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Zuzana Fungáčová, Anastasiya Shamshur, Laurent Weill

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Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex
http://large.em-strasbourg.eu/

IFS
Institut de Finance
de Strasbourg

Does Bank Competition Reduce Cost of Credit?

Cross-Country Evidence from Europe[1]

Zuzana Fungáčová[#]
Bank of Finland

Anastasiya Shamshur[+]
University of East Anglia and CERGE-EI

Laurent Weill[*]
EM Strasbourg Business School, University of Strasbourg

Abstract

Despite the extensive debate on the effects of bank competition, only a handful of single-country studies deal with the impact of bank competition on the cost of credit. We contribute to the literature by investigating the impact of bank competition on the cost of credit in a cross-country setting. Using a panel of firms from 20 European countries covering the period 2001–2011, we consider a broad set of measures of bank competition, including two structural measures (Herfindahl-Hirschman index and CR5), and two non-structural indicators (Lerner index and H-statistic). We find that bank competition increases the cost of credit and observe that the positive influence of bank competition is stronger for smaller companies. Our findings accord with the information hypothesis, whereby a lack of competition incentivizes banks to invest in soft information and conversely increased competition raises the cost of credit. This positive impact of bank competition is however influenced by the institutional and economic framework, as well as by the crisis.

JEL Codes: G21, L11.
Keywords: bank competition, bank concentration, cost of credit.

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[#] Bank of Finland Institute for Economies in Transition (BOFIT), Snellmaninaukio, PO Box 160, FI-00101 Helsinki. Email: zuzana.fungacova@bof.fi
[+] Norwich Business School, University of East Anglia, Norwich Research Park, Norwich, Norfolk, NR4 7TJ; CERGE-EI, Charles University and the Academy of Sciences, Prague. Email: a.shamshur@uea.ac.uk
[*] Corresponding author. Institut d'Etudes Politiques, Université de Strasbourg, 47 avenue de la Forêt Noire, 67082 Strasbourg Cedex. Phone: 33-3-68-85-81-38 Fax: 33-3-88-41-77-78 Email: laurent.weill@unistra.fr

1. Introduction

The debate on the effects of bank competition is far from settled. While the virtues of competition are obvious for many industries, increased competition in the banking industry has dubious benefits due to the peculiar features of the industry and the crucial role of information. Bank competition can be detrimental to financial stability, while information asymmetries influence the relationship between bank competition and access to credit (Berger, Klapper, and Turk-Ariss, 2009; Beck, De Jonghe, and Schepens, 2013; Ryan, O'Toole, and McCann, 2014).

The theoretical literature provides conflicting predictions concerning the impact of competition on access to credit. The *market power hypothesis* suggests that greater bank competition relaxes financing constraints and leads to lower lending rates. This hypothesis is in line with the general economic theory that suggests that greater competition is associated with lower prices. The *information hypothesis* rejects this view, arguing that increased bank competition bolsters financing obstacles and drives up lending rates (Petersen and Rajan, 1995; Dell'Ariccia, and Marquez, 2006). The information hypothesis assumes that lower competition increases the incentive for banks to invest in soft information. Thus, a higher level of bank competition lowers investment in banking relationships and impairs access to credit.

A large body of empirical literature considers the influence of bank competition on access to credit. While these studies range widely in geographic scope and employ a variety of indicators for access to credit and competition measures, they usually come down on the side of the market power hypothesis, i.e. that greater bank competition is associated with better access to credit. In a cross-country study, for example, Beck, Demirgüc-Kunt, and Maksimovic (2004) investigate the impact of bank concentration on access to finance measured by survey data on the financing obstacles perceived by firms. They find a positive impact of bank concentration on financing obstacles. Love and Peria (2012) also perform a similar cross-country investigation using an alternative measure for bank competition, the Lerner index. Although competition alleviates financing obstacles they find the effect depends on the economic and financial environment. Carbo-Valverde, Rodriguez-Fernandez, and Udell (2009) analyze the relation between bank competition

and credit availability, measured at the firm level by the dependence on trade credit, on a sample of Spanish small and medium-sized enterprises (SMEs). They, too, find that greater bank competition is associated with lower credit constraints. Ryan, O'Toole, and McCann (2014) examine the impact of bank competition measured by the Lerner index on credit constraints for a sample of firms from 20 European countries. They identify financial constraints through sensitivity of investment to the availability of internal financing. Their findings indicate that bank competition diminishes credit constraints.

While bank competition is found to facilitate access to credit in line with the market power hypothesis, the literature says little about the channels through which market power provides this beneficial effect. Bank competition seems to contribute to better access to credit by relaxing lending conditions such as collateral requirements (Hainz, Weill, and Godlewski, 2013) and reducing the cost of credit. It is then reasonable to ask whether greater bank competition actually reduces the cost of credit in line with this intuition and whether the market power hypothesis really drives a counterintuitive relation between competition and price on lending markets.

Notably, most studies give short shrift to the impact of bank competition on the cost of credit. The handful of works that take on this topic stem from the seminal investigation of Petersen and Rajan (1995) on the impact of bank concentration on loan rates. They find lower loan rates in concentrated banking markets, evidence that supports the information hypothesis. In contrast, several single-country studies (Sapienza, 2002, for Italy; Kim, Kristiansen, and Vale, 2005, for Norway; and Degryse and Ongena, 2005, for Belgium) provide evidence that supports the market power hypothesis, i.e. they find a positive influence of bank concentration on loan rates.

