

Banking Sector Concentration and Firm Indebtedness: Evidence from Central and Eastern Europe

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Using data from the Amadeus firm-level database, this paper explores the impact of banking sector concentration on corporate debt in the manufacturing sectors in eight Central, Eastern and Southeastern European (CESEE) countries in the precrisis period 2002–2007. Our findings indicate that banking sector concentration has a positive effect, raising firm debt. This confirms the predictions of the relationship lending theory. However, in the CESEE countries with the most concentrated banking markets – such as Estonia and Lithuania – the effect on the corporate leverage ratio is found to be negative. We also show that young firms increase their leverage, while mature firms reduce their dependence on external financing when banking markets are more concentrated. Furthermore, the positive impact of banking sector concentration is weakened by EU accession and greater stock market capitalization, which can be explained by the financial deepening process and the improved availability of alternative sources of external finance.

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1 Introduction

The banking sectors in the Central, Eastern and Southeastern European (CESEE)² countries have gone through a fundamental transformation in the past 20 years. Banking system ownership shifted from the state to the private sector, and foreign-owned banks began to increasingly dominate the CESEE banking markets. At the same time, financial systems in the CESEE region remained bank-dominated, and banks became the key source of external (firm) finance for the private sector. Moreover, bank credit became crucial also for corporate investment and innovation activities in the CESEE countries and was thus an intrinsic part of the precrisis growth model in the region (Becker et al., 2010; Backé, Égert and Zumer, 2007). This, in turn calls for a better understanding of the determinants of private debt accumulation in the CESEE countries in the precrisis period. In this context, one question is how the structure of the banking sector, i.e. in particular its degree of concentration,³ influences the corporate leverage ratio in the manufacturing sector⁴

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² We focus on the following countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Slovakia. As many of the values of leverage for firms in Romania and Slovenia were missing in Amadeus, we excluded these countries from the estimations.

³ A central point of discussion in the theoretical literature is the link between competition and concentration in the banking industry. While some theoretical contributions (i.e. the efficiency theory) claim that the efficiency of larger banks enhances their performance, other theoretical approaches (i.e. the structure-conduct-performance theory) postulate that a higher concentration of the banking market encourages collusion and reduces efficiency, i.e. decreases competition. The second approach has been broadly confirmed by empirical evidence for developed countries (e.g. Birkker and Haaf, 2002) as well as for a sample of CESEE countries (e.g. Delis, 2010). Hence, in line with these studies, we presume that higher levels of concentration are associated with a lower level of competition in the banking market.

⁴ For reasons of comparability, we opted to focus only on firms in the manufacturing sector. The inclusion e.g. of financial corporates would distort comparability, as they have a different liability structure than manufacturing firms.

of the CESEE countries – and this is the specific research question that is tackled in this paper. We explore this issue by using firm-level data. We also address the reversed causality problem in our analysis, as the banking sector itself could be influenced by firms' financing decisions. In our analysis, we focus on the precrisis period, during which private sector debt accumulated substantially. This period forms a rather homogeneous sample of firms without the incisive structural breaks that would likely occur if we had included the period after the onset of the crisis. Moreover, firm-level data for CESEE countries are available only with a considerable time lag so that only few data points are available to study developments since the onset of the crisis.

Two different theories explain the impact of banking sector concentration on firm debt. The first theory, the market power theory, implies that the increase of industry concentration is related to a reduction of competition and to greater inefficiencies in markets without information asymmetries. Hence, any deviation from perfect competition on the credit market introduces inefficiencies that could lead to credit rationing, reduced credit demand by firms, or both. The second theory, the relationship lending theory, states that on markets with asymmetric information, higher banking sector concentration increases the incentives for banks to reduce information asymmetries by acquiring soft information through relationships with corporates. Fewer information asymmetries would have a positive impact on credit to firms.

The available empirical evidence on Western European banking markets has so far shown a predominantly negative effect of banking sector concentration on firm debt. However, these studies have also indicated that small and young firms, which have less access to other sources of external financing, could benefit more from relationship lending in more concentrated banking markets. It is also well known that banks behave differently in different institutional frameworks, implying that results for the developed countries might not be valid for the CESEE countries. The question is even more relevant for most CESEE countries because banking sector concentration is high there.⁵ Interestingly, empirical evidence on the effect of banking sector concentration on firm leverage is still missing for the CESEE countries. This paper intends to fill the gap in the empirical literature.

The paper is organized as follows: In the following section, the findings of both the theoretical and the empirical literature on the impact of banking market structure on corporate debt leverage are summarized. Section 3 outlines the methodological approach and discusses the variables included in the estimations. After the data and the summary statistics are introduced in section 4, the baseline results are presented and discussed in section 5. Section 6 explores the firm and country heterogeneity of the impact of banking sector concentration. Section 7 concludes, addressing the threats from elevated banking sector concentration in the CESEE countries.

⁵ For instance, in the precrisis period 2002–2007, the banking sector concentration ratio (CR5, the concentration ratio of the five largest banks in a country) in the CESEE countries in our sample averaged between 49.4% in Poland and 98% in Estonia, whereas the CR5 ratio in the EU-15 countries varied between some 21% (Italy, Germany) and almost 80% (the Netherlands, Finland).

