third quarter of that year, 'wave 2' (W2) captures the fourth quarter of the year and the first quarter of the following year. Therefore, our sample covers the period 2010Q4–2014Q1 (i.e. 2010W2–2013W2). We only include information starting from 2010W2 because previous waves covered considerably fewer firms and relatively more firms from the largest four euro area countries. Each of the survey rounds included here covers more than 5000 firms. During the period under study, the survey

was conducted in so-called ECB waves and European Commission waves. The ECB waves cover a limited number of euro area countries, whereas the Commission waves cover all euro area countries and some surrounding countries.[5] Given that we want to make use of the time dimension in the data, we keep only those countries that are included in all waves. These are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. Table 1 provides an overview of the number of firms included in our regression sample by country and wave.

To achieve representativeness, the SAFE sample is stratified by country, firm size class, and economic activity. The sample covers the following size classes: micro (1–9 employees), small (10–49 employees), and medium-sized (50–249 employees) enterprises. For reasons of comparison, a sample of large enterprises (more than 250 employees) is also included. In terms of economic activity, stratification is done at the one-digit level of NACE rev.1.1. Economic activities include the four broad sectoral categories of Industry, Construction, Trade, and Services.[6]

Table 2 provides a detailed overview of the distribution of firms according to different characteristics. With respect to firm size, three quarters of firms in the sample employ less than 50 workers. The most important sectors are Services (37 percent of firms) and Trade (28 percent). Interestingly, although the majority of firms is very small, nearly 80 percent of the firms are at least 10 years old. Regarding ownership, more than 80 percent of firms belong to families or an individual person.

Firms' credit costs. Our main focus is on changes in firms' cost of external financing. The SAFE data reveal that European SMEs frequently use bank loans as well as overdrafts and credit lines as a means of external funding. In our sample, an average of about 40 percent of SMEs in the euro area rely on these bank-intermediated funding sources. Again, reliance on different financing instruments varies significantly across countries. Yet, bank credit and overdrafts rank among the most important external funding sources.

SAFE question Q10, which asks about the firm's change in loan rates, is used in order to measure changes in firms' incurred financing costs, applying a dummy variable that takes on the value of 1 if a firm experienced an increase in its rates on bank loans, overdrafts, or credit lines over the previous six months, and zero otherwise. This measure covers all firms that have applied for or renewed bank loans over the previous six months. Thus, SAFE allows us to concentrate on changes in the financing conditions for new loans. In addition, we construct a categorical variable that equals 1 if a firm experienced a reduction in its loan rates, 2 if the loan rate remained unchanged, and 3 if it went up.

Table 3 provides information on firms' financing conditions by country and across time. It reveals that, across countries, SMEs are affected quite differently. While, on average, 20 percent of German SMEs in our sample report loan rate increases during the period 2010W2–2013W2, nearly 80 percent of Spanish firms have done so. Overall, small firms in the GIIPS-countries have suffered much more from loan rate increases than SMEs in the remaining euro area countries. Regarding the evolution of credit conditions over time, loan rates increased most broadly in 2011. Since then, fewer firms have experienced increasing loan rates. Still, about 30 percent of firms in our sample report an increase in credit costs during the 2013Q4–2014Q1 period.

3.2. Macro-level data

Cross-border credit. To analyze the effects of credit market fragmentation on firm-level credit constraints computed using SAFE data, we need semi-annual data on credit inflows into the euro area countries. We retrieve quarterly data and assign the average of the second and third quarter to 'wave 1' for each year. The average across the fourth quarter of the current year and first quarter of the following year is assigned to 'wave 2', such that both the firm-level and the macroeconomic information is timed equivalently.

In order to measure the *direct* effect of cross-border bank lending on the financing situation of firms, we need information on the inflows of credit to the private non-financial sector for each of the 11 euro area countries included in the sample; ideally this information would only concern SMEs. Unfortunately, sectoral breakdowns of cross-border banking data are still rather scarce. The data closest to our needs are available from the *International Banking Statistics* by the Bank for International Settlements (BIS). A detailed description of all variables and sources is in Data Appendix. We use quarterly country-level information on international bank claims to the non-bank private sector from the *Consolidated Banking Statistics*. These claims comprise loans and securities of all banks reporting to the BIS, consolidated across each bank. Hence, inter-office positions are netted out. The non-bank private sector includes private firms and private households, as well as non-bank financial institutions like special purpose vehicles, insurance companies, money market funds and the like. To the best of our knowledge, data on cross-border bank credit to non-financial firms are currently not publicly available for our sample period.[7] Thus, we take international bank claims against the private non-bank sector from the *Consolidated Banking Statistics* as a proxy.

Besides the direct effects of cross-border lending, a retrenchment in credit market integration can impact the financing conditions of firms *indirectly*; for example via the funding situation of lenders. In order to evaluate the effects of cross-border

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[5] For a detailed overview over the countries covered in the different waves, see ECB (2014).

[6] Industry includes: mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; Trade: wholesale and retail trade; repair of motor vehicles, motorcycles and personal household goods; and Services: enterprises in transport and storage; accommodation and food service activities; information and communication; real estate activities; professional, scientific and technical activities; administrative and support service activities; arts, entertainment and recreation; other service activities.

[7] However, the BIS has started to provide such information for the most recent quarters.

Table 1
SAFE country composition. This table gives the number of firms by year and wave in our sample.

Country	Year and wave						
	2010W2	2011W1	2011W2	2012W1	2012W2	2013W1	2013W2
Austria	393	363	349	370	372	376	347
Belgium	410	399	414	395	402	397	414
Germany	792	661	683	711	641	649	644
Finland	432	442	416	349	384	373	371
France	784	774	760	767	736	762	783
Greece	362	418	397	361	356	325	362
Ireland	381	355	344	338	352	354	370
Italy	753	685	659	734	621	686	655
Netherlands	401	402	404	381	383	378	393
Portugal	400	406	399	394	410	383	347
Spain	721	706	699	709	699	705	699
Total	5829	5611	5524	5509	5356	5388	5385

Table 2
Firm characteristics. This table gives the number of firms according to different firm characteristics provided by SAFE.

	Frequency	Percent
Employment (categories)		
From 1 employee to 9 employees	14,514	37.60
From 10 employees to 49 employees	14,533	37.65
From 50 employees to 249 employees	9555	24.75
Main activity		
Industry	9622	24.93
Construction	4125	10.69
Trade	10,715	27.76
Services	14,140	36.63
Age of the firm		
10 years or more	30,556	79.16
5 years or more but less than 10 years	5176	13.41
2 years or more but less than 5 years	2409	6.24
Less than 2 years	461	1.19
Main owner of the firm		
Public shareholders, as your company is	1109	2.87
Family or entrepreneurs	21,939	56.83
Other firms or business associates	3915	10.14
Venture capital firms or business angel	443	1.15
A natural person, one owner only	10,564	27.37
Other	632	1.64

Table 3
Loan rate increases by country and time. This table presents the share of firms that have experienced loan rate increases in our sample.

Country	Year and wave							Total
	2010W2	2011W1	2011W2	2012W1	2012W2	2013W1	2013W2	
Austria	0.44	0.65	0.41	0.26	0.29	0.30	0.27	0.37
Belgium	0.57	0.47	0.42	0.35	0.26	0.30	0.23	0.37
Finland	0.46	0.30	0.26	0.44	0.60	0.77	0.52	0.49
France	0.46	0.59	0.51	0.23	0.17	0.19	0.21	0.34
Germany	0.37	0.44	0.16	0.16	0.10	0.13	0.08	0.20
Greece	0.81	0.84	0.81	0.66	0.47	0.55	0.34	0.67
Ireland	0.73	0.82	0.64	0.52	0.49	0.40	0.34	0.57
Italy	0.61	0.81	0.80	0.76	0.68	0.61	0.52	0.68
Netherlands	0.52	0.52	0.50	0.43	0.68	0.38	0.27	0.46
Portugal	0.79	0.75	0.70	0.72	0.58	0.55	0.27	0.62
Spain	0.85	0.87	0.85	0.78	0.80	0.72	0.45	0.77
Total	0.57	0.66	0.55	0.46	0.40	0.38	0.28	0.47

credit on financing constraints of SMEs in a broader sense, we use BIS data on total international bank claims, as well as international claims on banks from the *Consolidated Banking Statistics*. Total international bank claims comprise cross-border claims of all reporting banks against all counterparties (banks, non-bank private sector, public sector) in the

destination country, plus local claims of banks' foreign affiliates in foreign currency. Given that the BIS data is published in current USD, we transform the series into EUR using nominal exchange rates from the *International Financial Statistics* (IFS) and deflate using consumer price indexes from the IFS to obtain real cross-border bank claims.

