Bank competition and firm credit availability: firm-bank evidence from Europe

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Abstract

This paper examines the impact of bank competition on firms' access to credit using a large panel of 900 banks matched to almost 60.000 firms across the euro area over the period 2010-2016. Results provide empirical support for the *market power hypothesis* whereby low inter-bank competition worsens firms' credit conditions. We find that higher bank market power is associated with lower short and long-term bank credit, higher reliance on trade credit and higher funding costs for customer firms. Furthermore, high bank market power is especially detrimental for opaque firms, suggesting that lower inter-bank competition exacerbates the financial constraint of borrowers that are more exposed to information problems. By contrast, we find limited evidence consistent with the *information hypothesis*: among firms related to banks with high market power, those served by small banks are less credit constrained than those served by large banks.

Keywords: Banks, inter-bank competition, firms' access to finance.

JEL classification: G21, G32, D22, D40.

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1 Introduction

Does inter-bank competition ultimately benefits firms' access to credit? Unlike most industries, the peculiar features inherent to the banking business and the key role of information prevent a straightforward answer. Indeed, economic theory makes conflictive predictions on whether borrowers benefit from competition between lenders. On the one hand, *the market power hypothesis* holds that greater competition leads to higher and cheaper allocation of credit to firms (Pagano, 1993). On the other hand, the *information hypothesis* argues that banks are more likely to form long-term relationships with borrowers when operating in a non-competitive market. Strong competition would hence discourage relationship lending and impair firms' access to credit (Petersen and Rajan, 1994, 1995).

Current interest in banking consolidation across the European Union (EU) further underscores the salience of this issue. The move to a Banking Union is expected to usher in greater cross-border banking consolidation by creating a large EU-wide banking market (**?**). Furthermore, there is a widespread concern that the EU's over-reliance on banks has adverse implications for financial stability and economic growth (Langfield and Pagano, 2016; Nuoy, 2017).[1] As a result, EU policy makers tend to welcome cross-border banking consolidation as a vector of European financial integration as well as a remedy to overbanking (Nuoy, 2017). However, less attention is being devoted to the potential implications of greater bank concentration on corporate credit conditions.

In this paper we empirically investigate the impact of inter-bank competition on firms' access to credit by using a database that matches almost 60.000 firms to 900 banks located in the euro area over the period 2010-2016. The structure of the data allows to directly test how a bank's market power – as measured by the Lerner index at the bank level – affects the credit availability of its customer firms. Similarly to Amiti and Weinstein (2011, 2013), we exploit the variation in the credit availability of firms within the same industry but related to banks with different levels of market power. This procedure allows to identify the effect of bank competition on financial constraint net of industry-wide credit demand. Lender and borrower specific determinants of financial constraint are also controlled for through balance sheet and income statement information at both firm and bank level.

We find evidence that rejects the information hypothesis in favour of the market power hypothesis: weaker inter-bank competition is associated with lower short and long-term bank credit, higher reliance on trade credit and higher funding costs for customer firms. Importantly, the fact that firm borrowing decreases while funding costs and reliance on trade credit increase indicates that low bank competition has a negative impact on firms through credit supply restrictions. Furthermore, we find heterogeneous effects of bank competition across firms and banks. In the cross-section of firms, higher bank market power is especially detrimental for credit availability precisely where the information hypothesis predicts it should be most beneficial. Among firms related to banks with high market power, small, low quality and opaque firms receive less short and long-term bank credit than large, high quality and transparent firms. Similarly, opaque firms whose relationship bank enjoys high market power also rely more on trade credit and face higher funding costs than more transparent firms. In the cross-section of banks, we find limited evidence consistent with the information hypothesis: Among firms related to banks with high market power, firms served by large banks tend to obtain less short and long-term credit as compared to firms served by smaller banks.

Overall, we consider our results to be mostly consistent with the market power hypothesis,

[1] The EU banking market is large by international standards: as of 2017, total banking assets accounted for 280% of GDP. By comparison, total assets of the US banking sector accounted for just 88% of GDP (Nuoy, 2017).

whereby lower inter-bank competition exacerbates the financial constraint of borrowers more exposed to information problems. By contrast, the limited evidence supporting the information hypothesis suggests lower inter-bank competition may improve access to credit insofar it nurtures credit relationships between small banks and small firms who have a strong interest in forming long-term relationships (Berger et al., 2005, 2017).

Our paper is related to the broad literature assessing the relation between bank competition and firms' access to credit.[2] Economic theory yields two contradictory predictions about such relation. The *market power hypothesis* maintains that less competitive banking markets lead to restricted credit allocation at a higher price. This may come about because low inter-bank competition engenders X-inefficiencies in the absorption and intermediation of resources, thus leading to higher interest rates and/or rationing (Pagano, 1993; Guzman, 2000) and because it stifles the pressure for innovation and the expansion of financial services to a pool of borrowers previously excluded by institutional finance (Vives, 2001). By contrast, *the information hypothesis* argues that lower inter-bank competition is associated with higher credit availability. This view is centred on credit relationships between lenders and borrowers. Since limited competition encourages relationship building and inter-temporal sharing of surplus between banks and firms, a monopolistic lender may be more willing to offer credit than a similarly placed lender in competitive market (Petersen and Rajan, 1994, 1995; Dell'ariccia and Marquez, 2006).[3] Strong competition on credit markets may instead be incompatible with the creation of mutually beneficial relationships between borrowing firms and creditor banks.

Subsequent empirical work tested these theoretical predictions. For instance, Beck et al. (2004) find that high bank concentration – as measured by banking regulatory policies and by the market share of the largest three domestic banks – tends to increase firms' reported obstacles to obtain finance. Similarly, Love and Martínez Pería (2015) find bank concentration – as captured by the Lerner and Boone indexes at the country level – to be negatively associated with firms' reported access to credit but significantly less so in countries with more developed private credit information sharing schemes (e.g. credit bureaus and credit registries). Leon (2015) uses firm level data on developing and emerging countries and finds that firms' reported credit constraint appears to be alleviated by bank competition. Using firm level data on Spanish SMEs matched to regional bank data, Carbo-Valverde et al. (2007) study how bank market power affects firm's reliance on trade credit - a proxy for financial constraint - and find that a negative association between bank market power and credit availability when banks' competition is captured by the Lerner index, while results are reversed if the HHI is employed. Furthermore, Jayaratne and Wolken (1999) and Berger et al. (2004) fail to find a relation between concentration and dependence on trade credit, while Degryse and Ongena (2008) note that more concentrated market are characterised by significantly larger spreads in both deposit and loan markets. Other papers provide evidence in favour of the information hypothesis. For example, Marquez (2002) shows that in more competitive banking systems, borrower-specific information tends to become more dispersed, thus entailing less efficient screening and higher lending rates. Using U.S. Internal Revenue Service data on small firms, Zarutskie (2006) finds that newly formed firms have significantly less outside

[2]See Cetorelli and Gambera (2001) for an overview about the theoretical and empirical literature on bank concentration.

[3]As noted by Petersen and Rajan (1995), a monopolistic lender may be able to share in the future surplus of the firm through the future rents the former will be able to extract. For instance, the lender may back-load interest payments over time, so to subsidize the firm in bad times and extracting rents in good times. The same argument is made by Mayer (1988) who suggests that a monopolistic bank may be willing to provide credit to a distressed firm as it expects to reap a share of the firm's future profit in the form of higher interest rate payments. By contrast, a bank operating in a competitive market would expect the firm to switch to cheaper funding alternatives as soon it recovers financial health, which would discourage the bank to provide rescue funding to begin with.

debt in more competitive banking markets, and suggests this may be due to the fact that stronger competition discourages lenders from financing new firms with unknown credit quality. Cetorelli and Gambera (2001) and Bonaccorsi di Patti and Dell'Ariccia (2004) find that higher concentration is positively related to growth in industrial sectors that are more dependent on external finance. More recently, using a panel of firms from 20 European countries covering the period 2001-2011, Fungáčová et al. (2014) find that stronger inter-bank competition (as measured by both structural and non-structural metrics computed at the country-level) tends to increase the cost of credit for corporate borrowers, particularly so for small firms.