2 Banking Sector Concentration and Corporate Leverage: Review of the Literature

The cost of capital is closely related to the investment decisions of a firm as well as to the firm's value and performance. Therefore, the importance of firm debt relative to other sources of finance is the subject of numerous theoretical contributions.⁶ More specifically, the impact of banking sector competition on firm leverage is unclear from both the empirical and the theoretical perspective. Two main theories postulate the effect of banking market structure on corporate leverage. The first theory, the market power hypothesis (Carbó-Valverde, Rodríguez-Fernández and Udell, 2009), implies that higher concentration corresponds to increasing market power. When banks exert their market power, loans are priced higher than under perfect competition; hence, fewer firms will take out a loan. Therefore, the market power hypothesis postulates that a higher degree of banking sector concentration implies higher interest rates on loans and lower credit demand, which hampers growth. In addition, as Black and Strahan (2002) have shown, fewer enterprises are established in a concentrated banking market.

The second theory, the relationship (i.e. information-based) theory, implies that higher concentration in the banking market translates into a reduction of information asymmetries and hence into a reduction of credit rationing (Stiglitz and Weiss, 1981). Consequently, banks could invest more in relations (i.e. credit could be offered on the basis of the future profits of the firm) and would not be dependent only on transactional lending (i.e. reliance on readily observable information about the borrower). In addition, banks could also monitor other activities of the borrowing firms, such as deposits at the same bank (Kane and Malkiel, 1965). Moreover, as shown in a theoretical model by Petersen and Rajan (1995), lending to young firms with no performance record could be more intense in more concentrated markets because banks with larger market power could recoup the cost of lending over time.

Other theoretical studies conclude that relationship lending with increased monitoring could induce firms to avoid myopic behavior and hence permits more corporate investment (e.g. Von Thadden, 1995). Additionally, higher bank concentration could make banks more efficient because the standards of information sharing improve in parallel with concentration (Japelli and Pagano, 2006). For instance, Brown, Jappelli and Pagano (2009) perform analysis based on the Business Environment and Enterprise Performance (BEEPS) 2005 firm survey data for 24 transition countries and find that the more developed the information sharing standards between the banks are, the more the costs of investment financing decline, and the fewer obstacles there are to investment financing. Furthermore, the monopoly gains of the bank can be eroded by information "leaks" when such firm registers are available (e.g. Padilla and Pagano, 1997). On a negative note, though, when confronted with higher loan interest rates, borrowers (firms) could also adjust their investment policies in favor of high risk. However, Agoraki, Delis

⁶ In particular, the pecking order hypothesis captures the costs of asymmetric information and prioritizes the sources of financing according to the "principle of least effort" (adverse selection) (Myers and Majluf, 1984). Hence, firms prefer internal sources of finance to debt when managers know that the firm is overvalued. Internal finance, in turn, is preferred to equity financing. By contrast, the tradeoff theory states that the capital structure of a firm is the balance of the tax savings from debt to deadweight bankruptcy costs (for a more detailed review, see Hake, 2012).

and Pasiouras (2011) have shown for the CESEE countries in the period 1998–2005 that, while banking markets had become more concentrated, less risk-taking behavior (as measured by the ratio of nonperforming loans) could be observed.

Most of the empirical evidence on the impact of banking sector concentration on corporate debt is based on U.S. or Western European data. The early empirical literature on the U.S. banking markets in the 1960s and 1970s finds a negative correlation between concentration and proxies for risk-taking behavior, as for instance the debt-to-assets ratio and the ratio of nonperforming loans to total loans (Rhoades and Rutz, 1982). Later, Petersen and Rajan (1994) find support for the relationship lending theory in a study on U.S. SMEs and hence assume a positive effect on the borrowed quantity. The effect on the cost of lending, though, is not as clear: The paper shows that the availability of “soft” information does not usually translate into lower interest rates; it affects the duration of the relationship instead.

By contrast, in the analysis of U.S. firms, Zarutskie (2006) finds a generally positive effect of enhanced competition on credit supply, but this effect tends to be negative in the case of information-sensitive borrowers such as small and young firms. In a cross-industry and cross-country study (including both developed and developing countries), Cetorelli and Gambera (2001) generally confirm the positive effect of banking sector competition on corporate credit growth but also find that fast-growing industries tend to benefit more from a concentrated bank sector because of enhanced relationship lending. Their paper, though, does not include the CESEE countries. Going further, in a more recent study on nonfinancial SMEs in Western European countries, Baert and Vander Vennet (2009) find a negative correlation between firm leverage and increased bank market power. In addition, this study tests whether the effect is different for firms in different size groups and concludes that the theory of relationship lending cannot be supported. Conversely, in an extensive study on the determinants of firm book leverage with firm-level data from 39 countries (including developing countries but not CESEE countries), González and González (2008) find that banking sector concentration has a positive impact on firm debt, which suggests that the information asymmetries between firms and banks are reduced. This study concludes that banking sector concentration could be regarded, up to a point, as a substitution for the weak legal enforcement of property rights.