Domestic credit. In addition to cross-border credit, we use data on domestic lending as an explanatory variable. Giannetti and Laeven (2012) present evidence for a "flight home" effect during the global financial crisis: Banks withdrew capital from abroad and tilted their loan portfolio more toward domestic lending - independent of the fundamentals in the home country. Due to the ongoing deleveraging and potential financial protectionism, this focus on domestic credit markets may persist in the aftermath of the crisis. Thus, the reduction in cross-border lending since the crisis may have been compensated in different euro area countries, at least partially, by increased domestic lending.

To control for such changes in the lending behavior of banks, we include domestic bank credit to the private non-financial sector from the BIS in the regression model. Again, this series includes domestic credit to private non-financial corporations, but also to private households and non-profit institutions serving households (NPISHs).

Total credit to the private non-financial corporations. In order to evaluate how changes in loan rates are affected by overall credit, we use *The Statistics on Credit to the Private Non-Financial Sector* by the BIS. The dataset provides information on total credit from all sources, i.e. independent of the type or country of origin of the lender. Total credit data are available for the entire private non-financial sector (non-financial corporations, households, and NPISHs), as well as for private non-financial corporations at quarterly frequency. We use the latter series here.

Fig. 5 plots the semi-annual growth rates of the different credit aggregates. In the aftermath of the crisis, (real) credit to the private sector declined, on average, in our sample of 11 euro area countries. The upper panel reveals that, on average, domestic banks have significantly reduced their lending to the private sector - the reductions, as measured by log-differences, are more pronounced than the reductions in total credit to the private sector. When looking at the growth rates of cross-border credit, it appears that euro area credit markets became increasingly segmented through the beginning of 2013. In particular, cross-border claims on banks in the euro area economies were reduced. This decline in wholesale funding possibilities of euro area banks has contributed to the reduction in domestic bank credit. At the end of 2013, a modest increase in cross-border interbank lending could be observed.

3.3. Regression model

In order to analyze how credit market segmentation in the euro area affects the external financing costs of SMEs, we proceed as follows. In a first step, we use a linked micro-macro dataset to estimate a pooled probit model where the dependent variable equals one if a firm has experienced an increase in its lending rates and zero otherwise. Our explanatory variables of interest are different credit aggregates. We evaluate the effect of changes in total credit to non-financial firms and then consider the effects of changes in domestic and cross-border bank credit separately. The correlogram of the different credit measures (Table 4) reveals that international bank credit and domestic bank credit to the private sector are positively (and statistically significantly) correlated in our sample of 11 euro area countries, with a correlation coefficient of .31. This may be a first hint at the indirect channel of international credit market fragmentation: a contraction in cross-border credit may come with a contraction in domestic bank credit. Moreover, total international credit is more closely related to movements in cross-border credit to banks than to non-banks, reflecting the importance of the international interbank linkages of European banks.

Credit market segmentation and the financing cost of firms. Using the micro-macro data set described above, we model the probability of a firm seeing its loan rate increase as follows:

$$Pr[R_{isct} = 1] = \alpha_c + \theta_s + \lambda_t + \beta_1 ForCred_{ct} + \beta_2 DomCred_{ct} + \gamma Z_{ct} + \xi X_{isct} + \epsilon_{isct} \quad (1)$$

where R_{isct} is a dichotomous variable that equals one if firm i in country c and sector s reports a loan rate increase at time t, and zero otherwise, $ForCred_{ct}$ is the growth rate of cross-border credit, and $DomCred_{ct}$ is the growth rate of domestic bank credit to the private sector. Z_{ct} is a set of macroeconomic control variables, and X_{isct} is a set of firm covariates to control for observable firm-level heterogeneity. In addition, country dummies (α_c), sector (θ_s), and time dummies (λ_t) are included in each regression to control for time-invariant country and sector characteristics as well as for common time trends in the data. Note that we cannot include firm-level fixed effects as many firms report to SAFE just once. Dropping all these firms would significantly reduce our sample size. Therefore, we estimate Eq. (1) using a pooled probit model.

Following the literature, we control for borrower characteristics using information on firm size, age, and ownership structure from SAFE. To control for firm size, we include a binary variable into the regression model that equals one for firms with more than 50 and less than 250 employees (medium-sized firms) and zero for the smaller ones. We group micro and small firms together, as they are similar in terms of financing needs and structures, particularly when thinking about getting credit from foreign banks, relative to medium sized firms that are more financially sophisticated. For example, medium-sized firms take more loans, and loan rates decrease in firm size. To control for firm age, we include a variable that equals one if a firm is 10 years or older and zero otherwise.

According to previous findings, we expect a negative link between credit costs and firm size and age. Concerning ownership, firms owned by other firms or by shareholders are expected to be less credit constrained than those owned by an individual entrepreneur or a family. Previous literature has underlined the importance of firm ownership and firm age as determinants of firms financing constraints (Beck et al., 2006; Angelini and Generale, 2008). Regarding ownership structure,
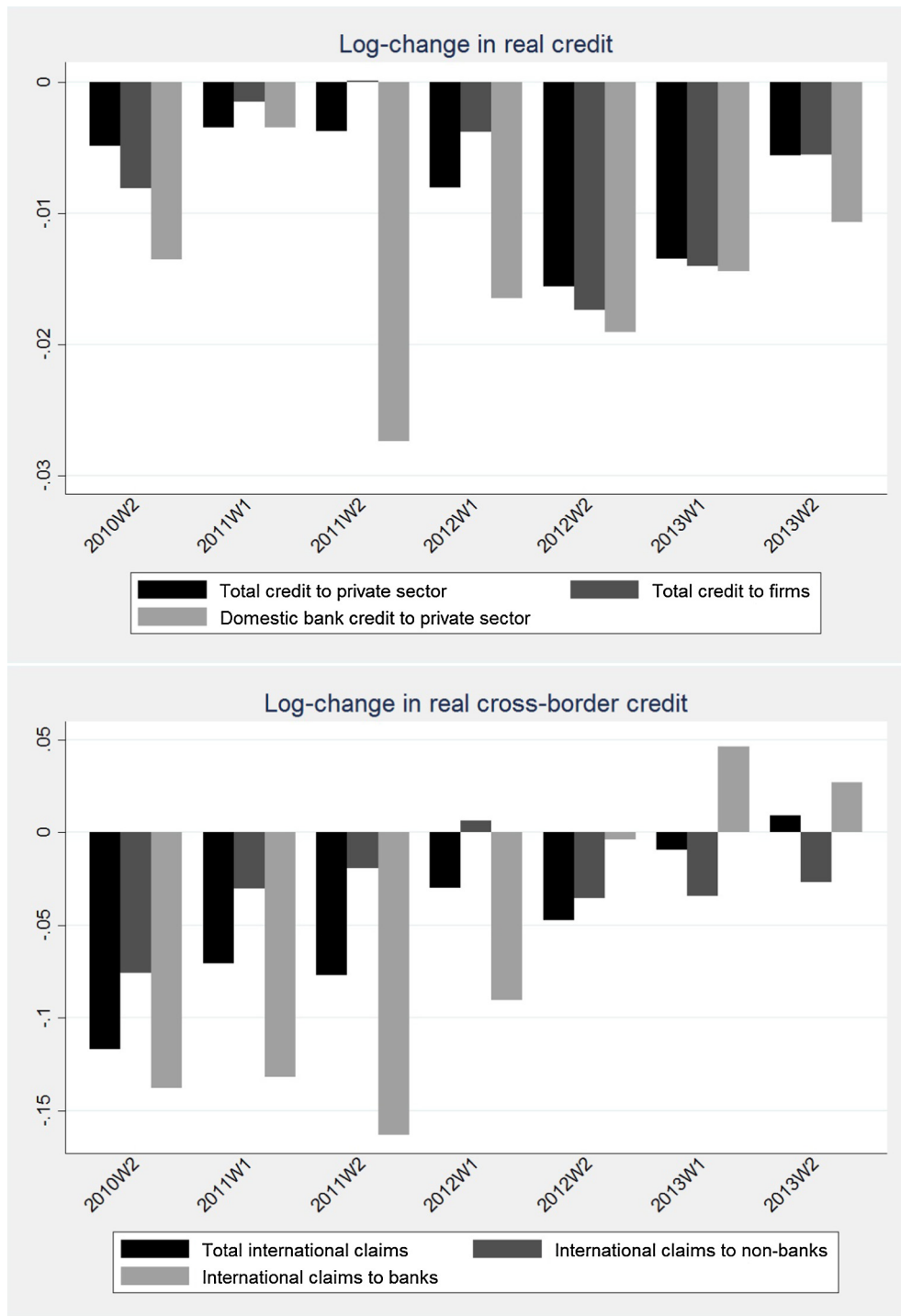
Fig. 5. Log-changes in real credit. This figure plots the sample means of the change in total, domestic and cross-border credit. All credit series are available from the BIS. The timing of the variables corresponds to the SAFE waves. *W* denotes the waves of the survey. While 'wave 1' (W1) of each survey year covers the second and third quarter of that year, 'wave 2' (W2) captures the fourth quarter of the year and the first quarter of the following year. Therefore, our sample covers the period 2010Q4–2014Q1 (i.e. 2010W2–2013W2).