Our paper makes two main contributions to this empirical literature. First, we investigate the relationship between bank competition and firm credit availability using a database that matches firms to their reference bank.[4] We are therefore able to measure directly how a firm's credit outcomes respond to changes in its relationship bank's market power, while simultaneously controlling for firm, bank and industry characteristics. To the best of our knowledge, this is the first study to employ matched data to measure the effect of bank competition on firms' financial constraint. We claim that this advances current literature for the following reasons. First, from the perspective of bank competition, the relevant lending markets may be local in nature (Maudos and de Guevara, 2007; Berger et al., 2009; Fungáčová et al., 2014; Drechsler et al., 2017) . In this sense, using Lerner indexes at the bank-level, rather than country or regional averages, may better capture the degree of local market power of financial intermediaries faced by borrowing firms. Second, this data allow to explicitly take into account the role of bank-firm relationships, which is crucial to effectively discriminate between the market power and information hypotheses, since the latter is predicated upon the importance of such lending relationships.

Second, we uncover and measure important heterogeneities in how bank competition affects credit availability across firms. In this sense, our paper is related to Ryan et al. (2014) who find important heterogeneity across firm size and opacity in the way bank competition affects SME financing constraints. Our results corroborate and expand their work by finding that weaker inter-bank competition worsens access to credit for opaque,small and illiquid firms. The finding that bank competition does not affect all firms and banks equally has potential consequence for competition policies aimed at maintaining a competitive banking environment and the provision of credit to firms, in particular to financially constrained firms and SMEs.

The rest of the paper is structured as follows. Section 2 discusses our database and details the derivation of the Lerner index as measure of bank market power. The identification strategy and the econometric model are also discussed. Results are presented in section 3, while section 4 concludes.

2 Empirical strategy

2.1 Matched firm-bank data

We combine bank data from Orbis Bank Focus with firm data from Amadeus Banker.[5] Restricting our research to the euro area, we extract annual information on 3.650 banks and 2.056.537 firms for the period 2010-2016. We then match banks to firms using the information on the identity of

[4]In constructing the database, we follow Dwenger et al. (2018), Popov and Rocholl (2018) and De Marco (2019) which use similar matched data from similar data sources to investigate the transmission of financial shocks from banks to customer firms.

[5]Orbis Bank Focus (previously Bankscope) contains information on over 40,000 public and private banks around the world, while Amadeus contains financial information on over 24 million public and private European companies. Both databases are compiled by Bureau Van Dijk, a Moody's Analytics company.

firms' reference banks contained in Amadeus Banker as in Dwenger et al. (2018) and De Marco (2019). Specifically, we perform a "fuzzy merge" using bank names and country location reported in each database.[6] Restricting the sample to banks for which the Lerner index could be estimated yields to a final database containing 335.656 bank-firm observations: 901 banks matched to 59.023 firms (i.e. 25% and 3% of the original samples, respectively) covering 11 euro area countries for the period 2010-2016.[7]

While we do not observe whether the firms hold deposits with and/or borrow from these banks, for the purpose of this paper, we consider a reference bank as the primary institution from which firms obtain most of short and long term credit (Ongena et al., 2015; Dwenger et al., 2018) and with which are likely to build lasting relationships in the sense of Petersen and Rajan (1994, 1995).[8] Activities related to the provision of credit and monitoring allow reference banks and firms to form ties through repeated interaction over time and across multiple financial products. For instance, firms typically hold checking and savings account at their reference bank, while in turn banks also provides support for IPOs. The deep and complex dimension of bank-firm relationships facilitates the storing of information and may increase the availability of funds to the firm (Petersen and Rajan, 1994, 1995).[9] Moreover, these relationships imply that banks and firms are interdependent: shocks affecting banks are likely to be reflected on customer firms, and vice versa (Chodorow-Reich, 2014; Amiti and Weinstein, 2011). In this respect, some evidence is reported in appendix B: firms' total bank borrowing is strongly correlated to loans and key balance sheet variables of their reference bank.

With respect to other comparable sources of firm-bank matched data, our database presents some advantages. As noted by Dwenger et al. (2018), financial accounts data include a large number of SMEs (99% of our sample). In contrast, other sources of firm-bank matched data are based on the syndicated loans market, which typically involves large loans made from large banks to large firms (Ivashina and Scharfstein, 2010; Chodorow-Reich, 2014; Acharya and Steffen, 2015). Alternatively, credit registry data do include small firms but are only available for individual countries (Jiménez et al., 2012, 2014; Andrade et al., 2018; De Jonghe et al., 2019; Degryse et al., 2019). To-date, a European-wide credit registry is not available. By using matched financial accounts data on European firms and banks we go beyond a specific limitation of alternative source by obtaining a cross-country panel that includes a very large number of SMEs which are likely to be most bank dependent and therefore to be affected by their banker's exercise of market power.

Our database presents however two important limitations. First, we only have information updated on 2016 on the relationship banks in Amadeus. In other words, bank-firm records are a snapshot of borrowers-lenders relationships at one point in time and are retroactively imputed for previous years. We note however that, using equivalently sourced data for Germany, Dwenger et al. (2018) are able to obtain the relationship bank information updated over time and show that in their sample relationship are very sticky: only 3% of sampled firms every swap a lender for

[6]The fuzzy merge is carried out using the Stata ado file reclink2 written by Micheal Blasnik which uses a bigram string comparator to calculate the fraction of consecutive character matches between two string variables (banker name). To ensure accuracy, we also perform a clerical review of all matches.

[7]Many observations are lost as the "banker name" variable was not available for Italy, Belgium, Finland, Slovakia and Luxembourg. Further observations on firm-bank pairs are lost since the Lerner index cannot be estimated for Greek, Estonian and Lithuanian banks. The remaining countries are Austria, Cyprus, France, Germany, Ireland, Latvia, Malta, Netherlands, Portugal, Slovenia and Spain).

[8]As noted by Dwenger et al. (2018), if our bank-firm matches reflect only partially true lending relationships, our estimates should be considered as lower bounds.

[9]For instance, by monitoring cash flows through its checking account the bank can learn about the firm's sales. In addition, the bank reaches cost efficiencies by spreading the fixed costs related to producing information over multiple products (Petersen and Rajan, 1995).

another, and less than 2% add or interrupt a relationship bank in any given year. Furthermore, the overwhelming majority of the firms in our sample are SMEs which are far more likely to rely on a single lender and to face significant switching costs to change banker (Cressy and Olofsson, 1997). Consistent with this view, only 9% of firms in our sample are related to more than one bank.[10] For these reasons, and because our sample period is relatively short (7 years), we regard as tenable the assumption that bank-firm relationships remain stable over our period of interest.

Second, we do not observe the amount lent by a relationship bank to a specific firm , but rather the total amount funds borrowed by a firm in any given year – potentially from different banks – and we have no information on the exact share lent by each bank. We therefore work under the assumption that the relationship bank provides the largest share of loans and that the total amount of funds borrowed effectively captures the intensive margin of the credit relationship. Available evidence also supports this assumption. For instance, Cressy and Olofsson (1997) note that the main sources of finance for European SMEs are retained earnings, trade credit and credit from a single bank, while Petersen and Rajan (1994) report that US SMEs obtain between 75% and 95% of their loans from their main bank. Considering the bank-based nature of Europe corporate finance and the relative scarcity of non-bank alternatives for SMEs, these figures are likely under-estimates in the European context. Furthermore, given that 91% of firms in our sample are related to a single bank, we believe this is a reasonable approximation. We also provide in-sample evidence showing that firms' bank credit is closely related to their reference bank's total loans (see appendix B).

2.2 Bank market power: the Lerner index

Studying the impact of bank market structure on firms' credit outcomes requires a measure of inter-bank competition. However, there is currently no consensus over the best indicator. Broadly speaking, competition metrics can be classified in two categories: structural and non-structural indicators. The former are theoretically rooted in the Structure-Conduct-Performance (SCP) view whereby bank concentration creates an environment that unfavourably affects bank conduct and performance: in other words, concentration is negatively associated with a bank's competitive conduct and favours profitability. Related empirical research commonly uses structural measures of concentration such as the Herfindahl-Hirschman-Index (HHI) or the n-firm concentration ratio to proxy for market power (Berger and Hannan, 1989, 1992).[11] Yet, recent empirical work cast doubts over the reliability of concentration as a proxy for bank competition (Bikker et al., 2012) and the contestability of the banking sector. In particular, Claessens and Laeven (2004), Schaeck and Cihák (2012) and Love and Martínez Pería (2015) argue that concentration measures market structure rather than market conduct. Furthermore, structural indicators were found to lack consistency and robustness (Berger and Udell, 1995; Rhoades, 1995; Jackson, 1997; Hannan, 1997). In the attempt to remedy these shortcomings, a second category of indicators related to new Industrial Organisation (IO) methods sought to measure competition directly rather than via proxies such as market shares and market structures. These indicators include the Lerner index and the H-statistic based on the Panzar-Rosse model (Panzar and Rosse, 1987).