To our knowledge, just a few studies have empirically analyzed the effect of banking market structure on firm leverage in the CESEE countries (Coricelli et al., 2010; Agoraki, Delis and Pasiouras, 2011), but they did not focus directly on the link between banking sector concentration and firm leverage. The present study therefore complements this literature by analyzing the effect of banking sector competition on corporate debt in a sample of CESEE countries. We venture that due to several factors, the impact of banking sector competition in the CESEE countries on corporate debt could differ from the respective effects shown to be in force in advanced economies. First, the role of foreign-owned banks in the countries of the sample has increased substantially in the past decade. A considerable number of banks entered the market through the acquisition of domestic banks, which were previously mainly under state ownership. Second, relationship lending could also benefit older and larger firms with an established relationship with the lender; hence, foreign-owned banks could prefer to follow the policy of the

acquired bank. Furthermore, even in a more concentrated market, banks could turn out to be very risk averse and hence could favor safer lending to established firms at the expense of lending to young and financially distressed firms.

3 Econometric Specification and Variables

We adopt a model of capital structure that considers firm-level characteristics (demand determinants), banking sector characteristics at the country level (supply determinants) and general macroeconomic indicators. Hence, the main model we estimate is:

$$\ln Leverage_{ijt} = \alpha + \beta X_{jt-1} + \chi \ln Y_{ijt-1} + \eta Ind_{kjt-1} + \varphi Z_{jt-1} + \alpha_i + \eta_t + \varepsilon_{ijt} \quad (1)$$

with $i=1,\dots,N$ firms, $k=1,\dots,K$ manufacturing sectors, $t=2002,\dots,2007$ years, $j=1,\dots,J$ countries; the residual (ε_{ijt}) is independent and identically distributed. Moreover, in the estimations, all variables are lagged with one period due to endogeneity concerns.

The model above has been estimated by applying a panel fixed effects estimator (here, fixed effects (α_i) refer to the firm level). In addition, we included time fixed effects (η_t) to control for unobserved effects that vary across time rather than across firms and that impact firm leverage (Baltagi, 2008). Consistently with other studies (e.g. Booth et al., 2001; Baert and Vander Vennet, 2009), we also argue that this is the proper estimation method in this setting, as (1) this approach alleviates the omitted variables bias in the setting of unbalanced panels, and as (2) the Hausman test rejected the application of the random effects estimator while showing the fixed effects estimator to be consistent and more efficient. Unfortunately, country and industry dummies cannot be included in the fixed effects model because they are highly correlated with firm fixed effects. Clustering at the country level is not possible, as the number of parameters to be estimated exceeds the number of clusters (Baltagi, 2008). Hence, to control for industry and country fixed effects, we additionally applied a pooled ordinary least squares (OLS) estimation.

Generally, firm leverage is measured in the literature as the book leverage ratio (total firm debt to total assets) or market leverage (debt divided by the sum of book debt plus the market value of its equity). In this respect, market leverage is a forward-looking measure and book leverage represents a backward-looking measure (Frank and Goyal, 2009). We opted for using the book leverage measure because only a few firms in our sample have data on firm equity. In addition, this measure is in line with recent studies (e.g. Coricelli et al., 2010).

X_{jt-1} encompasses banking sector concentration measures at the country level. In line with existing empirical evidence (e.g. Gonzáles and Gonzáles, 2008), our preferred measure of banking sector concentration is the asset share of the five largest banks in the total sum of assets of all credit institutions in a given country (CR5 ratio). Due to potential drawbacks of this measure (such as a considerable correlation with country size), we also applied the Herfindahl index, which is calculated as the sum of the squared market shares (according to total assets) of all credit institutions in a country (ECB, 2006; ECB, 2008). The correlation between these two concentration measures is high and amounts to some 90%. Moreover, note that potential correlations of the concentration measures with

time-invariant firm-, industry- or country-specific characteristics are captured by the chosen estimation techniques above.

Y_{ijt-1} includes firm-level credit (demand) factors used in the corporate finance literature, such as firm size, firm profitability and firm tangibility. These firm-level control variables are in line with those used in other studies on the determinants of firm leverage (e.g. Frank and Goyal, 2009), and their influence is related to the impact of the pecking order theory as well as the tradeoff theory outlined above.

Generally, the impact of the above-mentioned firm-level covariates on firm debt cannot be certified a priori. On the one hand, firm leverage could be positively related to firm size, as larger firms tend to be more diversified and typically have a lower risk of default. On the other hand, though, larger firms are more transparent to outside investors and hence may prefer issuing equity to taking out a loan (Rajan and Zingales, 1995). Furthermore, firm tangibility, measured as the ratio of firm fixed assets to total assets, illustrates the collateral assets a firm could offer when applying for a loan. Its influence on corporate leverage should hence be positive. Moreover, higher firm profitability expresses the generation of cash flow and the firm's preference to finance future investments from internal funds, which is consistent with the pecking order theory (Myers and Majluf, 1984; Booth et al., 2001). Additionally, Jensen (1986) suggests that managers prefer to avoid the disciplinary role of debt in an ineffective market of corporate control; hence, the correlation is negative. In addition, the main model is altered in the robustness tests section later on by adding some interaction variables, such as the interaction terms of banking sector concentration and firm size, firm age and firm-level profits. Finally, in line with Rajan and Zingales (1995) as well as Baert and Vander Vennet (2009), we also include median industry leverage (Ind_{kjt-1}) to capture the target industry capital structure.