firms owned by other firms may be less financially constrained due to access to internal group funds. The estimations show that firms owned by shareholders are affected less by loan rate increases than firms from the reference category that includes firms owned by family, entrepreneurs or private persons. This link between firms owned by shareholders and their

Table 4

Correlogram: Log-change in credit measures. This table presents correlations between the log-difference of different credit measures. The first row of each credit measure reports the correlation coefficient. The second row shows p-values, while the third row reports the number of observations.

	Total credit to firms	Domestic bank credit to private sector	Total international claims	International claims to non-banks
Domestic bank credit	**0.25*** (0.03) 77	**1** 77		
Total international claims	**0.08** (0.47) 77	**0.31*** (0.01) 77	**1** 77	
Int. claims to non-banks	**0.06** (0.63) 77	**0.10** (0.37) 77	**0.41*** (0.00) 77	**1** 77
Int. claims to banks	**0.01** (0.94) 77	**0.24*** (0.03) 77	**0.80*** (0.00) 77	**0.02** (0.88) 77

[*] Statistical significance at the 5%-level. The bold numbers report the correlation coefficients.

lower probability of financing constraints or loan rate increases may at least partially be due to the link between ownership structures and firm size as Ferrando and Griesshaber (2011) point out.

As we are interested in the effect of a reduction in cross-border credit supply on firms' loan rates, one important challenge here is to control for changes in firms' loan demand. If loan demand of firm i increases and this is not controlled for, loan rates may increase (the loan demand curve shifts out), and our estimates are biased upwards. By contrast, if loan demand is not controlled for and declines, loan rates tend to decline (as loan demand shifts inwards) so that our estimates are biased downwards. Following Banerjee (2014), we include a control variable related to firms' loan demand, namely a dummy variable that equals one if a firm's most pressing problem is to find customers. The idea is that firms should have a lower demand for new credit - and hence a lower likelihood of seeing their credit conditions tightening - if they have difficulty in selling their products. We also include dummies indicating the sector the firm operates in (Construction, Industry, Services, Trade) in all regressions, because the previous literature shows that the firms' need for external financing varies significantly by sector (e.g. Rajan and Zingales, 1998; Friedrich et al., 2013). In the robustness tests below, we also include sector-time dummies to control for changes in loan demand at the sector-level.

In terms of macroeconomic control variables, we include aggregate deposit rates, countries' interbank dependence, and the change in the number of banks in order to control for common banking system characteristics. All these variables are retrieved from the ECB Data Warehouse. We expect a higher probability of a loan rate increase for firms in countries with higher deposit rates, a higher degree of interbank dependence, and a larger reduction in the number of banks. Higher interbank dependence can aggravate the funding situation of domestic banks in times of stress in the banking sector. This can lead to lower lending and higher lending rates. Banking systems that rely less on interbank funding and more on other types of liabilities like customer deposits are funded more solidly and hence can charge more stable lending rates. The interbank dependence variable can be seen as a control variable for the wholesale funding situation of banks here. Moreover, we add an indicator of economic risk. As banks have adjusted their risk perceptions in the realm of the crisis, this may imply that they charged higher risk premia and, hence, loan rates for SME loans. The economic risk indicator is available from the *International Country Risk Guide*, a proprietary database that is also used by firms and banks to assess business risks. It includes information on GDP per capita, GDP growth, inflation, as well as the budget balance and the current account relative to GDP. In addition, we include 5-year sovereign credit default swap (CDS) spreads to control for differences in sovereign risk, given that our sample period includes the European sovereign debt crisis. These data are retrieved from *Thomson Reuters Datastream*.[8] Table 5 presents summary statistics for all variables included in the regression sample.

One problem with this type of micro-macro data and the non-linear probit regression model is determining the appropriate level at which to cluster standard errors. The observational unit in our data set is the firm, which is nested within sectors and countries. Ideally, we would like to cluster at the broadest level, i.e. the country level. However, cluster-robust estimation relies on the number of clusters going to infinity (Cameron and Miller, 2015). As the number of countries in our sample is small (as is the number of sectors), we cluster at the firm level. Yet, in robustness tests, we check how the significance of our results is affected when clustering at the country level.

Running a simple pooled probit model on firms' loan conditions means that we look at firms that actually applied for and were granted credit. This implies a non-random selection of firms into our regression sample, leading to potentially biased estimates. Firms that did not apply for a loan – either because they were discouraged or because they did not need a new loan – may have seen larger increases in loan rates than firms that received new credit, e.g. due to high fixed costs of using

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[8] We also added net interest margins, financial risk, and the ratio of total credit to the private sector relative to GDP to all regressions. Credit to GDP is often used as a measure of financial development in large country samples. Yet, it is also a measure of the degree of debt financing and, hence, leverage in an economy. Including theses additional macro-variables leads to a very high degree of multicollinearity though. That is why we opt for the more parsimonious specification here.

Table 5
Summary statistics. This table gives summary statistics for the baseline regression sample.