Our aim in this study is to examine the impact of bank competition on the cost of credit. We advance the understanding of the effects of bank competition by contributing to the literature in two respects.

First, we provide the first cross-country analysis investigating the impact of bank competition on the cost of credit using micro-level data. In a cross-country sample, we utilize the variation in bank competition that guarantees satisfactory degrees of freedom for the estimations. We use a panel of firms from 20 European countries for which we have firm-level data on the cost of credit. The banking sector plays dominant role as a

source of financing for firms in the majority of these countries. Beck, Demirgüc-Kunt, and Levine (2004) show that the institutional and economic framework influences the impact of bank concentration on access to credit. Here, we investigate the possible influences of the institutional and economic environment of a country on competition and cost of credit. Our large cross-country sample provides a suitable setting for determining whether country characteristics influence this relationship.

Second, we consider a broad set of indicators to measure bank competition. The measurement of competition is subject of a major debate in the empirical literature on banking. Structural measures such as the Herfindahl-Hirschman index and concentration indices are widely adopted (e.g. ECB, 2014), even if they only infer degree of competition from indirect proxies such as market share rather than provide exact measures of competition. In contrast, non-structural measures such as the Lerner index and the H-statistic infer bank conduct directly and have become increasingly popular in empirical works on banking. For example, Maudos and Fernandez de Guevara (2007), Turk-Ariss (2010) and Carbo-Valverde, Rodriguez-Fernandez, and Udell (2009) all show that the link between bank competition and financing constraints can be influenced by the choice of competition measure. An analysis of the effects of bank competition must therefore consider several competition metrics to check if results are consistent across these measures. We use four competition measures in our work: two non-structural indicators (Lerner index and the H-statistic) and two structural measures (Herfindahl-Hirschman index and CR5). Our analysis provides a comprehensive view of the influence of bank competition on the cost of credit.

We face two immediate challenges in our investigation. Measurement of the *cost of credit at the firm level* is difficult due to data constraints. Data on individual loans are available, but exist only for certain countries (Degryse and Ongena, 2005) or are available exclusively for large loans (e.g. Qian and Strahan, 2007). Our question, however, is of particular interest for small companies, given the potential role of bank incentives to invest in soft information and the limited access of these companies to other sources of finance. Thus, we use accounting data to measure the cost of credit and calculate the ratio of interest expenses to total bank debt. This indicator measures the

implicit interest rate charged the firm by banks.[2]

Moreover, because we require information on a battery of competition measures for a large set of European countries and we cannot measure bank competition at the local level for each firm, we must rely on *aggregate measures of competition*. Such information is only available at the aggregate level, which explains the common use of aggregate measures of bank competition in cross-country studies on the impact of bank competition (e.g. Beck, Demirgüc-Kunt, and Levine, 2004; Love and Peria, 2012; Hainz, Weill, and Godlewski, 2013; and Ryan, O'Toole, and McCann, 2014).

This study is divided into five sections. Section 2 presents the data. Section 3 describes the measures of competition and the econometric specifications. Section 4 displays the results. Section 5 provides concluding remarks.

2. Data

We use firm-level data from Amadeus, the database maintained by Bureau Van Dijk, which contains comprehensive financial information on public and private companies across Europe. Focusing on EU 20 countries for the period from 2001 to 2011,[3] our sample contains over 13 million firm-year observations for more than 4.5 million firms. The annual panel is constructed by combining multiple updates of the Amadeus database. Every update contains a snapshot of currently active population of firms and the up to ten most recent years of firms' financial data. If a firm stops providing financial statements, it is removed from the database after four years. Using multiple snapshots of the database lets us add back observations for firms not present in more recent updates. It eliminates the survivorship bias and extends firms' historical financial data beyond the most recent ten years.

Most firms in Amadeus report unconsolidated financial statements, but consolidated statements are provided if available. In our dataset, we use unconsolidated

[2] Carbo-Valverde, Rodriguez-Fernandez, and Udell (2009) also use this indicator to measure the loan interest rate for each firm.
[3] Austria, Belgium, Bulgaria, the Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Latvia, the Netherlands, Poland, Portugal, Slovenia, Romania, Slovakia, and Spain.

financial statements to avoid double counting firms and subsidiaries or operations abroad and exclude firms that report only consolidated statements. We also exclude the financial intermediation sector and insurance industries (NACE codes 64–66), which have a different balance sheet and specific liability structure.

The key firm-level variable is *Cost of credit* defined as the difference between the ratio of financial expenses divided by bank debt[4] and the country's nominal short-term interest rate. This measure of the implicit interest rate, which is in line with Carbo-Valverde, Rodriguez-Fernandez, and Udell (2009),[5] captures the cost of credit well. The majority of our sample consists of micro and small enterprises that lack access to non-bank funding sources, so the majority of their financial expenses are loan expenses.

Two firm-level control variables are taken from the literature. The first is *Size* defined as the log of total assets as firms of different size have different financing patterns (Beck, Demirgüç-Kunt, and Maksimovic, 2008). The second is *Tangibility,* measured as the ratio of tangible fixed assets to total assets. A higher proportion of tangible assets that could serve as collateral may indicate better opportunities for obtaining external financing.