The Lerner index measures a bank's ability to set its price above the marginal cost and provides a bank-specific measure of market power. By way of interpretation, a bank with Lerner index near zero has little market power, whereas a bank whose Lerner index is close to one is

[10] These firms are on average almost twice as large as single-bank firms: specifically, the average size of multi-bank firms is € 6.1 million while that of single-bank firms is € 3.8 million.

[11] The Hirschmann–Herfindahl index of concentration is the sum of the squares of the market shares (assets) of each bank in each country.

akin to a monopolist. The Lerner index presents multiple advantages over alternative metrics of competition. First, the Lerner index is the only bank level measure of market power in addition to the bank's market share (Beck et al., 2013). While the Lerner index is a proxy for current and future profits deriving from pricing power, market share also captures the implicit rents extracted from being too big to fail. As such, market share is subject to measurement error as a proxy for pricing power. Second, the Lerner index captures pricing power on both the asset and liability side of the bank's balance sheet, since it calculates the differences between profits on assets and costs of funding operations (Beck et al., 2013). Third, unlike the H-statistic, estimating the Lerner index does not require a banking system to be in long run equilibrium (Schaeck and Cihák, 2012). Fourth, unlike market concentration and market shares, the Lerner index does not depend on the definition of geographic product market (Aghion et al., 2005). This task is particularly complex for the banking industry given the extent of transnational operations.[12] As our main purpose is to examine the bank-firm level association between competition and access to credit, we follow recent literature (Maudos and de Guevara, 2007; Berger et al., 2009; Beck et al., 2013; Anginer et al., 2014; Fungáčová et al., 2014) and use the Lerner index as our main measure of competition. Given the estimates of a bank's price and marginal cost, the Lerner index is calculated as:

$$Lerner_{b,t} = \frac{P_{b,t} - MC_{b,t}}{P_{b,t}}$$

where P is proxied by total operating income over total assets. The marginal cost (MC) is derived from a translog function as explained in appendix A. We thus obtain a Lerner index for each bank and each year, and have a direct measure of bank market power for our main analysis. In table 1 we document that aggregate Lerner indices are meaningfully and statistically correlated with other standard measures of inter-bank competition and market structure.

Table 1: Pair-wise correlations between different measures of banking concentration and competition, p-values in parentheses.

	Lerner	Market share	HHI	CR5
Market share	0.2436			
	(0.0000)			
HHI	0.6012	0.7781		
	(0.0000)	(0.0000)		
CR5	0.6225	0.6647	0.9811	
	(0.0000)	(0.0000)	(0.0000)	
-(H-statistic)	0.7197	-0.6994	-0.1060	0.0746
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

[12] Admittedly, the estimation of the cost function requires choosing the scope of the market (Beck et al., 2013). We estimate the cost function by country but as robustness check we make sure that estimating a cost function at the euro area level does not alter our results.

Specifically, table 1 reports correlations between non-structural measures (the Hirschmann-Herfindahl index, the CR5 concentration ratio[13] and bank level market shares), the Panzar-Rosse H-statistic and the country average of the Lerner index previously estimated. All indicators are at the country-year level and are defined so that an increase in the metric corresponds to less competition (i.e. we take the negative of the H-statistic). The Lerner index is positively and significantly correlated to all other measures, which further corroborates our choice of using it as measure of inter-bank competition.

2.3 Identification and econometric model

Testing how bank competition affects credit availability runs into identification issues. Indeed, firms' credit conditions are usually affected by factors unrelated to the state of inter-bank competition. However, most of them – industry demand, factor endowments and prices, business cycle – can be thought of as common to all firms within an industry at a given moment in time. Additionally, as noted by Bonaccorsi di Patti and Dell'Ariccia (2004), firms within the same industry are likely to share a similar exposure to asymmetric information problems stemming from the technology prevailing in that particular sector.

Following Amiti and Weinstein (2011, 2013), we exploit the fact that some firms are linked to banks with higher market power than other firms within the same industry in the same year. Hence, we use industry-year fixed effects to sweep out all supply-and-demand shocks and information issues shared by all firms within an industry in a given year, thus identifying how a firm's credit availability is affected by the market power of its main lender. Specifically, we estimate the following model:

$$y_{f,i,t} = \alpha_{i,t} + Lerner_{b,t-1}(\beta_1 + \beta_2 F_{f,i,t-1}) + \gamma_1 F_{f,i,t-1} + \gamma_2 B_{b,t-1} + \gamma_3 Y_{f,b,t} + \varepsilon_{f,i,t} \quad (1)$$

where $y_{f,t}$ is a firm level outcome variable measuring access to credit, f indicates firms, b banks, i industries and t years. Specifically, as in De Marco (2019) we use 4-digits North American Industry Classificaion System (NAICS) codes to identify 280 industrial sectors. We then use four measures of credit availability: short and long-term bank credit, trade credit and cost of funding. The first two measures correspond to the amount of credit a firm receives by banks in any given year and is a direct indicator funds borrowed from financial intermediaries. However, measuring credit availability directly is problematic. Since bank credit is jointly determined by supply and demand, regressing firms' bank credit on bank market power may lead to simultaneity bias if bank market power affects both the supply of and demand for bank lending (Petersen and Rajan, 1994, 1995). However, since using industry-year fixed effects already absorbs all sector-specific cyclical demand for credit, this concern should be less severe in our set up.[14] Nonetheless, we use two additional proxies of credit conditions: trade credit and cost of funding. The idea for trade credit is as follows. In order to finance new investment, credit rationed firms will turn to more expensive sources of finance, whereas firms with access to bank credit are less likely to recur to more expensive sources. The credit borrowed from more expensive sources should then capture the extent to which firms are supply constrained by banks (Petersen and Rajan, 1994, 1995; Nilsen, 2002; Carbo-Valverde et al., 2007).[15]

[13] This reflects the market share of the largest five banks in each country.

[14] Simultaneity bias may apply only insofar credit demand at the firm level is systematically associated to its reference bank's market power, i.e. if firms associated to banks with high market power demand systematically more (or less) credit.

[15] Trade credit is a short-term loan a supplier provides to customers in concurrence with the sale of his products

Recent research cast doubts on the reliability of trade credit as proxy for financing constraint by emphasising the informational content of trade credit (Giannetti et al., 2011; Agostino and Trivieri, 2014). Specifically, trade credit may send a positive signal to banks on the creditworthiness of potential borrowers, in turn making banks less reluctant to lend. In this sense, rather than a substitute, trade credit may be seen as a complement to bank lending. However, since this signalling should be especially valuable for relatively uninformed banks that do not dispose of soft information on firms, we regard this specific concern to be less relevant in our analysis for it focuses on banks that are already in a lending relationship and are therefore unlikely to be uninformed.

We also construct a measure of firms' funding cost as a fourth proxy of firms credit conditions. Similarly to Fungáčová et al. (2014) and Carbo-Valverde et al. (2007), this is the ratio between a firm's financial expenses and total liabilities, and it is taken as a summary of firms' funding costs. As for trade credit, we would expect credit constrained firms to face higher borrowing costs.

The main dependent variable is the banks' Lerner index discussed in section 2.2. Vectors F and B contain, respectively, firm and bank level control variables. As in Beck et al. (2013) the Lerner index and all firm and bank level variables enter the model with a lag to mitigate endogeneity concerns related to reverse causality. Vector Y contains country level control variables such as real GDP growth, inflation and the sovereign yield spread.[16] The interaction term is designed to capture how the effect of bank market power on credit availability varies across firms. Finally, industry-year fixed effects ($\alpha_{i,t}$) are included to absorb all time-varying industry-specific shocks.

Model 1 allows testing the following theoretical predictions. First, for the information hypothesis, higher bank market power should increase the benefits of relationship lending and hence increase credit availability for all firms across the board. Accordingly, one would expect β_1 to be positive (negative) when $y_{f,t}$ is bank credit (trade credit or cost of funding). Second, for the information hypothesis, by increasing the incentive to engage in relationship lending, higher bank market power (i.e. an increase in the Lerner index) should increase credit availability especially for firms facing asymmetry information problems such as small, illiquid, unprofitable and opaque firms. The coefficient β_2 is then expected to be positive (negative) when $y_{f,t}$ is bank credit (trade credit or funding cost). Third, for the information hypothesis, firms whose reference bank has a comparative advantage or is specialised in relationship lending – e.g. small banks – should benefit relatively more of lower levels of inter-bank competition. Accordingly, the coefficient β_1 is expected to be more positive (negative) when $y_{f,t}$ is bank credit (trade credit or funding cost) when the estimating sample is restricted to firms borrowing from small banks.