Besides the firm-level and banking sector characteristics and in line with other studies (e.g. De Haas and Peeters, 2004; Hanousek and Shamshur, 2011), we also included country-level control variables (Z_{jt-1}), such as GDP growth, the rate of inflation and the EBRD index of development of the financial sector.⁷ Consistently with other empirical studies, the inflation rate could positively influence the level of corporate debt, as it tends to decrease interest rates in the short run. By contrast, inflation could also be negatively related to firm-level leverage, as higher inflation tends to discourage lenders from giving long-term credits. Furthermore, we included GDP growth as a proxy for firm financing needs and thus expect a positive impact. Several studies so far have shown that GDP growth is negatively related to total corporate debt (Demirgüç-Kunt and Maksimovic, 1996). The rationale behind this phenomenon is that since firms with large growth opportunities tend to use less debt, as argued by Myers' hypothesis (Myers, 1977) and as corporate growth is positively related to GDP growth, the impact of economic growth on corporate debt is also negative. The EBRD banking sector index has also been included to capture the development of the banking sector in a country. Hence, this determinant indicates financial deepening, and we expect it to have a positive effect on firm debt leverage.

⁷ Previous studies on the effect of banking sector concentration on firm debt (see Northcott, 2004, for a summary) show that not only the degree of concentration but also certain policies that promote competition and the development of the banking sector have an effect.

Finally, in the robustness section of the paper, we also included the extent of alternative sources of external finance (i.e. the degree of stock market capitalization) as well as other country-level control variables, such as the interest rate and an EU accession dummy.⁸ The EU accession dummy is related to the enhanced availability of different sources of external finance and consequently to the financial deepening process (e.g. the development of stock markets). Hence, we presume that both the higher stock market capitalization and EU accession of these countries would reduce the impact of the concentration of the banking sector. Finally, we also account for the average price of loans (i.e. the real interest rate) and expect a negative effect when banking markets are more concentrated.

4 Data and Descriptive Statistics

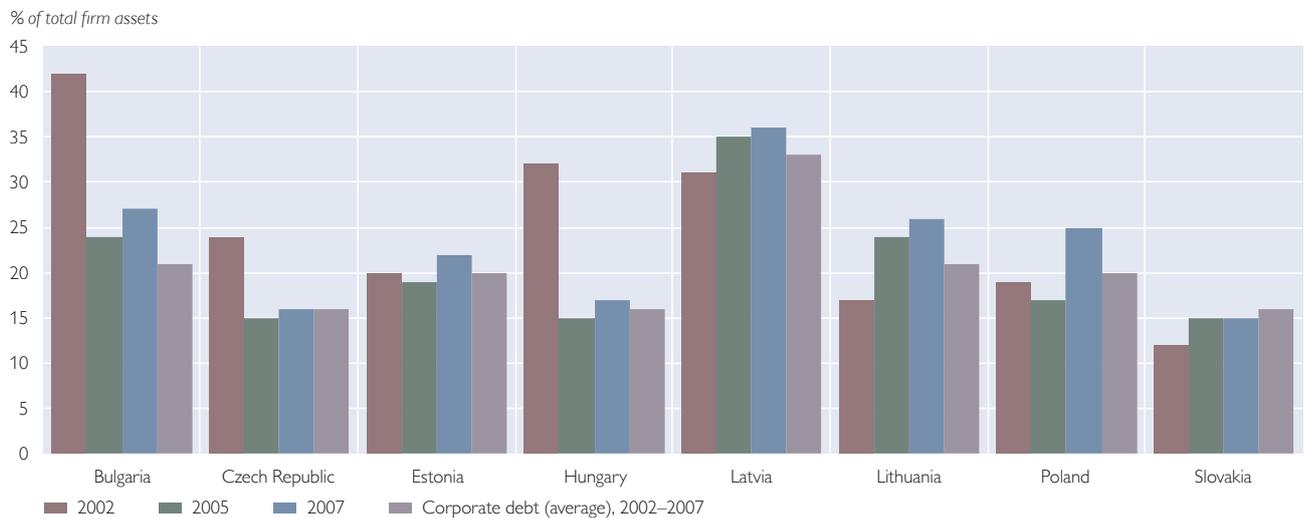
This chapter draws on firm-level data included in the 2009 version of the Amadeus database, which is a pan-European database providing financial statement data for a large set of private and public companies in more than 30 European countries, including the countries in Central and Eastern Europe. The database includes balance sheet and ownership information for companies, but coverage of the relevant variables for the years before 2002 and also in 2008 is limited, so that in the empirical analysis we had to restrict the period to the time from 2002 to 2007. This paper focuses on firms in the manufacturing sectors in eight CESEE countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Slovakia. Hence, the final dataset consists of an unbalanced panel of some 16,000 firms in the manufacturing sectors in our sample of CESEE countries, with firms in the Czech Republic, Hungary and Poland accounting for the prevailing share of firms. Among the key advantages of the data from our perspective is that they cover both listed and unlisted firms of a wide variety of size and age categories. On a negative note, however, the coverage of Amadeus differs across years, sectors and countries. In addition, it is difficult to distinguish between enterprises exiting due to insolvency and enterprises that do not report data for several years. Having that in mind, the Amadeus database still represents one of the key firm-level data sources for cross-country analyses. Next to the firm-level data, we also use country-level measures of banking sector concentration that come from the European Central Bank (ECB), while additional data are drawn from the World Bank and the European Bank for Reconstruction and Development (EBRD). We introduce the data in this section and complement the description with a detailed table in the annex.