Variable	Obs	Mean	Std. dev.	Min	Max
Sample of firms with information on loan rate changes					
Firm size (1:medium-sized)	14,395	0.31	0.46	0	1
Firm age (1:more than 10 years)	14,395	0.80	0.40	0	1
Turnover	14,395	1.74	0.77	1	3
Ownership	14,395	0.13	0.34	0	1
Most pressing pb: Finding customers	14,395	0.21	0.41	0	1
Most pressing pb: Labor cost	14,395	0.14	0.35	0	1
Most pressing pb: Competition	14,395	0.11	0.31	0	1
Deposit rate, %	14,395	2.52	0.63	1.03	4.51
Interbank dependence, % of assets	14,395	14.39	6.31	6.64	31.14
Growth in number of banks	14,395	−3.71	6.35	−32.00	2.50
Economic risk	14,395	−35.98	3.50	−43.71	−26.50
CDS Spread	14,395	7.03	25.72	0.12	149.04
Total credit to firms, log-diff	14,395	−0.01	0.02	−0.07	0.04
Total credit by domestic banks to private, log-diff	14,395	−0.02	0.03	−0.14	0.06
Total international credit, log-diff	14,395	−0.03	0.08	−0.32	0.23
International credit to non-banks, log-diff	14,395	−0.02	0.07	−0.37	0.14
International credit to banks, log-diff	14,395	−0.05	0.20	−1.01	1.11
Full sample					
Firm size (1:medium-sized)	38,602	0.25	0.43	0	1
Firm age (1:more than 10 years)	38,602	0.79	0.41	0	1
Turnover	38,602	1.62	0.75	1	3
Ownership	38,602	0.15	0.35	0	1
Most pressing pb: Finding customers	38,602	0.24	0.43	0	1
Most pressing pb: Labor cost	38,602	0.14	0.34	0	1
Most pressing pb: Competition	38,602	0.13	0.34	0	1
Deposit rate, %	38,602	2.50	0.66	1.03	4.51
Interbank dependence, % of assets	38,602	14.80	6.66	6.64	31.14
Growth in number of banks	38,602	−3.79	6.47	−32.00	2.50
Economic risk	38,602	−36.29	3.74	−43.71	−26.50
CDS Spread	38,602	8.26	28.91	0.12	149.04
Total credit to firms, log-diff	38,602	−0.01	0.02	−0.07	0.04
Total credit by domestic banks to private, log-diff	38,602	−0.01	0.03	−0.14	0.06
Total international credit, log-diff	38,602	−0.03	0.09	−0.32	0.23
International credit to non-banks, log-diff	38,602	−0.02	0.07	−0.37	0.14
International credit to banks, log-diff	38,602	−0.05	0.22	−1.01	1.11

bank credit. In order to take this potential downward bias of our estimates into account, we also estimate a probit model with Heckman selection (van de Ven and van Praag, 1981), i.e. a two-step estimator that controls for sample selection.

Similar to Popov and Udell (2012) and Beck et al. (2014), we model a firm's decision to participate in the credit market using a dichotomous variable that equals one if a firm has applied for a loan and zero otherwise. In the first-stage of the Heckman procedure, the selection equation, we regress this dichotomous loan application variable on all regressors included in the baseline Eq. (1), as well as on two additional variables, the so-called exclusion restrictions. Credible identification rests on including at least one variable, i.e. one exclusion restriction, into the selection equation that has a non-zero effect on the selection variable (loan demand), but not on the outcome variable, i.e. the dependent variable in the actual regression of interest (loan rate increase). The first additional variable in our selection equation equals one if a firm reports its most pressing problem to be competition, and zero otherwise. The second exclusion restriction is based on a variable that takes on a value of one if a firm's most pressing problem is high labor input costs.

We expect a negative link between both the competition and the labor cost variable based on the following reasoning: stronger or increasing competitive pressure can reduce a firm's expectation about its future growth. For example, when more firms are active in the market and compete for product demand, it becomes more difficult for a firm to expand turnover, especially during times of weak aggregate demand. Based on a theoretical model of demand for credit lines, Martin and Santomero (1997) show that firms with lower growth perspectives have lower credit demand. Looking at the link between our competition variable and a firm's expected growth over the next two years (see SAFE question Q17), we see a negative and statistically significant correlation in our sample.

A similar intuition can be evoked for firms reporting their most pressing problem to be labor and production costs. If input costs become the most important issue, growth perspectives of the firm can be hampered, as it gets harder for the firm to sell its products at a price that is low enough to allow for expansion. Again, we see a negative and significant correlation between firms expected growth and our labor cost variable. Hence, it seems plausible that firms that report their most pressing problem to be input costs have lower growth expectations and hence demand less credit. In addition, Banerjee (2014) also finds a negative effect of input cost on loan demand of firms, based on the size of new loans from the SAFE-data.

Differential effects: The role of firm size. In addition to estimating Eq. (1) with the probit approach discussed above, we analyze whether firms of different size are affected differently by credit market fragmentation. To that aim, we interact all credit variables with an indicator variable that equals one if a firms has more than 50 employees ($Size_{isct}$), and is, hence, classified as a medium-sized firm, and zero otherwise:

$$Pr[R_{isct} = 1] = \alpha_c + \theta_s + \lambda_t + \beta_1 ForCred_{ct} + \beta_2 DomCred_{ct} + \beta_3 ForCred_{ct} \cdot Size_{isct} + \beta_4 DomCred_{ct} \cdot Size_{isct} + \gamma Z_{ct} + \xi X_{isct} + \epsilon_{isct}$$
(2)

Note that the interaction variable, $Size_{isct}$, is always included individually in the regressions and is subsumed under the term X_{isct}. Even if larger firms are expected to have more favorable financing conditions than smaller firms that are inherently more opaque and risky, credit market fragmentation may affect the larger firms in our sample more than smaller ones due to potential direct linkages to foreign banks or larger reliance on bank credit in general.

Table 6
Determinants of loan applications. This table reports estimation results (average marginal effects) from the first-stage estimation of a probit with selection. The dependent variable equals 1 if a firm has applied for a loan. Credit aggregates are expressed as log-differences. A set of country, sector, and time dummies is included in each regression. Robust standard errors are clustered at the firm-level.

	(1)	(2)	(3)
Firm size (1:medium-sized)	0.107***	0.107***	0.107***
	(0.007)	(0.007)	(0.007)
Firm age (1:more than 10 years)	0.010	0.010	0.010
	(0.007)	(0.007)	(0.007)
Ownership	−0.063***	−0.063***	−0.063***
	(0.008)	(0.008)	(0.008)
Most pressing pb: Finding customers	−0.102***	−0.101***	−0.102***
	(0.006)	(0.006)	(0.006)
Most pressing pb: Competition	−0.113***	−0.113***	−0.113***
	(0.008)	(0.008)	(0.008)
Most pressing pb: Labor cost	−0.063***	−0.063***	−0.063***
	(0.008)	(0.008)	(0.008)
Deposit rate, %	−0.015	−0.016	−0.014
	(0.011)	(0.011)	(0.011)
Interbank dependence, % of assets	0.006**	0.007***	0.007***
	(0.002)	(0.002)	(0.002)
Growth in number of banks	−0.001*	−0.001	−0.001
	(0.001)	(0.001)	(0.001)
Economic risk	0.008***	0.009***	0.009***
	(0.003)	(0.003)	(0.003)
CDS spread	−0.000**	−0.000**	−0.000**
	(0.000)	(0.000)	(0.000)
Total credit to firms, log-diff	0.447**		
	(0.174)		
Total credit by domestic banks to private, log-diff		0.159	0.108
		(0.143)	(0.145)
Total international credit, log-diff		−0.007	
		(0.040)	
International credit to non-banks, log-diff			−0.075
			(0.047)
International credit to banks, log-diff			0.008
			(0.014)
Country dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes
Observations	38,602	38,602	38,602
No. of firms	26,032	26,032	26,032
Pseudo R-squared	0.0574	0.0573	0.0574

* Statistical significance at the 10%-level.
** Statistical significance at the 5%-level.
*** Statistical significance at the 1%-level.

4. Estimation results

4.1. Credit growth and financing costs of SMEs

Before coming to the effects of credit market fragmentation on loan rate increases for SMEs, let us look at the first-stage selection equation. Table 6 reveals that medium-sized firms are more likely to apply for a loan than small ones. Furthermore, firms that are owned by shareholders are less likely to apply for a bank loan, probably due to the fact that they can resort to other means of financing. As expected, firms facing strong competition, high labor costs, or weak demand for their products are less likely to apply for credit. Turning to the macroeconomic control variables, firms in countries with a higher interbank dependence are more likely to send out a loan application. We also find some evidence that firms in countries with higher CDS spreads are less likely to apply for loans.