(Nilsen, 2002) and it typically is an inferior substitute to bank loans for a number of reasons: first, unlike bank loans trade credit is intrinsically linked to the purchase of goods; second, while bank loans are long-term, trade credit is usually very short-term (30 days in the US according to Nilsen (2002)); third, given the supplier is not necessarily a financier, the customer faces significant late payment penalties (both explicitly pecuniary as well as implicit such as the cost of damaging a long-term relationship (Petersen and Rajan, 1994)). Therefore, while trade credit is available to most firms, they usually prefer bank loans given the former's unattractiveness. For instance, **?** calculates that foregoing trade credit early discount correspond to an annualised borrowing rate of 44.6%.In studying how bank market power affects credit availability by contrasting bank and trade credit, we also make the implicit assumption that the market power of suppliers providing trade credit is industry specific. This is supported by the observation that discount terms in trade credit contracts are typically set at the industry level (Dun and Breadstreet, 1970; **?**). Hence, as noted by Petersen and Rajan (1994), using industry dummies will also control for differences in terms and conditions for trade credit financing across industries.

[16]This variable measures the difference between the yield on a country's 10-year government bond and the yield on the 10-year German's Bund. As in (Albertazzi et al., 2014), this variable aims to capture cross-country divergence in funding conditions arising during the sovereign debt crisis.

3 Results

This section presents the main results. We first focus on the overall effect of bank market power on firms' access to credit and then look at how this relationship varies across firms and banks.

3.1 The effect of bank market power on firms' access to credit

Estimates on the overall impact of bank competition on firm's access to credit are reported in table 2. Specifically, we estimate model 1 with industry-year fixed effects and cluster standard errors at the bank level. We test here the first theoretical predictions outlined in section 2.3: for the information hypothesis, higher bank market power should be related to higher credit availability for customer firms. The test therefore rests on the sign and statistical significance of β_1.

In table 2 we report four different panels, each containing a different measure of firms' credit constraint. Across all specifications, results strongly reject the information hypothesis: Banks' Lerner index is negatively related to short- and long-term bank credit and positively related to trade credit and cost of funding. In other words, firms whose reference banks enjoy high market power tend to borrow less, draw more trade credit and face higher funding costs, consistent with the notion that market power has a negative effect on credit availability. Taken together, these findings suggest that firms served by banks with high market power are systematically more likely to faced tighter credit conditions. Moreover, the result is economically significant: For the full specification (column 3 of each panel), estimates indicate that a one standard deviation increase in banks' Lerner index (i.e. 0.16) is associated to a 20% decrease in both short- and long-term credit, to a 14% increase in trade credit and to a 8% increase in funding cost by customer firms.

These results hold across different specifications. For each panel, the second column adds add firm level variables in order to control for firm balance sheet characteristics that may explain some of the cross-firm variation in credit availability. First, the log of firm sales complements the log of firm total assets in capturing firm size and is included since a firm's financing patterns vary widely with size (Beck et al., 2008, 2013).[17] Second, firm cash flows and profitability (the ratio of profit before taxes over total assets) are added as observable measures of firm performance and quality (Carbo-Valverde et al., 2007). Third, firm default risk is defined as the ratio of operating profits to interest paid. As noted by Carbo-Valverde et al. (2007) this variable captures operating risk by showing how many times interest paid are covered by operating profits. Fourth, firm transparency is defined as the ratio of tangible fixed assets over total assets and measures the extent to which a firm can post tangible collateral to obtain external financing (Bonaccorsi di Patti and Dell'Ariccia, 2004; Freixas and Rochet, 2008; Fungáčová et al., 2014). Similarly, in the third column of each panel we add bank-level variables to capture bank balance sheet characteristics that are traditionally considered as determinants of credit supply. First, bank credit risk is defined as non-performing loans over total loans and control for the (ex-post) quality of banks' loan portfolios (Carbo-Valverde et al., 2007). Second, bank profitability, measured by return on assets, stands to capture any linkage between bank performance and credit supply (Carbo-Valverde et al., 2007). Third, bank risk is measured by the log of the Z-score (Beck et al., 2013) and measures distance from insolvency (Roy, 1952). In the fourth column of each panel, we re-estimate the model using a Lerner index calculated from a euro area level cost function (rather than country by country) as discussed in section 2.2.

[17] For instance, large firms may benefit from internal capital market and thus face minor financial constraint (Carbo-Valverde et al., 2007).

Table 2: The effect of market power on firms' credit availability

	Panel I				Panel II				Panel III				Panel IV			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Dep. variable	ln (Short-term loans)$_{f,t}$				ln (Long-term loans)$_{f,t}$				ln (Trade Credit)$_{f,t}$				Cost of funding $_{f,t}$			
Lerner$_{b,t-1}$	-1.707***	-1.011***	-1.262***	-0.852*	-2.168***	-1.568***	-1.310***	-0.757**	0.289*	0.757***	0.877***	0.622***	0.576***	0.538***	0.552***	0.437***
	(0.255)	(0.304)	(0.407)	(0.485)	(0.293)	(0.295)	(0.422)	(0.339)	(0.158)	(0.115)	(0.159)	(0.170)	(0.115)	(0.110)	(0.118)	(0.136)
ln(total assets)$_{f,t-1}$	1.021***	0.799***	0.802***	0.802***	0.956***	0.948***	0.946***	0.942***	0.948***	0.380***	0.382***	0.382***	0.00494	0.0155	0.0158	0.0151
	(0.0288)	(0.0630)	(0.0627)	(0.0625)	(0.0291)	(0.0556)	(0.0554)	(0.0555)	(0.0181)	(0.0423)	(0.0419)	(0.0417)	(0.00937)	(0.0151)	(0.0148)	(0.0152)
ln(Sales)$_{f,t-1}$		0.285***	0.287***	0.304***		-0.0549	-0.0591	-0.0402		0.724***	0.729***	0.717***		0.0314	0.0318	0.0248
		(0.0716)	(0.0705)	(0.0697)		(0.0531)	(0.0525)	(0.0526)		(0.0604)	(0.0612)	(0.0587)		(0.0199)	(0.0198)	(0.0187)
ln(Cash flow)$_{f,t-1}$		-0.0229	-0.0243	-0.0249		0.0370	0.0365	0.0381		-0.0495	-0.0493	-0.0503		-0.0382**	-0.0380**	-0.0382**
		(0.0516)	(0.0517)	(0.0518)		(0.0298)	(0.0296)	(0.0305)		(0.0406)	(0.0405)	(0.0408)		(0.0168)	(0.0167)	(0.0173)
Profit margin$_{f,t-1}$		-1.008**	-0.994**	-1.001**		-0.369	-0.385	-0.418		-1.397***	-1.385***	-1.364***		0.289	0.288	0.299
		(0.476)	(0.481)	(0.470)		(0.292)	(0.285)	(0.298)		(0.352)	(0.353)	(0.352)		(0.352)	(0.351)	(0.355)
Default risk$_{f,t-1}$		-0.394***	-0.394***	-0.398***		-0.226***	-0.227***	-0.232***		-0.0263**	-0.0269**	-0.0259**		-0.0448***	-0.0450***	-0.0441***
		(0.0520)	(0.0519)	(0.0517)		(0.0489)	(0.0491)	(0.0493)		(0.0112)	(0.0113)	(0.0112)		(0.0102)	(0.0101)	(0.0102)
Transparency$_{f,t-1}$		0.969***	0.990***	1.047***		2.114***	2.075***	2.131***		-0.477***	-0.460***	-0.492***		-0.252***	-0.251***	-0.272***
		(0.246)	(0.251)	(0.255)		(0.284)	(0.278)	(0.278)		(0.125)	(0.122)	(0.125)		(0.0371)	(0.0383)	(0.0402)
ln(total assets)$_{b,t-1}$			0.0239	-0.0658			0.00296	-0.0847*			-0.0547**	0.00704			0.00462	0.0407
			(0.0513)	(0.0571)			(0.0464)	(0.0468)			(0.0218)	(0.0220)			(0.0182)	(0.0269)
RoA$_{b,t-1}$			6.360	-0.571			-3.985	-11.31***			-1.587	1.768			-2.489	-0.194
			(7.479)	(6.674)			(6.260)	(4.074)			(3.069)	(2.041)			(2.371)	(1.525)
ln(Z score)$_{b,t-1}$			0.897	0.441			-0.925	-1.256			1.664**	2.046**			-0.459	-0.220
			(1.547)	(1.493)			(0.970)	(1.037)			(0.803)	(0.867)			(0.281)	(0.305)
NPL ratio$_{b,t-1}$			0.641	0.141			-3.249**	-4.158***			0.739	1.277			0.899	1.158
			(2.182)	(2.266)			(1.527)	(1.559)			(0.941)	(0.913)			(0.766)	(0.792)
Inflation$_{fb,t}$	0.0989	0.206***	0.211***	0.240***	0.262***	0.288***	0.249***	0.283***	0.0380	0.132***	0.148***	0.126***	-0.129***	-0.116***	-0.113***	-0.128***
	(0.0687)	(0.0691)	(0.0686)	(0.0658)	(0.0927)	(0.0839)	(0.0753)	(0.0855)	(0.0319)	(0.0422)	(0.0426)	(0.0454)	(0.0404)	(0.0388)	(0.0400)	(0.0445)
Real GDP growth$_{fb,t}$	45.60***	38.84***	38.13***	50.83***	23.31***	14.59**	15.92***	30.33***	-30.59***	-25.90***	-25.00***	-34.07***	4.752	5.589*	5.638**	-0.162
	(6.973)	(6.483)	(6.350)	(7.877)	(8.900)	(6.641)	(6.087)	(8.457)	(3.845)	(4.991)	(4.416)	(5.923)	(3.140)	(2.951)	(2.815)	(3.538)
Sovereign spread$_{fb,t}$	32.90***	48.25***	46.69***	58.55***	22.87***	22.65***	22.86***	35.01***	-2.277	31.68***	33.31***	24.70***	-0.467	-0.183	-0.240	-5.158**
	(6.111)	(6.249)	(6.252)	(5.730)	(5.104)	(5.412)	(6.566)	(5.189)	(3.336)	(4.657)	(4.468)	(4.615)	(1.618)	(1.840)	(2.097)	(2.500)
Industry×Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	5,772	5,772	5,772	5,772	5,615	5,615	5,615	5,615	7,087	7,087	7,087	7,087	6,214	6,214	6,214	6,214
R-squared	0.467	0.503	0.504	0.503	0.589	0.629	0.630	0.628	0.614	0.717	0.718	0.717	0.097	0.105	0.106	0.104