To assess whether the impact of competition differs depending on firm size, we distinguish among micro firms (i.e. firms with fewer than ten employees or a turnover or total assets less than 2 million euros), small and medium-sized firms (either less than 250 employees or a turnover less than 50 million euros or balance sheet total less than 43 million euros) and large firms.[6] Micro firms (36 %), and small and medium-sized firms (58 %) together constitute about 94 % of our entire sample.

Country-specific variables come from different datasets. Two competition measures (Lerner index, CR5) come from the Global Financial Development Database (GFDD). As the Herfindahl-Hirschman index is missing in this database, we draw on the ECB's SDW database for our information. As the H-statistic has many missing values in the GFDD, we use the H-statistic estimated with Bankscope data from Weill (2013).

[4] Bank debt in the Amadeus database is decomposed between short-term bank debt ("loans") and long-term bank debt ("long-term debt"). We define bank debt as the sum of both components.
[5] Carbo-Valverde, Rodriguez-Fernandez, and Udell (2009) define the loan interest spread as the difference between the ratio of loan expenses to bank loans outstanding and the interbank interest rate.
[6] For a detailed classification of firms by size in Europe, see http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm

One additional country-level variable comes from the GFDD: *Private credit* defined as the ratio of private credit by deposit money banks and other financial institutions to GDP. *GDP per capita* and *Inflation* are both extracted from the World Development Indicators. *Rule of law* comes from the Worldwide Governance Indicators.

Following other studies, we require that all key variables have non-missing values. All explanatory variables are truncated at 1 %, top and bottom. The resulting sample constitutes an unbalanced panel.

Descriptive statistics of all variables are presented in Table 1 and the definitions of variables in the Appendix.

3. Methodology

3.1 Competition measures

The literature on industrial organization provides a number of indicators, based on different methodological approaches, for measuring bank competition. They can be classified into two categories. The first relies on the traditional Structure-Conduct-Performance (SCP) model, whereby structural indicators are used to measure competition. The SCP paradigm states that higher concentration in the banking market is negatively associated with competitive conduct and leads to higher profitability as banks are able to set higher loan rates or lower deposit rates. Indicators used to measure competition include the Herfindahl-Hirschman index (HHI) and *n*-bank concentration ratios such as CR5, the market share of the five largest banks.

Unlike the SCP, the second category of competition measures, which are based on the new empirical industrial organization, develops non-structural measures of competition that take into account bank conduct. While the SCP approach posits that competition can be inferred from indirect proxies like market structure or market share, non-structural measures measure directly banks' conduct in response to changes in demand and supply conditions without taking market structure into account. These

measures include the Lerner index and the H-statistic based on the Rosse-Panzar model. All rely on the analysis of the effective behavior of firms in the market.

Both structural and non-structural measures of competition are used in empirical banking studies. However, given the limitations of structural measures, non-structural measures have recently become increasingly important.

To provide a broad perspective of the impact of bank competition on the cost of credit, we follow the existing research and consider four measures of bank competition.

The Herfindahl-Hirschman index and CR5 are structural measures. The Herfindahl-Hirschman index is the sum of the squares of market shares for all firms in the industry. During the observation period, its value ranges between 0.0158 in 2001 to 0.4039 in 2005. CR5 is the five-bank concentration ratio defined as the percentage of the market controlled by the top five banks in the market in total assets. By this measure, the banking systems of European countries are fairly concentrated (maximum value 100 for Estonia, minimum value 47.85 for Italy).

We further employ two non-structural measures. The Lerner index is defined as the difference between price and marginal cost, divided by price. It indicates the effective behavior of banks by measuring the ability of a bank to set its price above marginal cost and thus the individual bank's market power. A higher Lerner index value suggests lower bank competition. Its mean values by country are generally within the range from 0.09 for Germany to 0.27 for Bulgaria (Finland, with a value of -0.12, is the exception). The H-statistic is estimated using the Rosse-Panzar model (Rosse and Panzar, 1977). It is the sum of the elasticities of total revenues to input prices. The H-statistic value provides information on the nature of competition in a market. A value below or equal to 0 indicates monopoly, between 0 and 1 monopolistic competition, and 1 perfect competition. Following the lead of e.g. Claessens and Laeven (2004), we consider the H-statistic as a continuous measure of competition. It ranges between -0.1575 and 0.8324 in our sample.

3.2 Econometric specifications

Our main interest is the relationship between competition in the banking sector and the cost of credit for a firm. Panel dimension of our data enables us to control for firm-level heterogeneity. We start with the estimation of the following base specification:

$$y_{ijt} = \alpha + \beta X_{ijt} + \gamma Z_{jt} + Competition_{jt} + \theta_i + \mu_t + \varepsilon_{ijt} \ , \qquad (1)$$

where y_{ijt} is the cost of bank credit for firm i in country j at time t; X is a set of firm-specific determinants (*Size, Tangibility*); Z is a set of country-level variables (*Private credit, Rule of law, GDP per capita, Inflation*); *Competition* stands for one of the four competition measures; θ is a firm fixed effect, μ is a time fixed effect, and ε is a random error term.

All models are estimated with firm fixed effects. Standard errors are clustered by firm; we do not cluster by country. Even if clustering by country might be preferable in some cases (Pepper, 2002), the true standard errors could be consistently estimated when the number of clusters approaches infinity. When the number of clusters is low (less than 50) and cluster sizes unbalanced,[7] inference using a cluster-robust estimator may be incorrect (Nichols and Shaffer, 2007; Cameron and Miller, 2015). Thus, clustering by country is inappropriate for both criteria.