Table 7 presents the regression results for the increase in loan rates as the dependent variable. Larger firms, firms owned by shareholders, and firms that have great difficulty in finding customers are less likely to experience loan rate rises. Regarding the macroeconomic drivers of firms' credit costs, firms from countries with higher interbank dependence are more likely to experience loan rate increases. As expected, the higher the average deposit rate and, hence, banks' funding costs or the higher the economic risk at the country-level, the higher the probability of a loan rate increase for a given firm. The larger the reduction in the number of banks serving a firm's home country and, hence, the lower contestability in the credit market, the higher is the probability of a loan rate increase.

Table 7

Determinants of loan rate increases. This table reports estimation results (average marginal effects) from pooled probit regressions, with and without a Heckman selection approach. The dependent variable equals 1 if a firm reports an increase in its loan rate. Credit aggregates are expressed as log-differences. A set of country, sector and time dummies is included in each regression. Robust standard errors are clustered at the firm-level.

	(1)	(2)	(3)	(4)	(5)	(6)
Firm size (1:medium-sized)	0.011	−0.020**	0.011	−0.020**	0.011	−0.020**
	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)
Firm age (1:more than 10 years)	0.010	0.007	0.010	0.006	0.010	0.007
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
Ownership	−0.033***	−0.011	−0.033***	−0.011	−0.033***	−0.011
	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)
Most pressing pb: Finding customers	−0.030***	−0.005	−0.032***	−0.006	−0.032***	−0.006
	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)
Deposit rate, %	0.042**	0.043***	0.073***	0.070***	0.062***	0.060***
	(0.017)	(0.015)	(0.018)	(0.016)	(0.017)	(0.016)
Interbank dependence, % of assets	0.015***	0.012***	0.009**	0.006*	0.009**	0.006*
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
Growth in number of banks	−0.003***	−0.003**	−0.006***	−0.005***	−0.006***	−0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Economic risk	0.021***	0.016***	0.015***	0.011**	0.018***	0.013***
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
CDS spread	−0.000	−0.000	−0.001	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total credit to firms, log-diff	−1.545***	−1.515***				
	(0.272)	(0.259)				
Total credit by domestic banks to private, log-diff			−0.196	−0.223	−0.095	−0.119
			(0.241)	(0.221)	(0.244)	(0.225)
Total international credit, log-diff			−0.281***	−0.248***		
			(0.067)	(0.062)		
International credit to non-banks, log-diff					−0.124	−0.089
					(0.077)	(0.072)
International credit to banks, log-diff					−0.069***	−0.064***
					(0.023)	(0.021)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	yes	Yes	Yes	Yes	Yes	Yes
Wave dummies	yes	Yes	Yes	Yes	Yes	Yes
Observations	14395	14,395	14,395	14,395	14,395	14,395
No. of firms	10825	10,825	10,825	10,825	10,825	10,825
Pseudo R-squared	0.169	0.087	0.168	0.086	0.168	0.086

* Statistical significance at 10%-level.
** Statistical significance at 5%-level.
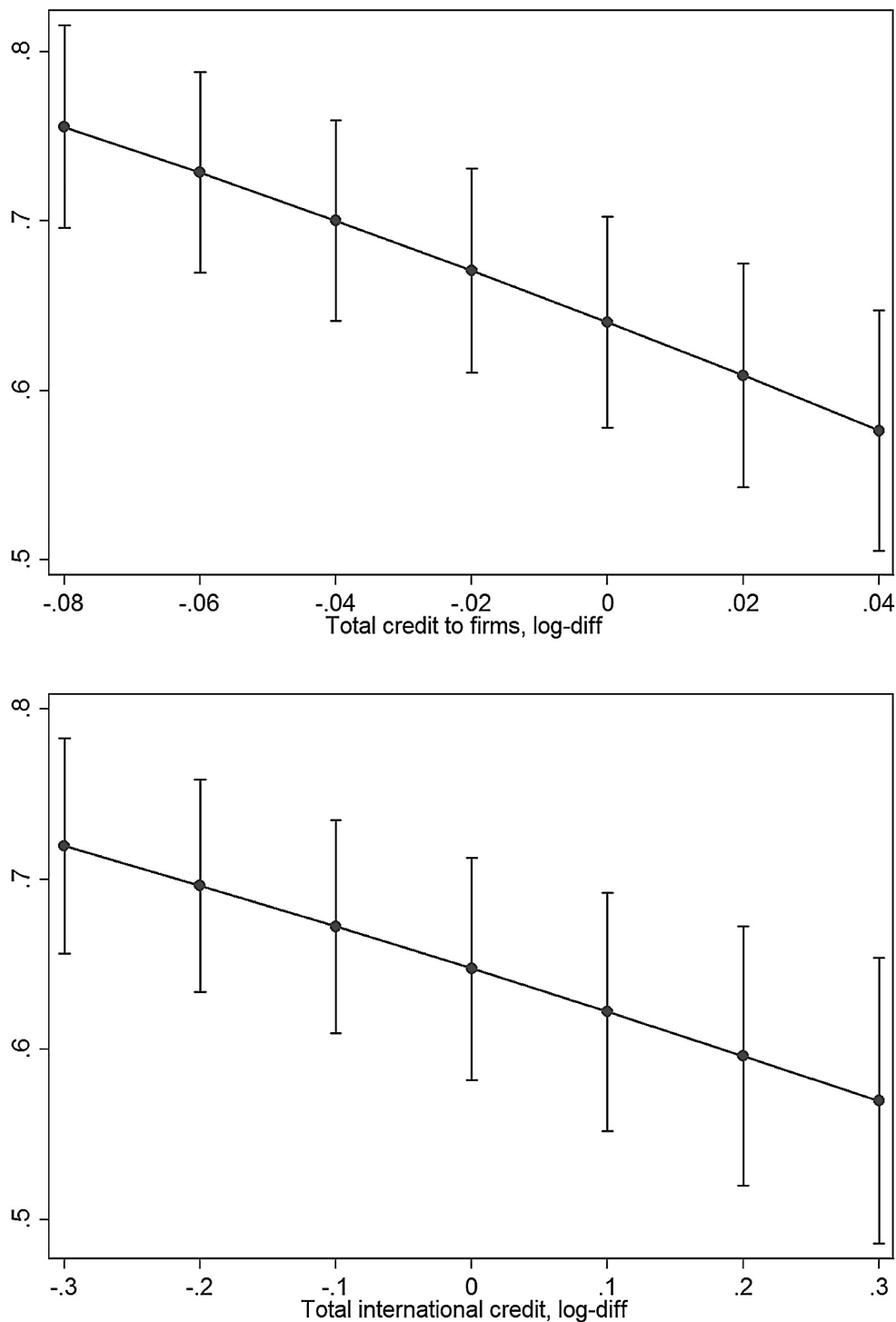*** Statistical significance at 1%-level.

Fig. 6. Predicted probabilities of a loan rate increase, by international credit growth. This figure plots the average adjusted predictions (AAPs) for different values of total and international credit growth, based on Table 7, columns (2) and (4), respectively. The AAPs are denoted by dots enclosed by 95% confidence bands.

Regarding the different credit measures, we find that larger reductions in total credit to non-financial firms make loan rate increases more likely - both in the probit model and in the model with Heckmann selection (columns 1 and 2). When considering domestic and cross-border credit separately, we find that only international bank credit growth has a negative and statistically significant impact on the likelihood of increasing loan rates for SMEs. The direct effect of domestic credit

Table 8

Determinants of loan rate increases, interactions with firm size. This table reports estimation results (coefficient estimates) from pooled probit regressions, with and without a Heckman selection approach. The dependent variable equals 1 if a firm reports an increase in its loan rate. Credit aggregates are expressed as log-differences. A set of country, sector, and time dummies is included in each regression. Robust standard errors are clustered at the firm-level.