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.2 The effect of bank market power across firms

In this section we investigate how bank market power affects financial constraint across firms to test the second theoretical predictions outlined in section 2.3. For the information hypothesis we would expect financially constrained firms – small, unprofitable, illiquid and opaque – linked to banks with higher market power to enjoy better access to credit relative to large, high quality and transparent firms. This test therefore hinges on estimates of β_2 as modelled in 1. Estimates are reported in table 3. As before, we report four different panels, each containing a different measure of firms' credit constraint.

First, we look at differential effects of bank competition for small and medium-sized enterprises (SMEs).[18] In table table 3, the interaction term in the first column of each panel indicate that SMEs serviced by banks with higher bank market obtain less short- and long-term bank credit, increase trade credit by less than larger firms, but do not face higher funding costs than larger firms. Specifically, the reduction in short and long-term bank credit associated with a one standard deviation increase in banks' Lerner is, respectively, 15% and 12% larger for SMEs. We interpret this findings as suggestive that higher bank market power leads to more severe credit rationing for small firms, which in turn find it more difficult to fully offset the reduction in bank credit with trade credit. This evidence is consistent with **?** and the well-established notion that small firms are more bank-dependent and more vulnerable to information problems than large firms. Indeed, information asymmetries are thought to be stronger for small firms due to their restricted credit history, short track record and lower ability to provide collateral. Conversely, large firms may benefit from internal capital market and may face less financing constraints (Carbo-Valverde et al., 2007; Andrieu et al., 2018).

Second, according to the information hypothesis, banks should lend more to lower quality firms in more concentrated markets. Again, we find evidence against this theoretical prediction. Estimates in columns 2,3 and 4 in each panel broadly indicate that firms with high cash flows buffer the negative effect of higher bank market power: on average, these recur less to trade credit, have a lower reduction in both short and long-term credit, but do not face systematically higher funding costs. Similarly, for a given level of bank market power, high profit firms recur to less trade credit but their bank credit is no less restricted than other firms, nor do they face higher borrowing costs.

[18] This is based on the definition of Small and Medium Enterprises by the European Union. A firm is considered a SME if it has (i) 250 or less employees or (ii) operating revenue in excess of EUR 50 million and total assets in excess of EUR 43 million.

Table 3: Effect of market power on firms' credit availability across firms

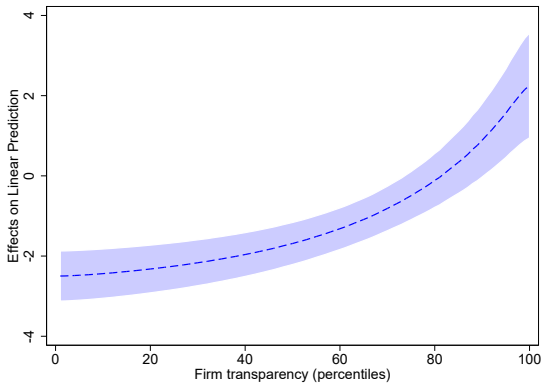
	Panel I				Panel II				Panel III				Panel IV			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Dep. variable	ln (Short-term loans)$_{f,t}$				ln (Long-term loans)$_{f,t}$				ln (Trade Credit)$_{f,t}$				Cost of funding $_{f,t}$			
Lerner$_{b,t-1}$	-0.481	-1.232***	-1.377***	-2.537***	-1.130***	-1.588***	-1.846***	-2.379***	1.227***	0.226	0.466***	0.698***	0.397**	0.453***	0.387***	0.599***
	(0.409)	(0.294)	(0.324)	(0.319)	(0.390)	(0.290)	(0.271)	(0.294)	(0.206)	(0.153)	(0.154)	(0.189)	(0.172)	(0.113)	(0.0616)	(0.126)
Lerner$_{b,t-1}$ ×SME$_f$	-0.959**				-0.726**				-0.930***				0.0543			
	(0.377)				(0.351)				(0.175)				(0.121)			
Lerner$_{b,t-1}$ × ln(cash flow)$_{f,t-1}$		0.141*				0.192**				-0.120**				0.00558		
		(0.0838)				(0.0918)				(0.0525)				(0.0289)		
Lerner$_{b,t-1}$ ×Profit margin$_{f,t-1}$			-0.0974				0.819				-2.258**				1.204	
			(2.024)				(1.279)				(1.112)				(1.174)	
Lerner$_{b,t-1}$ × Transparency$_{f,t-1}$				4.961***				2.368***				-1.565***				-0.684***
				(0.817)				(0.618)				(0.405)				(0.210)
ln(total assets)$_{f,t-1}$	0.981***	0.990***	0.995***	0.988***	0.873***	0.876***	0.883***	0.881***	0.722***	0.739***	0.736***	0.736***	0.0359***	0.0348***	0.0346***	0.0358***
	(0.0527)	(0.0509)	(0.0512)	(0.0509)	(0.0450)	(0.0464)	(0.0443)	(0.0443)	(0.0357)	(0.0343)	(0.0351)	(0.0349)	(0.0116)	(0.0114)	(0.0119)	(0.0121)
× ln(cash flow)$_{f,t-1}$	0.0405	-0.000758	0.0531	0.0529	0.0260	-0.0312	0.0369	0.0368	0.213***	0.272***	0.226***	0.227***	-0.0210*	-0.0238	-0.0216**	-0.0218**
	(0.0457)	(0.0572)	(0.0458)	(0.0457)	(0.0325)	(0.0487)	(0.0351)	(0.0352)	(0.0305)	(0.0414)	(0.0311)	(0.0310)	(0.0109)	(0.0180)	(0.0103)	(0.0101)
×Profit margin$_{f,t-1}$	-0.995**	-1.051**	-1.001	-1.067***	-0.217	-0.305	-0.584	-0.246	-3.219***	-3.260***	-2.375***	-3.276***	0.0631	0.0654	-0.405	0.0660
	(0.406)	(0.408)	(0.945)	(0.394)	(0.296)	(0.302)	(0.641)	(0.300)	(0.301)	(0.297)	(0.580)	(0.299)	(0.181)	(0.173)	(0.365)	(0.174)
×Default risk$_{f,t-1}$	-0.418***	-0.422***	-0.419***	-0.402***	-0.210***	-0.214***	-0.210***	-0.203***	-0.0418***	-0.0411***	-0.0408***	-0.0470***	-0.0433***	-0.0435***	-0.0450***	-0.0449***
	(0.0508)	(0.0510)	(0.0505)	(0.0495)	(0.0415)	(0.0424)	(0.0417)	(0.0409)	(0.0134)	(0.0136)	(0.0129)	(0.0135)	(0.00834)	(0.00869)	(0.00890)	(0.00868)
× Transparency$_{f,t-1}$	0.953***	0.939***	0.941***	-0.883**	2.053***	2.044***	2.045***	1.192***	-0.997***	-1.006***	-1.011***	-0.436*	-0.237***	-0.236***	-0.234***	0.0103
	(0.231)	(0.232)	(0.229)	(0.370)	(0.195)	(0.197)	(0.196)	(0.329)	(0.145)	(0.146)	(0.147)	(0.222)	(0.0458)	(0.0464)	(0.0461)	(0.0737)
Real GDP growth$_{bf,t}$	18.67*	19.05*	19.44*	14.01	8.899	8.854	9.544	7.051	-20.65***	-19.70***	-19.84***	-18.54***	4.866	4.797	4.718	5.520*
	(10.29)	(10.37)	(10.29)	(10.21)	(6.699)	(6.765)	(6.767)	(6.708)	(4.619)	(4.639)	(4.602)	(4.666)	(2.973)	(2.994)	(3.011)	(2.934)
Inflation$_{bf,t}$	44.79***	45.94***	45.88***	42.25***	38.28***	38.85***	38.49***	37.14***	5.279	6.124	6.183	7.381	-8.751**	-8.793***	-8.635***	-8.241**
	(10.24)	(10.37)	(10.24)	(10.04)	(8.196)	(8.525)	(8.246)	(8.234)	(5.145)	(5.289)	(5.184)	(5.144)	(3.376)	(3.358)	(3.320)	(3.340)
Sovereign spread$_{fb,t}$	39.25***	38.29***	40.11***	35.38***	20.09***	18.95***	20.54***	18.78***	7.799***	10.17***	8.882***	9.991***	-1.560	-1.670	-1.711	-1.118
	(5.712)	(6.063)	(5.959)	(5.657)	(4.290)	(4.272)	(4.339)	(4.258)	(2.700)	(2.749)	(2.673)	(2.771)	(1.552)	(1.624)	(1.560)	(1.562)
Industry×Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	6,913	6,913	6,913	6,913	6,761	6,761	6,761	6,761	8,466	8,466	8,466	8,466	7,683	7,683	7,683	7,683
R-squared	0.516	0.516	0.515	0.521	0.642	0.642	0.641	0.643	0.635	0.634	0.634	0.635	0.105	0.105	0.106	0.106