Chart 1 shows the cross-country average of firm indebtedness over the period 2002–2007 as well as at three years in this period show not only the average development but also the development over time. Among all firms, the average ratio is 0.21, but the degree of corporate indebtedness of manufacturing firms varies across countries, ranging from 0.16 e.g. in Slovakia to 0.33 in Latvia. When we turn to the change over time, the leverage ratio increased in the period between 2002 and 2007 in most countries, in particular in Latvia and Lithuania. In contrast, in the Czech Republic and in Slovakia, the corporate debt ratio barely changed

⁸ For a definition of the variables, see table A1 in annex 2.

Chart 1

Distribution of the Debt Ratio among Countries



over the period.⁹ This discrepancy could be due to the fact that these countries experienced their credit boom in the 1990s. Compared to studies dealing with Western European data, firm indebtedness as a share of total assets in the sample of our countries is larger, which can be partly explained by the underdeveloped markets for alternative external financing in the CESEE countries. For instance, for firms from EU-15 countries, Baert and Vander Venet (2009) find book leverage ratios that are similar to those of some of the CESEE countries in this study (Poland, Slovakia and the Czech Republic) but not as high as those of Bulgaria and the Baltic countries, where the mean corporate debt ratio is twice as large as the debt ratio in the EU-15 countries.

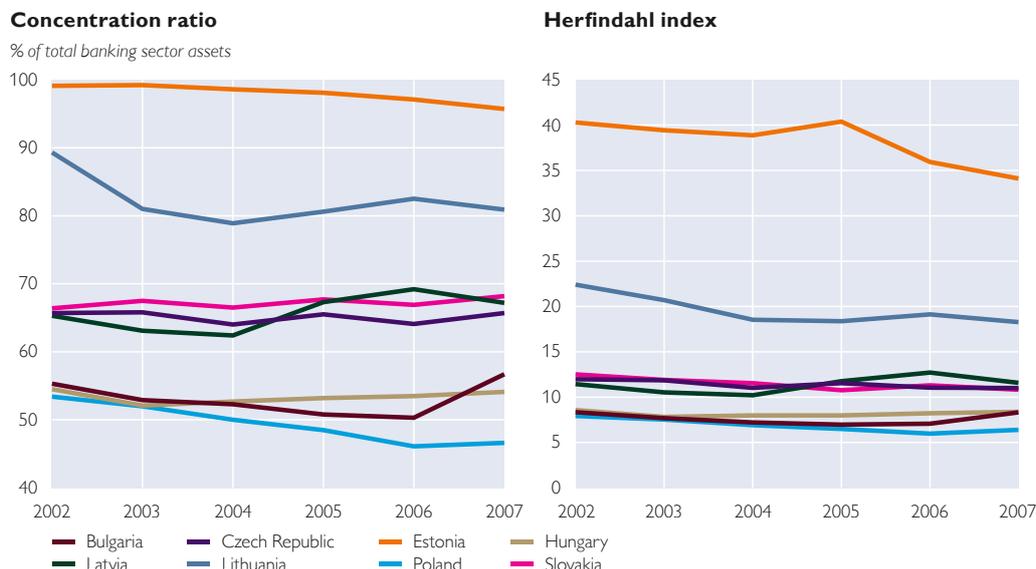
Turning our attention to the structural characteristics (i.e. the level of concentration)¹⁰ of the banking markets in the countries of our sample, a common characteristic is that the banking sectors demonstrate high concentration, but with a large country variance related partly to country size or to the different pace of introducing banking sector regulations (chart 2). For instance, the ratio of the five largest banks in Estonia amounts to over 90% of total assets, while in Poland this value averages some 50%. Moreover, the overall degree of concentration decreased slightly in the observation period, with the exception of Bulgaria, where the banking market shows higher concentration in 2007 than in 2002. In addition, the

⁹ Our data show a peak of the firm debt ratio in 2002 in Bulgaria, the Czech Republic and Hungary and a flattening afterwards. This could be explained by the low number of firms in Bulgaria in 2002 compared to the following years. However, the result is in line with aggregate data from Eurostat for the Czech Republic and Hungary. In addition, calculations of firm indebtedness on the basis of a balanced panel of firms yields a similar pattern of firm indebtedness in most of the CESEE countries in our sample. See the annex 1 for an assessment of the representativeness of the Amadeus database with regard to corporate leverage.