	(1)	(2)	(3)	(4)	(5)	(6)
Firm size (1:medium-sized)	0.004	−0.090***	−0.011	−0.103***	−0.002	−0.094***
	(0.029)	(0.033)	(0.032)	(0.035)	(0.031)	(0.034)
Firm age (1:more than 10 years)	0.032	0.022	0.032	0.021	0.031	0.021
	(0.030)	(0.028)	(0.030)	(0.028)	(0.030)	(0.028)
Ownership	−0.098***	−0.031	−0.100***	−0.031	−0.100***	−0.031
	(0.035)	(0.036)	(0.035)	(0.036)	(0.035)	(0.036)
Most pressing pb: Finding customers	−0.093***	−0.014	−0.096***	−0.016	−0.096***	−0.016
	(0.029)	(0.031)	(0.029)	(0.032)	(0.029)	(0.032)
Deposit rate, %	0.126**	0.132***	0.223***	0.220***	0.188***	0.187***
	(0.051)	(0.048)	(0.054)	(0.051)	(0.053)	(0.050)
Interbank dependence, % of assets	0.048***	0.038***	0.028**	0.018*	0.027**	0.018*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Growth in number of banks	−0.010***	−0.008**	−0.017***	−0.015***	−0.017***	−0.015***
	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
Economic risk	0.063***	0.049***	0.046***	0.033**	0.056***	0.041***
	(0.014)	(0.013)	(0.016)	(0.015)	(0.015)	(0.015)
CDS spread	−0.001	−0.001	−0.002*	−0.001	−0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total credit to firms, log-diff	−3.810***	−3.919***				
	(0.903)	(0.849)				
Total credit to firms × Larger firms	−3.315***	−2.916**				
	(1.209)	(1.142)				
Total credit by domestic banks to private, log-diff			−0.304	−0.520	0.021	−0.187
			(0.773)	(0.723)	(0.782)	(0.732)
Total credit by domestic banks × Larger firms			−1415	−0.945	−1327	−0.829
			(0.976)	(0.925)	(0.986)	(0.935)
Total international credit, log-diff			−0.645***	−0.562***		
			(0.219)	(0.204)		
Total international credit × Larger firms			−0.797***	−0.800***		
			(0.309)	(0.289)		
International credit to non-banks, log-diff					−0.289	−0.184
					(0.262)	(0.246)
International credit to non-banks × Larger firms					−0.246	−0.249
					(0.350)	(0.327)
International credit to banks, log-diff					−0.134*	−0.116
					(0.077)	(0.072)
International credit to banks × Larger firms					−0.292**	−0.328***
					(0.127)	(0.119)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	yes	Yes	Yes	Yes	Yes	Yes
Wave dummies	yes	Yes	Yes	Yes	Yes	Yes
Observations	14395	14,395	14,395	14,395	14,395	14,395
No. of firms	10825	10,825	10,825	10,825	10,825	10,825
Pseudo R-squared	0.169	0.087	0.169	0.087	0.168	0.087

* Statistical significance at the 10%-level.
** Statistical significance at the 5%-level.
*** Statistical significance at the 1%-level.

growth is statistically insignificant. Columns 5 and 6 reveal that the negative effect of cross-border credit is driven by cross-border interbank loans: the stronger the reduction in cross-border credit to banks, the higher the probability of increasing loan rates. By contrast, changes in cross-border credit to non-banks do not seem to matter for changes in the financing costs of SMEs. This may be due to the fact that direct foreign lending is less important for SMEs' external financing situation than lending by domestic banks. Moreover, this credit aggregate includes not only cross-border credit to SMEs, but also to non-bank financials and households, for example. Hence, the estimated coefficient on this variable should be interpreted with some caution. Overall, credit market fragmentation in the interbank market seems to have a more detrimental effect on the financing costs of SMEs than the reduction in direct cross-border lending to firms. This finding is in line with the empirical results of Iyer et al. (2014) for Portugal.
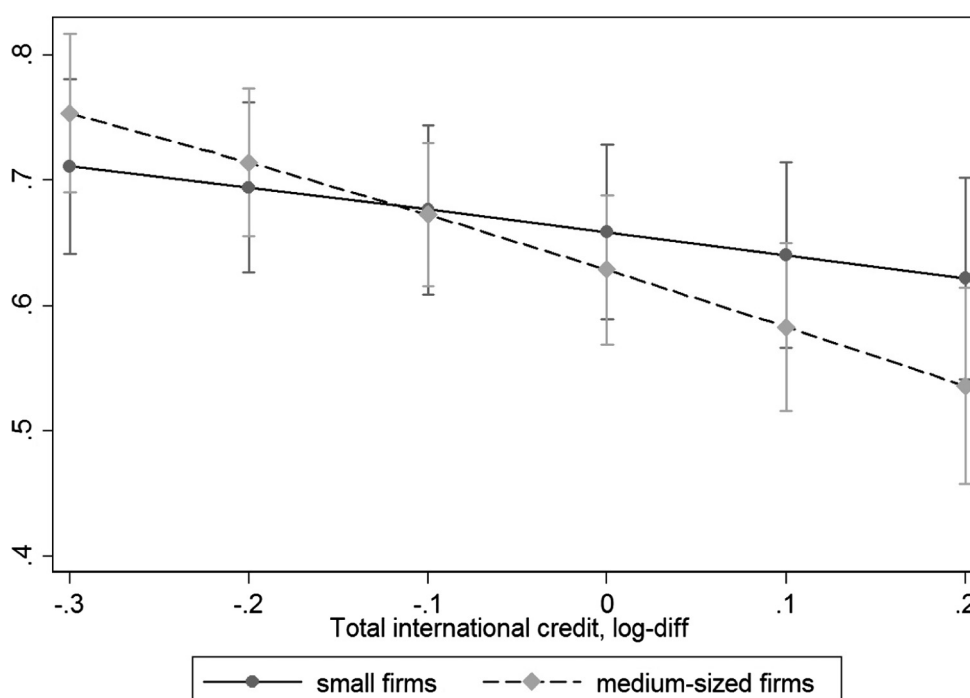
Fig. 7. Predicted probabilities of a loan rate increase for small and medium-sized firms. This figure plots the average adjusted predictions (AAPs) for different values of international credit growth, based on Table 8, column (4) in the paper, i.e. on the regression model where interactions between firm size and credit growth are taken into consideration. The AAPs are denoted by dots enclosed by 95% confidence bands.

Fig. 6 plots average adjusted predictions (AAPs) for different credit aggregates, based on the regression models using the Heckman selection approach. It illustrates that the probability of firms seeing their loan rates increase is higher, the larger the reduction in credit is - both for total and for the international credit variables.

Table 8 presents the regression results for interactions between the credit variables and the firm size dummy variable that equals one for firms with more than 50 employees, i.e. medium-sized firms. Again, the relation between credit growth and firms' likelihood of loan rate increases is negative and statistically significant. The coefficient on the interaction terms between larger firms and total credit, international credit and international credit to banks is negative and statistically significant.[9] As illustrated by Fig. 7, medium-sized firms have a lower likelihood of loan rate increases than small firms in countries where cross-border credit growth was not too negative. Yet, when credit significantly decreases (by more than 10%), large firms have a higher probability of loan rate increases than small ones - possibly because in the case of heavy credit market stress, larger firms are more likely to apply for and be granted credit than smaller ones that are more opaque and thus less likely to receive credit in times of banking sector stress. Loan rates charged to applicant firms are likely to be high in this environment.

4.2. Economic significance

In order to get an idea about the magnitudes of the above identified linkages between credit growth and the probability of loan rate increases, we now discuss and interpret the marginal effects from our regressions in greater detail. Given that the probit estimator is non-linear, the marginal effects of the independent variables in the model are non-constant. They vary with changes in the predictors.

When considering an average firm in an average credit market (all variables are set at their sample means), our results indicate that the probability of a loan rate increase faced by this firm is 67% in the 2010–2014 period (based on the model from column 2, Table 7).[10] Yet, this probability rises by 10 percentage points, up to 77%, if total credit growth is at the sample minimum (−0.07) and all other predictors remain at the sample means. If total credit growth is at its maximum (0.04), the probability of an average firm seeing its loan rate increase drops to 60% though. Overall, the probability of facing higher loan rates varies by 17 percentage points, depending on total credit growth in the country the firm operates in.