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

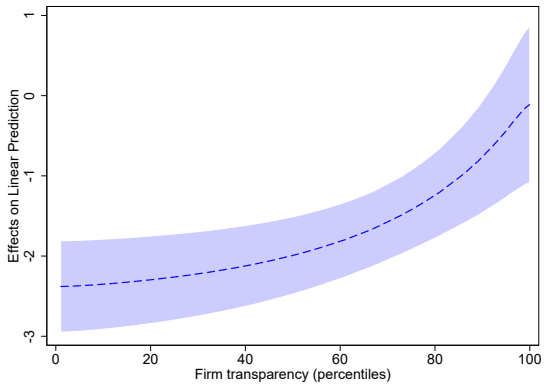
Figure 1: The heterogeneous effect of bank market power across firms

Estimated marginal effect of banks' lerner index on firms' credit availability as a function of firms' transparency, based on estimates reported in table 3.

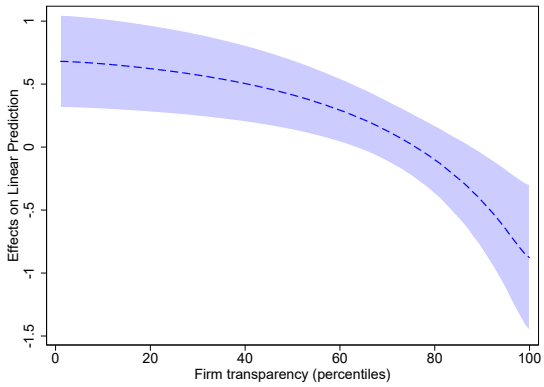
(a) Short-term loans



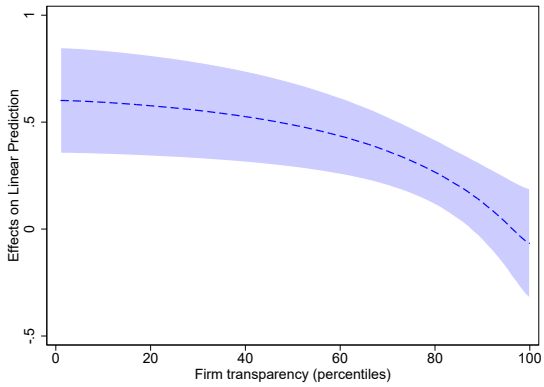
(b) Long-term loans



(c) Trade credit



(d) Cost of funding



Third, under the information hypothesis opaque firms should benefit of higher credit availability when serviced by banks with higher market power. Findings presented in column 4 of each panel strongly reject this hypothesis. Not only the adverse impact of market power on both bank and trade credit borrowed abates with firm's transparency, but the effect is reversed for short-term and trade credit for highly transparent firms. This strong heterogeneous effect is particularly evident by looking at figure 1. For instance, a one standard deviation increase in banks' Lerner is associated to a 40% decrease in short-term bank credit for a opaque firm (bottom decile) as opposed to a 16% *increase* in bank credit for a highly transparent firm (top decile). These results suggest that more opaque firms are more negatively affected by credit rationing, since information issues are more severe for borrowers that can post only limited physical collateral as guarantee for their borrowing (Freixas and Rochet, 2008; Bonaccorsi di Patti and Dell'Ariccia, 2004).

Overall, these results reject the information hypothesis in favour of the market power hypothesis. Indeed, higher bank market power is especially detrimental for credit availability precisely where the information hypothesis predicts it should be most beneficial: among firms related to banks with high market power, opaque firms receive less short and long-term bank credit, draw more trade credit and face higher funding costs. Conversely, high bank market power appear to

matter less for the credit availability of higher quality firms that are least exposed to information asymmetries.

3.3 The effect of bank market power across banks

Finally, we test for heterogeneity in the impact of bank market power on firms' financial constraint across banks. While we found no evidence supporting the information hypothesis either directly nor across firms, we can use variation across banks to uncover evidence on the way inter-bank competition affects credit availability. In particular, in this section we test the third theoretical predictions outlined in section 2.3: For the information hypothesis, among banks with high market power we would expect small and cooperative banks to grant better access to credit owing to their greater interest in sustaining long-term credit relationships.

Firms borrowing from small banks with high market power may obtain better credit conditions. According to Berger and Udell (2002) and Stein (2002), small banks may have a comparative advantage vis-à-vis large banks in relationship lending due to their simple organisational structure that is more congenial to the gathering of soft information. The idea is that relationship lending requires the gathering of soft information on borrowers as opposed to transaction lending that only requires hard information. In this activity, the size and organisational complexity of a bank is likely to matter. For smallest banks, the agency problem between management and loan officers – the latter being the likely depositary of the most valuable soft information on borrowers - is typically resolved with the president of the bank making or reviewing most of the business loans. In contrast, larger and more complex banks usually require more layers of management that may hinder the production of information-driven small business loans as opposed to their core business, i.e. transaction-driven loans and other capital market services for large firms. Furthermore, large, hierarchical firms may also be at a disadvantage in conveying the kind of soft information associated with relationship lending. A second argument relies on the observation that small banks are predominantly relationship lenders, while larger banks are predominantly transactional lenders. As noted by Boot and Thakor (2000), low inter-bank competition increases banks' marginal rents from relationship lending, thus encouraging investment in relationship-specific investments. This can be seen as a particular application of the general principle that low competition increases relationship-specific investment (Harris and Holmstrom, 1982). Therefore, for the information hypothesis one would expect that firms associated to smaller banks with larger market power benefit of larger credit availability given their banker's strong incentives to engage in relationship lending and exploit its comparative advantage vis-à-vis larger intermediaries.