We would ideally like to use instruments for our measure of bank competition in order to overcome potential endogeneity. Given the nature of our dataset, the extensive coverage of countries, and the lack of guidance from the existing literature, however, it is difficult to find appropriate instruments. Nevertheless, there are several arguments based on which the endogeneity problem can be reduced in our empirical analysis. First, bank competition is computed at the country level, while measures for cost of credit are firm-level characteristics coming from a different data source. It is therefore unlikely that cost of credit measures can influence bank competition. Second, the panel structure of our dataset allows us to include firm-level fixed effects and thus remove all time-invariant unobservable effects that could potentially affect both bank competition and cost of credit. Third, we perform the main estimations by lagging the observations by one year

[7] The low number of clusters may range from less than 20 to less than 50 clusters in the balanced case and even more clusters in the unbalanced case (Cameron and Miller, 2015).

for all independent variables to reduce the contemporaneous reverse causality. Our main results do not change.[8]

4. Results

This section presents the results of the estimations. We first comment on the main estimations and then provide the results by firm size. We continue with results including various interactions and complete the analysis with results for different sub-periods and several robustness tests.

4.1 Main estimations

We perform regressions explaining cost of credit determinants. Four regressions are estimated, each employing a different competition measure. Results are reported in Table 2. With the exception of the H-statistic, higher values of competition measures are associated with lower competition.

We observe that the coefficients are significant and negative for the Herfindahl-Hirschman index and CR5. These findings support the view that bank concentration is negatively associated with the cost of credit. We observe a similar pattern, i.e. a significant and negative coefficient, for the Lerner index. The coefficient for the H-statistic is positive and significant. The results for the four competition measures thus indicate that bank competition increases the cost of credit. This finding accords with the information hypothesis, whereby competition does not undermine the cost of credit.

Notably, both structural and non-structural measures lead to the same conclusion, indicating that the difference in results does not reflect the difference between structural and non-structural measures of competition.

In analyzing our other variables, we note that firm size and tangibility of assets are significantly negative, in line with the intuition that larger firms and firms with higher tangibility of assets are more likely to have lower cost of credit. As expected, better law

[8] These estimations are available upon request.

enforcement favors lower cost of credit, while higher inflation has a positive association with cost of credit. Interestingly, greater financial and economic development tend to enhance the cost of credit. This might be explained by the fact that access to credit is easier in more financially and economically developed countries, so young, riskier firms are also able to obtain credit. As these firms need to pay higher interest to compensate for their higher risk, the average cost of credit rises.

4.2 Estimations by size

Our main estimations indicate that bank competition influences the cost of credit in line with the information hypothesis, which says that banks invest more in soft information when competition is lower. Such investment helps banks mitigate information problems in lending. As a result, the information hypothesis should apply predominantly to SMEs, which typically are more opaque than larger firms (Berger and Udell, 1995). There is a large strand of literature showing that information asymmetries play a more significant role for SMEs, leading to the fact that investment of banks in relationship lending is of prime importance for their access to credit.

Following this hypothesis, we further investigate whether the relation between bank competition and the cost of credit differs with the size of firms. We expect to observe greater positive influence of bank competition on the cost of credit for smaller companies. We re-estimate our regressions by considering separately groups of firms by size: micro companies, SMEs, and large companies. The estimation results are presented in Tables 3 and 4.

Our findings strongly support the information hypothesis. The coefficient estimates for both the Lerner index and the Herfindahl-Hirschman index are negative and significant, indicating a higher cost of credit in more competitive environments for micro companies and SMEs. The coefficient is not significant for large companies. In the case of the H-statistic, the estimated coefficient is positive and significant for micro companies and SMEs, but not for large companies. These results support the information hypothesis with the H-statistic: greater competition is associated with greater cost of credit with this competition metric for smaller companies. This is in line with the

hypothesis that bank competition contributes to a higher cost of credit for these more opaque borrowers. We see, however, no difference for different sizes of firms in the findings for CR5: the coefficient is significantly negative for all three size classes of firms.

The estimations by size therefore indicate that the positive impact of bank competition on cost of credit is primarily observed for smaller firms that are most likely to be subject to adverse selection and other informational problems. These results provide additional support in favor of the information hypothesis.

4.3 Interactions with country-level variables

Our main estimations indicate that greater bank competition tends to contribute to higher cost of credit. As shown by Beck, Demirgüc-Kunt, and Maksimovic (2004), this influence can be either exacerbated or mitigated by the institutional and economic framework. We therefore consider three factors of this framework: financial development, economic development, and institutional development. Beck, Demirgüc-Kunt, and Maksimovic (2004) also take these three factors into account in their analysis of the relation between bank concentration and financing obstacles.

The information hypothesis posits that banks invest in soft information to gain better information about opaque borrowers. As a consequence, country-specific factors that affect information asymmetries may impact the relationship between bank competition and the cost of credit.

While, to our best knowledge, we provide the first cross-country analysis on the relation between bank competition and the cost of credit, it is worth mentioning that the related literature on bank competition and access to credit reports mixed results. Beck, Demirgüc-Kunt, and Maksimovic (2004) find no impact of financial development on the relation between bank concentration and financing obstacles, while greater economic and institutional development relaxes financing constraints and bank concentration increases financing obstacles. Similarly, Love and Peria (2012) report that low bank competition decreases access to finance, but greater financial development mitigates the negative impact of low bank competition and facilitates access to credit.