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[9] As stressed by Williams (2012), given that the value of the interaction changes with changes in the components only, no marginal effect of the interaction itself exists, but just the marginal effect of the component terms.

[10] We base our discussion of marginal effects on our preferred regression setup with Heckman selection here. However, the results based on the simple probit model are qualitatively the same.

Table 9

Determinants of loan rate increases, including large firms. This table reports estimation results (average marginal effects) from pooled probit regressions, including large firms (i.e. firms with more than 250 employees), with and without a Heckman selection approach. The dependent variable equals 1 if a firm reports an increase in its loan rate. Credit aggregates are expressed as log-differences. A set of country, sector, and time dummies is included in each regression. Robust standard errors are clustered at the firm-level.

	(1)	(2)	(3)	(4)	(5)	(6)
Firm size (1:medium-sized)	0.011	−0.019*	0.011	−0.019**	0.011	−0.019**
	(0.008)	(0.010)	(0.008)	(0.010)	(0.008)	(0.010)
Firm age (1:more than 10 years)	0.011	0.009	0.011	0.009	0.011	0.009
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
Ownership	−0.035***	−0.012	−0.035***	−0.012	−0.035***	−0.012
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Most pressing pb: Finding customers	−0.029***	−0.005	−0.031***	−0.006	−0.031***	−0.006
	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)
Deposit rate, %	0.037**	0.037**	0.070***	0.068***	0.058***	0.057***
	(0.016)	(0.015)	(0.017)	(0.016)	(0.017)	(0.016)
Interbank dependence, % of assets	0.015***	0.012***	0.008**	0.005	0.008**	0.005
	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Growth in number of banks	−0.003***	−0.003**	−0.006***	−0.005***	−0.006***	−0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Economic risk	0.022***	0.018***	0.016***	0.011**	0.019***	0.014***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
CDS spread	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total credit to firms, log-diff	−1.693***	−1.687***				
	(0.262)	(0.251)				
Total credit by domestic banks to private, log-diff			−0.234	−0.267	−0.117	−0.151
			(0.233)	(0.216)	(0.236)	(0.219)
Total international credit, log-diff			−0.317***	−0.290***		
			(0.064)	(0.061)		
International credit to non-banks, log-diff					−0.134*	−0.109
					(0.074)	(0.069)
International credit to banks, log-diff					−0.078***	−0.073***
					(0.022)	(0.021)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,645	15,645	15,645	15,645	15,645	15,645
No. of firms	11,727	11,727	11,727	11,727	11,727	11,727
Pseudo R-squared	0.17	0.05	0.169	0.05	0.169	0.05

* Statistical significance at the 10%-level.
** Statistical significance at the 5%-level.
*** Statistical significance at the 1%-level.

Repeating the same exercise for the effect of international credit growth, our results indicate similar effects: Here, the difference between the likelihood of loan rate increases in countries with the highest (0.23) and the lowest growth (−0.32) in international credit is 15 percentage points. Thus, the effect of a retrenchment in international credit on firms' loan rates is not only statistically, but also economically meaningful. Further, when comparing these marginal effects to those of firm-level characteristics, the impact of credit growth is important. For example, when computing marginal effects across the different firm sizes (small, medium sized) and keeping all other variables at their sample means, the probability of firm-level loan rate increases varies between 65 and 68% only.

4.3. Robustness tests

We run several alternative regressions in order to test the robustness of the results discussed above. Table 9 shows that adding a control group for large firms, i.e. firms with more than 250 employees, does not weaken our main results. Rather, it strengthens the result that the retrenchment in cross-border bank credit negatively affects, in particular, larger firms' cost of credit in the sample. Furthermore, dropping individual firm-level variables from the model or including a set of sector-and-time dummies does not affect our results.[11] Moreover, when clustering robust standard errors at the country level instead of at

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[11] We do not report all the robustness tests. The respective tables are available from the authors upon request.

the firm level, our results remain statistically significant. Changes in inflation are not explicitly considered by firms reporting loan rate changes. In order to rule out that our results are driven by changes in inflation, we include CPI inflation as an additional regressor. As expected, the estimation results reveal that if inflation rises, nominal interest rates on new loans are more likely to also rise, although the results are mostly not statistically significant. Still, the introduction of CPI inflation in the regression model does not alter our previous findings.

Second, we run ordered probit regressions where the dependent categorical variable is assigned a value of 1 if a firm's loan rate decreased over the past six months, a value of 2 if the loan rate was unchanged, and a value of 3 if the loan rate increased. The ordered probit regressions support our previous results that reductions in aggregate credit make loan rate increases more likely (and loan rate reductions less likely). Moreover, in this setup, the relationship between cross-border credit to non-banks and the likelihood of loan rate increases at the firm-level is negative and statistically significant. Hence, when differentiating between positive and negative loan rate changes, the estimation results suggest that fragmentation in the international market for credit to non-banks coincides with increased external financing costs for SMEs - even if direct foreign credit is not as important for SMEs as domestic credit.

Third, we aggregate SAFE-data for each country at the sector-level and estimate the following aggregate version of Eq. (1) using a fractional probit model, where the dependent variable is bounded between zero and one:

$$ShareR_{sct} = \alpha_c + \theta_s + \lambda_t + \upsilon_{st} + \beta_1 ForCred_{ct} + \beta_2 DomCred_{ct} + \gamma Z_{ct} + \epsilon_{sct} \tag{3}$$

$ShareR_{sct}$ is the share of firms in sector s and country c at time t that reported a loan rate increase. All time-varying, sector-specific factors, like changes in credit demand or sectoral business conditions, are controlled for by sector-time fixed effects (υ_{st}). As in the baseline specification, we also add sector, time, and country fixed effects. Apart from this, we include the same time-varying country-level variables as in the baseline regressions.

While some of the macroeconomic control variables do not significantly affect the sectoral share of firms with higher financing costs, Table 10 confirms our previous results that a retrenchment in international credit leads to a deterioration

Table 10
Determinants of loan rate increases, sector level. This table reports estimation results from fractional probit regressions. The dependent variable is the share of firms in sector s, country c at time t that report an increase in loan rates. Credit aggregates are expressed as log-differences. A set of country, sector, time and sector-time dummies is included in each regression. Estimations are conducted using robust standard errors.

	(1)	(2)	(3)
Deposit rate, %	0.069	0.12	0.093
	(0.078)	(0.082)	(0.082)
Interbank dependence, % of assets	0.035**	0.021	0.021
	(0.018)	(0.017)	(0.017)
Growth in number of banks	−0.007	−0.016***	−0.014**
	(0.005)	(0.005)	(0.006)
Economic risk	0.088***	0.062***	0.074***
	(0.019)	(0.024)	(0.024)
CDS Spread	0.000	0.000	0.000
	(0.002)	(0.002)	(0.002)
Total credit to firms, log-diff	−4.339***		
	(1.179)		
Total credit by domestic banks to private, log-diff		−1.014	−0.667
		(1.029)	(1.088)
Total international credit, log-diff		−0.920***	
		(0.244)	
International credit to non-banks, log-diff			−0.123
			(0.368)
International credit to banks, log-diff			−0.202**
			(0.086)
Country dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes
Sector-wave dummies	Yes	Yes	Yes
Observations	308	308	308
No. of countries	11	11	11
Pseudo R-squared	0.133	0.133	0.132

* Statistical significance at the 10%-level.
** Statistical significance at the 5%-level.
*** Statistical significance at the 1%-level.

of firms' borrowing costs. The sectoral version of the regression model corroborates the role of the interbank channel for firms' financing costs.

Fourth, we have tested the robustness of our results when dropping macroeconomic control variables. In unreported regressions, we find that our results, especially those concerning the credit aggregates, remain qualitatively unchanged and even become statistically more significant compared to our baseline specification. In addition, the negative coefficient on domestic credit turns statistically significant when dropping other banking-sector characteristics like interbank dependence and the deposit rate. All findings related to international credit growth remain unchanged.