Estimates reported in table 4 provide some evidence supporting this hypothesis. We report four different panels, each containing a different measure of firms' credit constraint, and estimate model 1 by splitting the sample in four buckets corresponding to four quartiles of bank distribution. We choose this procedure, instead of using interaction terms since double interactions between two bank level variables (*Lerner* $\times$ *bank size*) generate high collinearity among covariates. Findings indicate that the negative relation bank market power and short and long-term borrowing is stronger (more negative) for firms borrowing from larger banks. The magnitude of this effect is economically sizeable: on average a one-standard-deviation increase in bank market power (i.e. 0.16) is associated to a 52% (42%) reduction in short-(long) term credit for firms borrowing from large banks (4^{th} quartile), while the effects are undistinguishable from zero for firms borrowing from smaller banks (1^{st} quartile). On the other hand, the results in panels 3 and 4 indicate that the positive relation between bank market power and firms' trade credit and funding cost remains broadly similar for firms borrowing from banks of different sizes.

Table 4: Effect of market power on firms' credit availability across bank size

	Panel I				Panel II				Panel III				Panel IV			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Dep. variable	ln (Short-term loans)$_{f,t}$				ln (Long-term loans)$_{f,t}$				ln (Trade Credit)$_{f,t}$				Cost of funding $_{f,t}$			
Quartiles of bank size	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Lerner$_{b,t-1}$	0.280	0.478	-0.712**	-3.279***	0.0431	-0.256	-1.820***	-2.595***	0.407	1.320***	1.001***	0.806**	0.619*	0.414**	0.430***	0.626***
	(1.016)	(1.126)	(0.325)	(0.459)	(0.920)	(0.543)	(0.431)	(0.688)	(0.617)	(0.371)	(0.203)	(0.321)	(0.368)	(0.179)	(0.0707)	(0.181)
ln(total assets)$_{f,t-1}$	0.762**	0.760***	0.828***	0.746***	0.654***	0.912***	0.912***	0.945***	0.301	0.250***	0.424***	0.294***	0.0879	-0.0542	0.00942	-0.0176
	(0.349)	(0.191)	(0.0876)	(0.0746)	(0.237)	(0.144)	(0.0843)	(0.111)	(0.219)	(0.0718)	(0.0491)	(0.0883)	(0.114)	(0.0732)	(0.0189)	(0.0283)
ln(Sales)$_{f,t-1}$	0.112	0.0877	0.328***	0.292**	0.157	-0.0668	-0.0644	-0.0204	0.539***	0.974***	0.750***	0.689***	-0.107	0.0142	0.0349	0.0598*
	(0.153)	(0.216)	(0.0799)	(0.132)	(0.185)	(0.147)	(0.0461)	(0.107)	(0.155)	(0.0856)	(0.0353)	(0.126)	(0.171)	(0.0406)	(0.0223)	(0.0320)
ln(Cash flow)$_{f,t-1}$	0.249	0.120	-0.0963	0.0134	0.180	-0.0134	0.0444	0.00233	0.170*	-0.0581	-0.121***	0.0256	0.0229	-0.00527	-0.0330**	-0.0260
	(0.223)	(0.225)	(0.0577)	(0.0624)	(0.155)	(0.103)	(0.0558)	(0.0242)	(0.0876)	(0.0505)	(0.0305)	(0.0518)	(0.0826)	(0.0266)	(0.0149)	(0.0254)
Profit margin$_{f,t-1}$	-4.606***	-1.132	-1.669***	-1.108	0.406	-0.0614	-0.391	-0.460	-3.785**	-0.675	-0.968**	-1.632***	-0.842	-0.564	0.0861	0.559
	(1.636)	(1.392)	(0.602)	(0.833)	(1.258)	(1.326)	(0.540)	(0.335)	(1.557)	(0.906)	(0.456)	(0.463)	(0.572)	(0.674)	(0.115)	(0.657)
Default risk$_{f,t-1}$	-0.346	-0.363***	-0.548***	-0.264***	-0.0917	-0.193**	-0.303***	-0.127**	0.00679	-0.0691	-0.0216**	-0.00289	-0.0418	-0.0478***	-0.0340***	-0.0531**
	(0.289)	(0.0845)	(0.0639)	(0.0437)	(0.0899)	(0.0773)	(0.109)	(0.0436)	(0.0737)	(0.0623)	(0.00929)	(0.0168)	(0.0468)	(0.0129)	(0.00987)	(0.0199)
Transparency$_{f,t-1}$	1.687***	3.052***	0.881***	0.668**	1.643***	2.800***	2.079***	1.817***	-0.369	0.206	-0.522***	-0.263	-0.212	-0.391**	-0.224***	-0.244***
	(0.541)	(0.836)	(0.295)	(0.259)	(0.461)	(0.552)	(0.360)	(0.409)	(0.460)	(0.297)	(0.171)	(0.177)	(0.147)	(0.194)	(0.0637)	(0.0472)
Inflation$_{fb,t}$	92.70**	161.9	30.64***	79.20***	70.44*	-426.1**	32.16***	53.49***	2.154	30.01	18.52***	-6.627	-19.59**	11.29	-12.05**	-15.29**
	(44.96)	(97.51)	(7.578)	(13.90)	(38.97)	(184.8)	(10.38)	(11.64)	(31.93)	(28.48)	(6.066)	(5.884)	(8.628)	(19.17)	(5.233)	(5.782)
Real GDP growth$_{fb,t}$	51.54	49.95	33.57***	-65.01***	61.87	16.45	0.547	-19.19	-36.07	-45.15**	-16.48**	-8.489	2.704	6.888	8.018**	3.471
	(39.31)	(35.52)	(6.389)	(20.76)	(40.02)	(15.26)	(9.326)	(16.00)	(28.75)	(20.87)	(6.423)	(6.646)	(8.985)	(6.625)	(3.213)	(6.381)
Sovereign spread$_{fb,t}$	46.40*	133.3*	50.93***	36.56***	36.09	-315.4***	24.81***	4.198	38.83***	63.59**	39.23***	26.15***	-11.65	24.89*	-0.533	-0.911
	(25.86)	(69.21)	(7.953)	(7.491)	(26.71)	(115.4)	(8.547)	(11.66)	(9.103)	(28.42)	(3.916)	(7.304)	(7.757)	(13.83)	(2.487)	(3.802)
Industry × Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	404	586	3,192	2,270	366	637	3,115	2,262	509	730	3,951	2,837	492	741	3,422	2,530
R-squared	0.658	0.611	0.544	0.560	0.670	0.739	0.611	0.714	0.756	0.816	0.706	0.726	0.398	0.208	0.157	0.178

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These results are broadly consistent with the *information hypothesis*: insofar low competition fosters the establishment of bank-lender relationships, and that small banks have a comparative advantage in relationship lending, our results indicate that firms borrowing from large banks with high market power experience have worse credit availability than firms borrowing from small banks with high market power. In this sense our results are in line with Berger et al. (2005, 2017) and Berger and Black (2011).

4 Conclusion

In this paper we investigated how inter-bank competition affects firms' credit availability using a firm-bank matched database to test for the information and market power hypotheses. The former holds that lower competition encourages banks to establish long-term relationships with firms, thus improving credit availability; the latter expects bank market power to worsen credit conditions for borrowers owing to misallocations and distortions generally associated with the lack of competition.

Results reject the information hypothesis in favour of the market power hypothesis. Lower inter-bank competition is associated to lower, not higher, credit availability and higher borrowing costs for customer firms. Furthermore, the fact that quantity and price of bank credit (borrowing and funding costs/trade credit) move in opposite directions suggests that firms linked to banks with high market power are more credit constrained and more likely to turn to alternative more expensive sources of finance than firms linked to banks with low market power.

Looking at the cross-section of firms, we find the effect of bank market power on credit availability to be especially detrimental precisely where the information hypothesis predicts it should be most beneficial: For a given level of bank market power, opaque firms receive less short and long-term credit, draw more trade credit and face higher funding costs than transparent firms. Conversely, we find only limited evidence supporting the information hypothesis in the cross-section of banks. For a given level of bank market power, firms related to larger banks obtain less short and long-term bank credit than firms serviced by larger commercial lenders, but bank size does not seem to matter in terms of trade credit and funding costs.

Overall, we consider our results to be mainly consistent with the market power hypothesis, whereby lower inter-bank competition exacerbates the financial constraint of borrowers most exposed to information problems. However, our findings do not exclude that low inter-bank competition may benefit credit availability by encouraging credit relationships established between small banks and small firms who have a particular interest in forming long-term ties.