For bank competition and the cost of credit, we expect financial development and economic development to mitigate the existing positive relationship. Financial and economic development is often associated with lower information asymmetries (Godlewski and Weill, 2011), which could be due to the higher quality of risk analysis conducted by bank employees before loan approval. In any case, it seems reasonable to assume that the quality of the risk analysis increases with knowledge and skills of bank employees, which are positively related to financial and economic development. The information hypothesis further implies that opaque borrowers are the ones benefitting most from banks' investment in information collection. Hence, low competition should be more beneficial for the cost of credit in a country with higher financial and economic development, as such country is expected to face lower information asymmetries.

We assume that better law enforcement mitigates the positive relation between bank competition and the cost of credit. As observed by Beck, Demirgüc-Kunt, and Maksimovic (2004), a better institutional environment makes enforcement of contracts easier and increases the capacity of banks to screen potential borrowers. Better quality of institutions diminishes information asymmetries, mitigating the relevance of the information hypothesis.

For empirical testing of variations in the impact of bank competition on the cost of credit depending on country-level development, we include interaction terms between bank competition and financial, economic and institutional development indicators in our main model. If the information hypothesis applies, we expect positive and significant coefficients for the interaction terms when bank competition is measured by Lerner index, CR5, and the Herfindahl-Hirschman index (higher values for these competition indicators are associated with lower competition). We also expect lower H-statistic values for lower competition, and thus coefficients for interaction terms that are significantly negative. The estimation results are reported in Tables 5–7.

For financial development, we obtain the expected sign for the interaction term between bank competition and *Private credit* only with the CR5 measure, where the interaction term is both positive and significant. For the other two indicators, we get significant results that support the market power view. The interaction term is negative

and significant when bank competition is measured by Lerner index. The interaction term between the H-statistic and *Private credit* is significantly positive. The estimated coefficient for HHI is not significant. These results suggest that greater financial development strengthens the beneficial impact of low competition to attenuate the cost of credit, and further, that lower competition helps lower the cost of credit, an effect amplified by greater financial development.

How should we interpret such results? Apparently, greater financial development can provide greater incentives for banks to invest in relationship lending, notably through economies of scale associated with investment in soft information. As such, the information hypothesis gains relevance as the level of financial development increases.

For economic development (Table 6), we find evidence supporting our initial conjecture that greater GDP per capita lowers the beneficial impact of low competition on the cost of credit. This is evidenced by a positive and significant interaction term between bank competition and *GDP per capita* when competition is measured by Lerner index, CR5 and HHI, and by a negative and significant interaction term between H-statistic and *GDP per capita*.

We find mixed results when accounting for the institutional development (Table 7). On the one hand, the results with Lerner index, and H-statistic, support the expected view that greater institutional development reduces the beneficial impact of low competition on the cost of credit. The interaction term with *Rule of law* is positive and significant with Lerner index, and negative and significant with H-statistic. On the other hand, both structural measures of competition support the opposite view, i.e. the interaction term with *Rule of law* is negative and significant for the Herfindahl-Hirschman index and CR5.

Based on the above results, our investigation on how the institutional and economic framework influences the relation between competition and the cost of credit yields mixed conclusions. Financial development tends to foster the negative relation between bank competition and the cost of credit, while economic development seems to bolster it. Institutional development has no clear influence on the relationship of bank competition and the cost of credit.

4.4 Crisis period

We extend our analysis by examining if the crisis years that are part of our sample period influenced the relation between bank competition and the cost of credit. The crisis can exert an impact on the relation by affecting both competition and cost of credit. Namely, crisis could have reduced the degree of competition on banking markets in Europe by reducing the number of competitors due to mergers and acquisitions. Further, it could have increased cost of credit through higher loan losses and lower incentives for banks to invest in soft information with the increase of bank costs.

To investigate the impact of the crisis, we redo our estimations by adding a dummy variable equal to one for the crisis years 2008 to 2011 and an interaction term between the dummy variable and the competition measure. We note several striking results (Table 8).

First, the interaction term between the crisis variable and the competition is always significant. This suggests that the crisis period exerts an impact on the relation between bank competition and the cost of credit.

Second, the interaction term in all four specifications has an opposite sign from the competition measure. This supports the view that crisis periods weaken the impact of bank competition on the cost of credit. Here, the crisis reduces the positive impact of competition on the cost of credit for all competition measures.

This conclusion is important. It suggests that the impact of bank competition changes during periods of crisis, which means policy prescriptions need to adjust to take this into account. Indeed, while our results suggest that bank competition should not be fostered to lower the cost of credit, this policy would not apply in times of crisis.

4.5. Robustness tests

We check the robustness of our main findings in several different ways.

First, we use an alternative measure for the cost of credit in our estimations (Table 9). Using available items for a large number of companies in the Amadeus database, we redefine cost of credit as interest paid divided by total bank debt and observe results in

line with the information hypothesis, i.e. the coefficients are significant and negative for the Lerner index and CR5 and positive for the H-statistic. While significant in the main estimations, the negative coefficient for HHI is not significant here. Nevertheless, these results generally align with our main estimations and thus provide additional support for the information hypothesis.