Finally, we evaluate endogeneity issues. Our findings point to a negative link between aggregate credit growth and the probability of loan rate increases at the firm-level. It is unlikely that this result is driven by reverse causality, because increasing loan rates in a destination country of credit should make it more attractive for banks to lend. Thus, we would expect the effect of loan rate increases on credit growth to be positive or insignificant. Moreover, individual firm-level developments should not drive aggregate variables (Langfield and Pagano, 2016), especially when looking at small firms.

Potential instrumental variables for cross-border credit, like changes in the regulation of foreign bank entry, institutional changes, or creditor rights, are very similar in the countries considered here and do not vary much across the period 2010–2014. Still, we check whether categorical variables measuring the implementation of stricter capital and other regulatory requirements, taken from the prudential policy database developed by Cerutti et al. (2016), could be used to instrument aggregate credit variables in our sample. After selecting those potential instruments that do not seem to suffer from a weak instruments problem, we test for the exogeneity of the potentially endogenous credit aggregates. Yet, we cannot reject the null hypothesis of exogeneity, so that the probit model without instrumenting aggregate credit is the preferred specification here.

5. Conclusions

The aim of this paper is to shed light on real consequences of credit market fragmentation in the euro area since the crisis. SMEs in the euro area continue to receive special attention from policy makers, not least with regard to the design of the Capital Markets Union (CMU), as they were hit the hardest by the credit crunch during the crisis.

So far, the literature on the financing constraints of firms in the euro area concentrates on the importance of firm characteristics for credit conditions of firms. Yet, it is not yet investigated how the structural changes in cross-border banking affect the access of SMEs to finance. This study is a first step in filling this gap. Using a linked micro-macro panel data set, we examine the link between the retrenchment in cross-border bank lending and the evolution of financing costs for SMEs in the euro area.

Our paper has three main findings. First, we find that reductions in cross-border bank lending made loan rate increases for SMEs more likely. The effects are meaningful, both in statistical and in economic terms. For firms in countries with the strongest reductions in international credit, the probability of facing higher loan rates is 15 percentage points higher than for firms in countries with the most favorable evolution of international credit. Second, the larger the retrenchment in cross-border lending *to banks* was, the higher the likelihood that SMEs saw their credit costs rise. Thus, the negative link between total cross-border credit growth and the financing costs for firms seems to be driven by the interbank lending channel. Yet, we do not find a significant and consistent effect of direct cross-border lending to non-banks on SMEs financing costs. Third, we can show that, in particular, the medium-sized European enterprises included here have suffered from the fragmentation of international credit markets.

Overall, our results show that cross-border lending does indeed affect the access to finance for SMEs, though mostly indirectly through the interbank channel. To alleviate financing constraints for SMEs, one important factor is thus credit market integration.

Acknowledgements

Appendix A. Data Appendix

Variable	Source	Description
Costs of financing		
Increase in lending rates	SAFE Q10, (a): Have lending rates for your firms increased, decreased or remained the same over the past 6 months?	**1**: increased **missing**: DK/NA **0**: otherwise
Firm characteristics		
Firm size	SAFE D1: How many people does your company employ(part- or full time)?	**1**: 50–249 employees **0**: 10–49 employees
Firm age	SAFE D5: In which year was your firm registered?	**1**: 10 years or more **0**: less than 10 years
Sector	SAFE D3: What is the main activity of your company?	**Categorical variable** **1**: Construction **2**: Industry (Mining, Manufacturing) **3**: Services (Transport, Real Estate, Other Services) **4**: Trade (Wholesale and Retail) **Missing**: D3 > 7
Firm ownership	SAFE D6: Who are the owners of your firm?	**1**: Shareholders, other firms, other **0**: family or entrepreneurs, venture capital firms, natural person, one owner only **Missing**: DK/NA
Most pressing problem: finding customers	SAFE *Waves until 2012W1* Q0: What is currently your most pressing problem? *Waves as of 2012W2* Construct Q0 from Q0b and Q0c	**1**: Finding customers **0**: all other categories (Access to finance, competition, costs of production or labor, availability of skilled stuff or experienced managers, regulation, other) **Missing**: DK/NA and missings from Q0
Most pressing problem: input costs	SAFE *Waves until 2012W1* Q0: What is currently your most pressing problem? *Waves as of 2012W2* Construct Q0 from Q0b and Q0c	**1**: Costs of production or labour **0**: all other categories (Finding customers, competition, access to finance, availability of skilled stuff or experienced managers, regulation, other) **Missing**: DK/NA and missings from Q0

Data Appendix (*continued*)

Variable	Source	Description
Most pressing problem: competition	SAFE *Waves until 2012W1*	**1**: Competition **0**: all other categories (Finding customers, access to finance, availability of skilled stuff or experienced managers, regulation, costs of production or labor, other)
	<u>Q0</u>: What is currently your most pressing problem? *Waves as of 2012W2* Construct Q0 from Q0b and Q0c	**Missing**: DK/NA and missings from Q0
Total credit		
Total credit to private **non-financial firms**	BIS, Statistics on credit to the private non-financial sector	Credit to non-financial corporations **from all source**s independent of the country of origin or type of lender. This includes e.g. securitised credits held by the non-bank financial sector or cross-border lending. The coverage of financial instruments includes loans and debt securities. Adjusted for breaks, billions of local currency (EUR), original frequency: quarterly
Cross-border credit		
Total international cross-border bank claims	BIS, Consolidated Banking Statistics	Claims (amounts outstanding at quarter end) on destination country by all reporting countries, immediate borrower basis, in mio. USD, **international claims** (cross-border + local in foreign currency), original frequency: quarterly
International cross-border bank claims on **non-bank private** sector	BIS, Consolidated Banking Statistics	Claims on destination country by all reporting countries, immediate borrower basis, in mio. USD, international claims (cross-border + local in foreign currency), non-bank private sector includes claims against all non-banks (i.e. including financial non-banks and households), original frequency: quarterly
International cross-border bank claims on **banking sector**	BIS, Consolidated Banking Statistics	Claims on destination country banks by all reporting countries, immediate borrower basis, in mio. USD, foreign claims (cross-border + local in foreign currency), original frequency: quarterly
Domestic credit		
Domestic bank credit to **private non-financial sector** (non-financial corporations, households, NPISHs)	BIS, Statistics on credit to the private non-financial sector	Credit extended by domestic deposit-taking corporations except the central bank such as commercial banks, savings banks or credit unions and money-market funds, adjusted for breaks, billions of local currency (EUR), original frequency: quarterly.
Other macro variables		
Euro-Dollar nominal exchange rate	IMF, IFS	Euro per USD, end of period, original frequency: quarterly
Consumer price index	IMF, IFS	All items, index 2010 = 100, original frequency: quarterly

Data Appendix (*continued*)

Variable	Source	Description
Gross domestic product	Eurostat	In current mio EUR, according to ESTV 2010, original frequency: quarterly
Deposit interest rate	ECB, MFI Interest Rate Statistics	Interest rate on deposits with agreed maturity, annualized agreed rate, counterpart sector: non-financial corporations and households, original frequency: monthly
Interbank dependence	ECB, Statistics on Consolidated Banking Data	Interbank market dependence in % of total assets, domestic banks and foreign controlled subsidiaries and branches, original frequency: half-yearly
Number of banks	ECB, Statistics on Consolidated Banking Data	Total number of credit institutions, domestic banks and foreign controlled subsidiaries and branches, original frequency: half-yearly
Economic risk	International Country Risk Guide (ICRG), PRS Group	Economic risk rating, based on different risk components (GDP per capita, GDP growth, inflation, fiscal budget balance, current account balance), original frequency: yearly
CDS spreads	Thomson Reiters Datastream	5-year sovereign credit default swap spreads, original frequency: daily

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