These findings have direct implications for policy. The current impetus towards cross-country banking consolidation in the EU has the potential to significantly increase the market power of individual banking groups and to lower the level of competition in the banking sector. While policy makers have so far generally welcomed and encouraged these activities, our results suggests that efficiency and financial stability considerations should be weighed against the potential negative consequences for firms' access to credit, especially for small and medium enterprises.

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Appendix A Estimating the Lerner index

The Lerner index is defined as the ratio of the difference between price of output and marginal cost to the price. The price of output is the average price of bank output computed as the ratio of total income to total assets. The marginal cost is obtained by estimating a translogarithmic cost function with one output (total asset), and three proxies for input prices (labour, borrowing and capital). As in Demirguc-Kunt and Peria (2010), we estimate the following model:

$$\ln(TC)_{bt} = \alpha_0 + \alpha_1 y_{bt} + \frac{1}{2}\alpha_2(\ln y_{bt})^2 + \sum_{j=1}^{3}\beta_j \ln w_{bt,j} + \sum_{j=1}^{3}\sum_{k=1}^{3}\beta_{jk}\ln w_{bt,j} \times \ln w_{bt,k}$$
$$+ \frac{1}{2}\sum_{j=1}^{3}\gamma_j \ln w_{bt,j} \times \ln y_{bt} + Trend_t(\delta_1 + \delta_2 Trend_t + \delta_3 \ln y_{bt} + \sum_{j=1}^{3}\delta_4 \ln w_{bt,j}) + \epsilon_{b,t} \quad (2)$$

where b stands for banks and t for years. In model (1), TC denotes total costs (sum of total interest paid and operating costs), y total banking assets, w_1 labour price (staff expenses divided by total assets), w_2 the price of physical capital (non-interest expenses divided by total assets) and w_3 the price of borrowed funds (total interest paid divided by customer and short term funding).[19] Model (2) is estimated on a sample of 3650 euro area banks extracted from Orbis Bank Focus covering the period 2010-2016. The estimation is carried out country by country with bank-fixed effects. The estimated coefficients are employed to derive the marginal cost (MC):

$$\widehat{MC_{b,t}} = \frac{TC_{b,t}}{y_{b,t}}\left(\hat{\alpha_1} + \hat{\alpha_2}\ln y_{b,t} + \frac{1}{2}\sum_{j=1}^{3}\hat{\gamma_j}\ln w_{b,t,j} + \hat{\delta_3} Trend_t\right)$$

Finally, the bank-specific Lerner index is obtained as:

$$Lerner_{b,t} = \frac{P_{b,t} - \widehat{MC_{b,t}}}{P_{b,t}}$$

[19] To minimise the incidence of outliers, all variables are winsorised at the 1st and 99th percentiles.

Appendix B On the relation between firms and main banks

Bank credit obtained by firms may be an invalid proxy for the unobserved share of borrowing from the main banks. To test for its validity we first aggregate firm bank credit across firms for each bank, so to create a bank level variable that collects all bank borrowing by firms connected to that bank. While this is measure is spurious as banks (firms) likely lend (borrow) to other firms (from other banks) unreported in our database, unconditional correlations between bank and firm variables are high: the aggregate borrowing of firms moves closely to the total lending, total assets, leverage and non-performing loans (NPL) of the bank reported as their main lender (first column of table 5. This suggests there are indeed interdependencies between borrowers and lenders that may reflect credit relations.

Table 5: Pair-wise correlations between aggregate firm bank borrowing and banks' balance sheet variables, p-values in parentheses.

	ln sum of firm borrowing by bank	ln bank loans	ln bank total assets	bank equity /total assets
ln bank loans	0.3887			
	(0.0000)			
ln bank total assets	0.3543	0.9877		
	(0.0000)	(0.0000)		
Equity/total assets	0.314	-0.3083	-0.3252	
	(0.0000)	(0.0000)	(0.0000)	
ln bank NPL	0.192	0.8185	0.8014	-0.1482
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Still, it may be that firm aggregate borrowing and bank total lending co-move due to common cyclical trends. To check for that, we regress firm total borrowing on bank total lending conditional on several macroeconomic indicators. Estimates are reported in table 6. Conditional analysis confirms that firm aggregate borrowing by bank is correlated with bank total loans even when controlling for cyclical factors. Elasticities coefficients are positive and significant. For instance, 1% increase in bank loans is associated to a 77.5% increase in aggregate firm borrowing.

Table 6: Relation between aggregate firm borrowing and banks' balance sheets

	(1)	(2)	(3)	(4)
Variables	ln(sum of firm borrowing by bank)$_{b,t}$			
ln(Loans)$_{b,t}$	77.53***			
	(0.711)			
ln(Total assets)$_{b,t}$		59.65***		
		(0.778)		
Equity/assets$_{b,t}$			1,530***	
			(12.98)	
ln(NPL$_{b,t}$				69.90***
				(-1.013)
Real GDP growth$_{b,t}$	-13,307***	-55,917***	-55,527***	-59,691***
	(180.3)	(196.7)	(191.6)	(213.3)
Inflation$_{b,t}$	163.4***	56.44***	8.177***	47.52***
	-3.195	(-3.130)	(-2.960)	(-3.430)
Spread$_{b,t}$	-15,372***	-39,649***	-44,189***	-42,698***
	(106.4)	(116.0)	(108.5)	(125.1)
Observations	278,439	171,53	171,516	145,507
R-squared	0.182	0.568	0.587	0.523
Year FE	Yes	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix C Estimating the H-statistic

A large number of studies measured bank competition with the H-statistic (Panzar and Rosse, 1987), which captures the elasticity of banks revenues relative to input prices. The H-statistic takes values between 0 and 1. By way of interpretation, when the H-statistic takes the value of 1, the market is under perfect competition, when it takes the value of 0 the market is under a monopoly and between 0 and 1 the system operates under monopolistic competition. Indeed, under perfect competition, an increase in input prices raises both marginal costs and total revenues by the same amount, and hence the H-statistic equals 1. Under a monopoly, an increase in input prices results in a rise in marginal costs, a fall in output, and a decline in revenues, leading to a H-statistic less than or equal to 0. Following Demirguc-Kunt and Peria (2010) we estimate the following model:

$$\ln P_{b,t} = \alpha_i + \beta_1 \ln w_{1,b,t} + \beta_2 \ln w_{2,b,t} + \beta_3 \ln w_{3,b,t} + \ln w_{i,b,k} + y \ln Z_{b,t} + \delta D_t + \varepsilon_{b,t}$$

where b denote banks and t denotes years. As for the Lerner index, w_1 w_2 and w_3 denote the input prices of deposits, labour and capital, respectively. Z is a matrix of controls that includes the ratio of equity over total assets, net loans over total assets and the natural logarithm of total assets. D is a vector of year dummies and α_1 denotes bank fixed effects.

The H-statistic is then calculated as $H = \hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3$.

Appendix D Descriptive statistics

	(1) Obs.	(2) Mean	(3) Sd	(4) Min	(5) Max
Bank variables					
Lerner[1]	130,867	0.328	0.158	-0.655	0.842
Lerner[2]	171,100	0.304	0.127	-0.679	0.794
Total assets (€ million)	173,620	12,186	27,393	13	148,647
Return on Assets	173,287	0.007	0.007	-0.008	0.039
Z scores	172,176	-52.981	62.497	-1,557.744	7.095
NPL ratio	132,291	0.070	0.083	0.009	0.470
Firm variables					
Long-term loans (€ million)	203,299	1.912	32.523	0.000	3,877
Short-term loans (€ million)	102,457	1.009	8.883	0.000	751.661
Trade credit (€ million)	176,015	0.682	8.038	0.000	1,100.983
Cash flow (€ million)	152,555	0.293	7.147	-907.480	521.308
Sales (€ million)	211,054	5.412	79.634	-0.005	12104.450
Profit margin	155,841	0.010	0.179	-0.732	0.651
Default risk	106,558	0.403	1.134	0.000	7.084
Cost of funding	104,908	0.227	0.754	0.000	6.147
Transparency	289,229	0.268	0.268	0.000	0.974
Macroeconomic variables					
Inflation	335,656	0.0141	0.011	-0.016	0.042
Real GDP growth	335,656	0.011	0.019	-0.061	0.228
Sovereign spread	333,444	0.016	0.023	0.000	0.091

Notes: [1] Lerner index computed as described in appendix A, where the marginal cost is estimated with separate regressions for each country.
[2] Lerner index computed as described in appendix A, where the marginal cost is estimated with a single Euro area-wide regression.