¹⁰ We use the annual banking statistics of the ECB (ECB, 2006; ECB, 2008), which comprise data on different characteristics of the banking market structure in each of the EU member countries.

Chart 2

Banking Sector Concentration Measures in CESEE Countries



Herfindahl index averages around 10, which indicates a moderate degree of competition (again with a large country variation).¹¹

The descriptive statistics of the variables used in the analysis are presented in table 1. The firm book leverage varies among countries and has a mean of 16% and a median of 10% of total assets. The Herfindahl index varies between 5.6 and

Table 1

Descriptive Statistics of Firm-Level and Country-Level Characteristics

	Observations	Mean	Median	Standard deviation	Minimum	Maximum
Firm book leverage	44,893	0.21	0.16	0.18	0	0.99
Firm size (log)	44,791	8.29	8.24	1.44	1.1	15.63
Firm profits (log)	40,406	-2.53	-2.42	0.97	-10.05	-0.48
Firm tangibility (log)	44,668	-1.11	-0.9	0.81	-8.66	-0.12
Industrial leverage (median)	44,893	10.32	9.71	4.58	0.96	18.6
CR5 ratio	48	58.5	53.5	11.9	46.1	99.1
Herfindahl index	48	10.4	8.2	6.8	5.99	40.4
EBRD Banking Index	48	3.61	3.7	0.3	3	4
GDP growth rate	48	5.3	5.3	2.1	1	12.2
Inflation rate (CPI)	48	3.5	2.8	2.3	-1.1	10
Interest rate	48	0.05	0.04	0.034	-0.078	0.14
Stock market capitalization	48	26.5	28.1	12.9	4.7	55.1

Source: Author's calculations.

Note: Firm-level covariates in logs. Descriptive statistics computed after performing the baseline estimations in columns (1)–(2) in table 2.

¹¹ The Herfindahl index is defined as varying between 1 and 100. Values below 5 indicate low concentration, values of 7 to 11 correspond to moderate concentration, and a Herfindahl index of over 11 indicates high concentration. The index was computed on an unconsolidated basis (ECB, 2006; ECB, 2008).

40.4, with a standard deviation of 6.8, whereas the CR5 ratio varies between 46% and 99%, with a standard deviation of 11.9 percentage points. Moreover, the average cross-country share of young firms (i.e. aged less than nine years) is 14.7%, while the large firms and foreign-owned firms in our sample make up some 25% and 22.7% of all firms, respectively. In addition, the number of observations varies due to the unbalanced panel of the dataset.

5 Estimation Results

The baseline estimations with the two banking sector concentration indicators are shown in table 2. In models (1) and (2), a higher concentration of the banking market tends to sustain corporate leverage, which is supported by both competition measures.¹² Hence, an increase by one unit (i.e. one percentage point in the case of the CR5 ratio) of the concentration of the five largest banks in a country increases the corporate leverage ratio by up to 1.2% in the subsequent year, while the impact of the other banking sector concentration measure (the Herfindahl index) shows a positive though insignificant effect.¹³ Moreover, the effect is shown to be nonlinear, as the squared term of the CR5 ratio (in column 3) is negative and significant, implying that after a turning point the effect becomes less positive. Interestingly enough, due to the small magnitude of the quadratic term, the positive effect remains even at higher levels of banking sector concentration. Hence, the results support the relationship lending hypothesis in the theoretical literature and imply that on average, corporate debt increases when banking markets are more concentrated. In addition, in the process of financial deepening in the precrisis period, access to external finance is given also to a larger number of corporates in the economy.¹⁴ Notably, the positive impact of banking sector concentration in Eastern Europe stays in contrast to the results of recent papers analyzing corporate leverage and banking sector concentration in Western Europe (Baert and Vander Venet, 2009). Hence, probably due to the different degree of financial deepening (i.e. also the availability of the alternative sources of financing) and the insufficient protection of creditor and property rights (González and González, 2008), the effects of banking sector competition in the CESEE and the Western European countries differ.

As the fixed effects estimator assumes the same coefficient of the banking sector concentration measure for all countries in our sample, we have explored the country variability of banking sector concentration by applying a country-by-country approach (detailed results are available from the author on request).

¹² As the concentration measures are in levels and the dependent variable is in logarithm, the coefficients can be interpreted as percentage changes. Moreover, all the covariates included in the estimations have been lagged by one period to prevent any reverse causality problems, and the coefficients should be interpreted as the effect of the variable on corporate leverage one year later.

¹³ Even though the Herfindahl index is not significant in our baseline estimation, it yields significant results (table 4). Hake (2012) includes also the Lerner index as a further banking sector concentration measure to verify the robustness of the results. The Lerner index indicates the marginal price to marginal costs in the banking industry in a country (i.e. banks' market power with regard to their price-setting behavior). Interestingly, our results based on this measure also confirm the positive and significant impact of banking sector concentration on firm indebtedness (results are available from the author on request). However, we dropped these estimations from the paper due to the limited availability of data for the index (i.e. only for the period 2002–2005).

¹⁴ Unfortunately, we cannot account for the specific cost (i.e. the interest rate) and the currency denomination of the credit.