Second, we include the squared term for the competition measure in the estimations to consider possible nonlinearity in the relation between bank competition and cost of credit (Table 10). The coefficients for the squared term are significant for all four of our competition measures, but do not necessarily support a nonlinear relation.

In the case of Lerner index, the squared term and the linear term for bank competition are both significant and negative. Hence, the inclusion of a squared term supports the linear relation observed in the main estimations.

For the H-statistic and CR5, the inclusion of the squared term is of particular interest. The linear term alone is significantly negative and the squared term is significantly positive with the H-statistic, while the linear term alone is significantly positive and the squared term is significantly negative with the CR5. In other words, we observe a nonlinear relation for both indicators with greater competition disfavoring the cost of credit up to a certain value, above which greater competition favors the cost of credit.

We can compute this threshold for each indicator. For the H-statistic, the threshold is 0.005 while it is 0.621 for CR5. Both values are in the range of the values for the sample and below the mean. Thus, the analysis of the nonlinear relation suggests that the result that competition strengthens the cost of credit should only be observed after competition attains a certain level.

For the Herfindahl-Hirschman index, we also observe evidence in favor of a different nonlinear relation. The linear term alone is significantly negative and the squared term is significantly positive. These results support the view that initially the HHI value rises (i.e. competition goes down) and the cost of credit falls until a certain value for HHI is attained. Above that, the HHI value suggests the cost of credit rises. The threshold is 0.0026, which is in the range of our sample. Hence, this negative relationship between the Herfindahl-Hirschman index and the cost of credit, in line with our finding

that greater competition fosters cost of credit, reverses for values of HHI above this threshold.

Our analysis of the nonlinear relationship between bank competition and the cost of credit shows results differ depending on the competition indicator. However, they all provide evidence that greater competition strengthens the cost of credit for some values.

5. Conclusions

In this paper, we analyzed the impact of bank competition on the cost of credit using a cross-country sample of firms from 20 European countries over the period 2001–2011. The market power hypothesis predicts that we should observe a negative relationship between bank competition and the cost of credit, because greater competition reduces the market power of banks. The information hypothesis, in contrast, expects a positive link due to the incentives of banks to invest in soft information. While this question has been investigated in single-country studies, it has never been studied in a cross-country framework. We fill this gap and consider four competition measures commonly used in the literature to take into account the possible differences across these measures.

Our main finding is that bank competition enhances cost of credit in line with the information hypothesis. Our baseline estimations show a positive relation between bank competition and the cost of credit with each of our four competition measures. We find that this positive influence of bank competition is stronger for smaller companies, which also accords with the information hypothesis.

The positive impact of bank competition is influenced by two additional characteristics. It is lower during periods of crisis, and the institutional and economic framework influences the relation between competition and the cost of credit.

Overall, these findings do not support the intuitive view that bank competition contributes to a reduction of prices in line with the general economic theory. Nevertheless, the banking industry is special due to the importance of information asymmetries that provide incentive to invest in technologies that reduce such asymmetries. As such, greater competition may shape bank behavior through lower

incentives that result in higher lending rates. We corroborate the theoretical and empirical arguments of Petersen and Rajan (1995), who find lower loan rates in concentrated banking markets.

The take-away lesson for policymakers here is that pro-competitive policies in the banking industry can have detrimental effects. Our findings also agree with the view that banking competition can have a detrimental influence on financial stability and bank efficiency (Maudos and Fernandez de Guevara, 2007; Casu and Girardone, 2010).

The vices of greater bank competition, however, need to be put into perspective with the benefits on access to credit, as stressed by Beck, Demirgüc-Kunt, and Maksimovic (2004) and Ryan, O'Toole, and McCann (2014). Bank competition can contribute to better access to credit by lowering financing obstacles such as collateral requirements, even if it does not diminish the cost of credit. In addition, the influence of the cost of credit on access to credit is dependent on the elasticity of credit demand.

The present paper provides the first cross-country investigation of the impact of bank competition on the cost of credit. Our analysis may be extended in a number of ways to check the general applicability of these findings for other countries and the relevance of our interpretations of the findings.

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Table 1.
Descriptive statistics

This table provides descriptive statistics for the main firm-level variables used in the econometric analysis. Variable definitions are provided in the Appendix. Competition measures are scaled by 100 and the unit of observation is the firm.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Firm size	15 876 307	-0.174	2.029	-4.422	7.784
Profitability	15 815 714	0.032	0.153	-1.007	0.534
Tangibility	14 787 186	0.301	0.277	0.000	0.982
Cost of credit	15 514 105	0.069	0.097	-0.046	0.500
Lerner	15 340 332	0.002	0.001	-0.016	0.005
H-statistic	13 445 483	0.006	0.002	-0.002	0.008
CR5	15 691 243	0.786	0.121	0.479	1.000
Herfindahl-Hirschman index	15 760 781	0.001	0.001	0.000	0.004
Private credit	15 528 718	115.5	41.00	14.28	237.6
Rule of law	15 760 781	1.109	0.407	-0.160	1.977
GDP per capita	15 760 781	29 214	6 691	3 490	51 721
Inflation	15 760 781	2.244	1.239	-4.480	15.403

Table 2.
Main estimations

Panel estimations with firm fixed effects. Competition measure indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-1.144***	0.341***	-0.034***	-7.029***
	(0.041)	(0.092)	(0.001)	(0.303)
Size	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.042***	-0.041***	-0.042***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-1.42e-04***	-5.56e-05***	-1.57e-04***	-1.29e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.076***	-0.079***	-0.063***	-0.069***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	9.47e-06***	8.70e-06***	8.76e-06***	7.85e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.002***	0.003***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.071***	-0.116***	-0.044***	-0.034***
	(0.003)	(0.003)	(0.003)	(0.003)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.031	0.032	0.031	0.030
N	13 273 412	11 733 614	13 568 509	13 632 690

Table 3.
Estimations by size (1/2)

Panel estimations with firm fixed effects. Competition measure indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of Credit*					
	Lerner			H-statistic		
	Micro	SME	Large	Micro	SME	Large
Competition	-1.225***	-1.306***	-0.191	1.933***	0.716***	0.869
	(0.069)	(0.062)	(0.514)	(0.169)	(0.133)	(1.323)
Size	-0.021***	-0.009***	-0.011***	-0.022***	-0.010***	-0.006***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.002)
Tangibility	-0.042***	-0.045***	-0.057***	-0.041***	-0.043***	-0.023**
	(0.001)	(0.001)	(0.005)	(0.001)	(0.001)	(0.010)
Private credit	9.27e-05***	-7.93e-05***	2.07e-04***	9.27e-05***	-7.93e-05***	2.07e-04***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.063***	-0.079***	-0.035***	-0.071***	-0.086***	-0.046***
	(0.001)	(0.001)	(0.006)	(0.001)	(0.001)	(0.009)
GDP per capita	9.92e-06***	8.31e-06***	7.65e-06***	9.92e-06***	8.31e-06***	7.65e-06***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.003***	0.001***	0.001	0.005***	0.003***	0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Constant	-0.205***	-0.048***	-0.035	-0.210***	-0.053***	-0.090**
	(0.006)	(0.004)	(0.031)	(0.007)	(0.004)	(0.041)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.036	0.034	0.016	0.039	0.036	0.020
N	5 289 345	7 414 912	569 155	4 704 424	6 659 335	369 855

Table 4.
Estimations by size (2/2)

Panel estimations with firm fixed effects. Competition measure is indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of Credit*					
	CR5			Herfindahl-Hirschman index		
	Micro	SME	Large	Micro	SME	Large
Competition	-0.055***	-0.031***	-0.061***	-10.642***	-7.807***	-2.294
	(0.002)	(0.001)	(0.007)	(0.582)	(0.408)	(5.028)
Size	-0.021***	-0.009***	-0.011***	-0.021***	-0.009***	-0.011***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Tangibility	-0.042***	-0.044***	-0.057***	-0.042***	-0.044***	-0.057***
	(0.001)	(0.001)	(0.005)	(0.001)	(0.001)	(0.005)
Private credit	-3.53e-05***	-1.88e-04***	1.77e-04***	4.02e-05***	-1.66e-04***	1.62e-04***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.053***	-0.066***	-0.007	-0.054***	-0.073***	-0.032***
	(0.001)	(0.001)	(0.006)	(0.001)	(0.001)	(0.006)
GDP per capita	1.17e-05***	8.00e-06***	5.87e-06***	9.69e-06***	7.33e-06***	5.60e-06***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.003***	0.002***	0.001	0.003***	0.001***	0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Constant	-0.161***	-0.021***	-0.019	-0.145***	-0.012***	-0.023
	(0.006)	(0.004)	(0.030)	(0.005)	(0.003)	(0.030)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.034	0.017	0.036	0.034	0.016
N	5 402 133	7 594 598	571 778	5 430 217	7 629 706	572 767

Table 5.
Impact of financial development

Panel estimations with firm fixed effects. Competition measure is indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-0.030	-3.969***	-0.043***	-7.359***
	(0.081)	(0.102)	(0.002)	(0.659)
Competition × Private credit	-0.014***	0.058***	0.00011***	0.004
	(0.001)	(0.001)	(0.000)	(0.006)
Size	-0.003***	-0.004***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.042***	-0.041***	-0.042***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-1.2e-04***	-3.9e-04***	-2.5e-04***	-1.3e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.078***	-0.078***	-0.063***	-0.069***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	9.58e-06***	8.40e-06***	8.58e-06***	7.83e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.074***	-0.085***	-0.032***	-0.033***
	(0.003)	(0.003)	(0.004)	(0.003)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.031	0.034	0.031	0.030
N	13 273 412	11 733 614	13 568 509	13 632 690

Table 6.
Impact of economic development

Panel estimations with firm fixed effects. Competition measure is indicated at the top of the column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-19.121***	10.895***	-0.186***	-11.193***
	(0.264)	(0.182)	(0.005)	(1.800)
Competition × GDP per capita	0.001***	-3.10e-04***	5.11e-06***	1.11e-04**
	(0.000)	(0.000)	(0.000)	(0.000)
Size	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.042***	-0.041***	-0.042***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-1.3e-04***	-5.81e-05***	-1.58e-04***	-1.28e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.091***	-0.075***	-0.062***	-0.069***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	8.91e-06***	1.03e-05***	4.68e-06***	7.63e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.035***	-0.173***	0.078***	-0.027***
	(0.003)	(0.003)	(0.004)	(0.004)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.031	0.033	0.031	0.030
N	13 273 412	11 733 614	13 568 509	13 632 690