Interestingly, the results of table 2 are broadly confirmed (significantly positive in Hungary, the Czech Republic and Poland), with the notable exception of manufacturing firms in Bulgaria, where we obtain a confirmation of the market power hypothesis. The firms in these countries account for some 60% of the total number of firms in our sample. Nonetheless, we believe that the analysis based on the whole range of countries reflects a larger variation in the banking sector concentration measure and hence allows for a more precise estimate of the effects.

Turning our attention to the firm-level characteristics included in the table 2,¹⁵ firm size, firm tangibility and the industry mean debt ratio have positive and significant coefficients. Hence, larger firms and firms that can offer collateral have a larger debt-to-total assets ratio. In particular, our estimations show that a 10% increase in firm size and firm fixed assets leads to an increase of some 0.3% and 1% in the corporate leverage ratio, respectively. In addition, a 10% rise in firm profits leads to a decrease of 0.4% in the leverage ratio, as more profitable firms are apparently able to finance investment either through own cash flow or through the stock market. This result is also consistent with predictions by the pecking order theory. Furthermore, the mean industrial leverage is a common determinant included in other studies (Frank and Goyal, 2009) and represents the target capital structure of an industry.¹⁶ Interestingly, the positive impact of this indicator points to a potential for catching up (0.1% impact on firm leverage).

The analysis of the impact of the country-level characteristics shows that the inflation rate and GDP growth mostly have an insignificant impact on firm leverage. Nevertheless, the inflation rate has the expected positive impact, which can be explained by the decline in real interest rates as inflation increases and the consequent rise in loan demand. This phenomenon could also be related to the high level of corporate loan euroization in the countries in our sample, as both the theoretical and the empirical literature have shown that higher inflation could be positively related to larger share of loan euroization and hence to larger debt ratios. Moreover, the tradeoff theory suggests a positive effect as well, as the real value of tax deductions is higher when (expected) inflation is higher (Frank and Goyal, 2009). In line with previous studies, we have also found that GDP growth reduces the level of corporate debt in total firm assets, which could be explained by the fact that firms are able to earn higher profits in times of economic expansion, which itself (as shown by the impact of firm profits on debt leverage in our estimations) increases the possibility of investment from internal sources (e.g. retained profits) and consequently decreases borrowing from banks. Going further, the positive coefficient of the EBRD index of banking sector reforms reflects the positive impact of a strengthened regulatory framework and enhanced financial intermediation.¹⁷ In particular, the coefficients in table 2 show that an increase of

¹⁵ The control variables included are in line with similar studies (see González and González, 2008).

¹⁶ This measure has been estimated on the NACE Rev.2 4-digit level.

¹⁷ Unreported estimations also included the market capitalization ratio as an explanatory variable even though it has a marginal positive influence on corporate leverage level and shows that higher level of corporate governance standards which emerge from the higher degree of market capitalization translate into a higher degree of leverage. Admittedly, this variable is highly correlated with the EBRD index of banking sector reforms and hence was dropped from the estimations. However, it is included in the robustness checks section.

the EBRD index by one unit (i.e. from 2 to 3)¹⁸ increases the corporate debt ratio by some 20%.

The main results remain broadly the same in columns 4 to 6, where we performed several methodological checks. First, we estimated a balanced panel in terms of our dependent variable instead of an unbalanced panel (column 4). Second, in column (5), a dynamic estimation with a lagged firm leverage ratio was performed by applying the system generalized method of moments (GMM). The validity of the instruments was tested using the Sargan-Hansen test of overidentifying restrictions and the Arellano-Bond test for first and second order autocorrelation. Finally, we also performed a pooled ordinary least squares (OLS) estimation to explicitly account for industry and country fixed effects. Altogether, our main

Table 2

Baseline Results

	(1) CR5 ratio	(2) Herfindahl Index	(3) CR5 ratio squared	(4) Balanced panel	(5) System GMM	(6) Pooled OLS	(7) Endogeneity
CR5 ratio _{t-1}	0.012 *** (0.004)		0.015 *** (0.004)	0.010 * (0.006)	0.014 *** (0.004)	0.010 ** (0.005)	0.035 * (0.018)
Herfindahl index _{t-1}		0.034 (0.075)					
CR5 ratio squared _{t-1}			-0.000 ** (0.000)				
Firm debt ratio (lag) _{t-1}					-0.216 *** (0.007)		
Firm size _{t-1}	0.030 (0.018)	0.030 (0.018)	0.028 (0.018)	0.041 (0.030)	-0.029 (-0.018)	-0.075 *** (0.006)	0.030 ** (0.015)
Firm profits _{t-1}	-0.042 ** (0.007)	-0.042 ** (0.007)	-0.042 ** (0.007)	-0.062 *** (0.011)	-0.008 (0.007)	-0.110 *** (0.007)	-0.042 *** (0.007)
Firm tangibility _{t-1}	0.106 *** (0.017)	0.106 *** (0.017)	0.107 *** (0.017)	0.144 *** (0.028)	0.051 *** (0.016)	0.179 *** (0.009)	0.107 *** (0.013)
Industrial leverage (median) _{t-1}	0.012 ** (0.006)	0.012 ** (0.006)	0.012 ** (0.006)	0.016 * (0.009)	-0.006 (0.005)	0.019 *** (0.007)	0.012 ** (0.005)
GDP growth rate _{t-1}	-0.006 (0.006)	-0.004 (0.006)	-0.006 (0.006)	-0.017 * (0.009)	0.028 *** (0.005)	-0.017 ** (0.008)	-0.008 (0.006)
Inflation rate (CPI) _{t-1}	0.003 (0.005)	0.007 (0.005)	0.002 (0.005)	0.009 (0.008)	-0.005 (0.004)	0.002 (0.007)	-0.003 (0.007)
EBRD Banking Index _{t-1}	0.178 *** (0.052)	0.138 *** (0.051)	0.148 *** (0.051)	0.064 (0.090)	0.156 *** (0.048)	0.237 *** (0.074)	0.251 *** (0.074)
Observations	44,893	44,893	44,893	16,984	44,893	44,893	44,893
R ²	0.071	0.072	0.072	0.091		0.102	0.072
AR(1)					0.00[27]		
AR(2)					0.38[27]		
Hansen/Sargan test					0.80		
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	No	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Author's calculations.