Table 7.
Impact of institutional development

Panel estimations with firm fixed effects. Competition measure is indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-8.382***	14.068***	0.026***	-1.093
	(0.195)	(0.184)	(0.001)	(0.874)
Competition × Rule of law	4.130***	-8.814***	-0.090***	-4.235***
	(0.105)	(0.101)	(0.002)	(0.573)
Size	-0.003***	-0.004***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.042***	-0.041***	-0.042***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-1.5e-04***	-4.60e-05***	-2.33e-04***	-1.29e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.090***	-0.020***	0.012***	-0.066***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	9.56e-06***	7.88e-06***	9.11e-06***	8.00e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.002***	0.004***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.051***	-0.187***	-0.097***	-0.041***
	(0.003)	(0.003)	(0.003)	(0.003)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.031	0.034	0.031	0.030
N	13 273 412	11 733 614	13 568 509	13 632 690

Table 8.
Estimations for the crisis period

Panel estimations with firm fixed effects. Competition measure is indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-1.823***	3.978***	-0.033***	-8.493***
	(0.043)	(0.105)	(0.001)	(0.310)
Competition × Crisis	9.419***	-11.089***	0.006***	5.340***
	(0.110)	(0.169)	(0.001)	(0.148)
Size	-0.004***	-0.004***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.042***	-0.041***	-0.042***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-9.7e-05***	-2.41e-05***	-1.59e-04***	-1.11e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.073***	-0.080***	-0.063***	-0.068***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	8.42e-06***	6.95e-06***	8.37e-06***	6.45e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.003***	0.003***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.053***	-0.009**	-0.034***	0.005*
	(0.003)	(0.004)	(0.003)	(0.003)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.032	0.033	0.031	0.030
N	13 273 412	11 733 614	13 568 509	13 632 690

Table 9.
Robustness check: Alternative measure of cost of credit

Panel estimations with firm fixed effects. Competition measure is indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-1.411***	0.277***	-0.058***	-0.318
	(0.045)	(0.099)	(0.001)	(0.460)
Size	-0.003***	-0.003***	-0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.027***	-0.026***	-0.028***	-0.028***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	8.26e-05***	1.54e-04***	6.71e-05***	8.89e-05***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.096***	-0.098***	-0.072***	-0.090***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	7.17e-06***	7.42e-06***	5.56e-06***	6.49e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.003***	0.004***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.005*	-0.056***	0.062***	0.012***
	(0.003)	(0.003)	(0.003)	(0.002)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.049	0.051	0.050	0.048
N	10 643 150	9 454 541	10 933 579	10 997 664

Table 10.
Robustness check: Nonlinear relation

Panel estimations with firm fixed effects. Competition measure is indicated at top of column. Standard errors (in parentheses) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% levels, respectively. Variable definitions are provided in the Appendix.

	Dependent variable = *Cost of credit*			
	Lerner	H-statistic	CR5	HHI
Competition	-2.411***	-31.417***	0.190***	-28.534***
	(0.064)	(0.324)	(0.004)	(0.887)
Competition squared	-129.632***	2997.767***	-0.153***	5369.688***
	(4.574)	(28.856)	(0.003)	(206.176)
Size	-0.003***	-0.005***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.042***	-0.041***	-0.042***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-1.5e-04***	-3.36e-05***	-1.96e-04***	-1.28e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Rule of law	-0.079***	-0.088***	-0.066***	-0.064***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	9.51e-06***	7.61e-06***	1.04e-05***	6.79e-06***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.002***	0.003***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.065***	-0.004	-0.162***	0.002
	(0.003)	(0.004)	(0.003)	(0.003)
Firm fixed effects	Yes	Yes	Yes	Yes
R^2	0.031	0.034	0.031	0.030
N	13 273 412	11 733 614	13 568 509	13 632 690

Appendix

Variable	Definition
Firm size	= log(total assets). Source: Amadeus.
Tangibility	= tangible fixed assets /total assets. Source: Amadeus.
Cost of credit	= (financial expenses /total debt) – country nominal short-term interest rate. Source: Amadeus and SDW.
Lerner	Measure of market power in the banking market that compares output pricing and marginal costs (i.e. markup). An increase in the Lerner index indicates a deterioration of the competitive conduct of financial intermediaries. Source: Global Financial Development Database, World Bank.
CR5	Assets of five largest banks as a share of total commercial banking assets. Source: Global Financial Development Database, World Bank.
H-statistic	Degree of competition in the banking market as measured by the elasticity of bank revenues relative to input prices. The H-statistic suggests market structure on a continuum with 0 indicating monopoly and 1 perfect competition. Source: Global Financial Development Database, World Bank.
Herfindahl-Hirschman index	Defined as the sum of the squares of the market shares of all firms within the industry with market share expressed as a fraction. As a general rule, an HHI value below 1,000 signals low concentration, while an index reading above 1,800 suggests high concentration. Values between 1,000 and 1,800 indicate that an industry is moderately concentrated. Source: Global Financial Development Database, World Bank.
Rule of law	This variable captures the extent to which agents have confidence in the rule of law and how well they expects members of society to abide by the rules. In particular, looks at the perceptions about the quality of enforcement of contract law and property rights, as well as the behavior of the police and the courts, and the frequency of crime and violence. Source: Worldwide Governance Indicators, World Bank.
Private credit	Private credit by deposit money banks to GDP. Source: Global Financial Development Database, World Bank.

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Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex

http://large.em-strasbourg.eu/