Note: Firm fixed effects estimations. Robust standard errors in parentheses. The firm book leverage ratio is the dependent variable. Columns (1)–(3) are based on firm fixed effects estimations. Estimation (4) uses a balanced panel of firms (according to the leverage ratio). Number of instruments in squared brackets. Instruments include lagged levels of the dependent variable and independent variables dated t-2 or earlier. The tests in the system GMM estimation depict the p-values. Estimations (5) and (6) include country and industry fixed effects. Estimation (7) applies the deposits-to-GDP ratio as well as the EBRD competitiveness index as instruments for the CR5 ratio. The period of estimation is 2002–2007. R² is the within-R². *(**)[***] stands for significance at the 10%(5%)[1%] level.

¹⁸ The EBRD index changes in 0.3 steps. For more details see <http://www.ebrd.com/pages/research/economics/data/macro.shtml>.

result – the positive impact of banking concentration on firm book leverage – remains very stable across these different estimation techniques. The impact ranges from 1% to 1.4% in the case of a one percentage point increase in the CR5 ratio.

Finally, an issue in the estimations is whether the banking sector itself is influenced by firms' financing decisions, i.e. whether banking sector concentration influences firm-level debt or vice versa (the reversed causality problem with endogenous regressors as a consequence). Indeed, a higher demand for external financing due to increased levels of investment would induce changes in the banking sector structure, for instance through the entry of foreign banks. By contrast, lower demand for corporate debt could reduce bank profitability and hence could, in the extreme, lead to an exit of banks. Hence, an additional aspect of our analysis is to account for this potential endogenous relationship. Following contributions in the corporate finance literature that deal with the impact of banking sector concentration (i.e. Baert and Vander Vennet, 2009; Cetorelli and Gambera, 2001), we use total deposits as a share of GDP, the EBRD competition measure on the country level as well as the interaction of these two variables to derive an instrument for the banking concentration measure in column (7) of table 2. After verifying that the chosen instruments are valid ones (test for overidentifying restrictions), we applied a two-stage least squares (2SLS) instrumental variable estimation of the fixed effects panel data model. Interestingly, the effect of banking sector concentration appears to be even more pronounced (it nearly triples) if potential endogeneity is taken into consideration.

6 Robustness Section: Heterogeneity of the Impact of Banking Market Concentration

In this section, we focus on the potential heterogeneity of the impact of banking sector concentration on corporate leverage. Hence, we address the question whether the impact of the banking concentration measures vary with respect to firm characteristics (such as firm age, firm size, firm profitability and ownership status) and various country-level characteristics. In addition, we examine whether the degree of competition (i.e. above and below the median of the banking sector concentration measures) affects firm leverage differently.

First, we test whether the implications of the relationship (information-based) hypothesis also apply homogeneously for all firms, i.e. whether we can identify firm-specific differences according to the age of the firm. Previous empirical studies (e.g. Cetorelli and Gambera, 2001) found that even if the theory of relationship lending could not be corroborated in general, the impact of banking sector concentration is different (i.e. positive) for young firms. The rationale is that young firms are more dependent on external financing because their own cash flow is insufficient and access to the stock markets is more complicated. Hence, in a more concentrated banking market, due to relationship lending (i.e. banks could invest in the reduction of information asymmetries), young firms could reschedule their payments over several periods and pay less at the beginning and increase their repayment later on. In addition, firm age is a proxy for the information on firm quality, which is revealed to the market as a whole.

Following Rajan and Zingales (1995), who show that U.S. firms raise their external financing up to the tenth year of their life, we test whether young firms

will benefit from banking sector concentration (in terms of higher leverage in more concentrated markets, table 3) by adding an interaction term of a firm age-dummy and the respective banking sector concentration measure. Columns (1) and (2) show the effect of the banking structure on young firms (younger than nine years). Here, again, our results are consistent with the relationship hypothesis according to which young firms increase their debt ratio in more concentrated banking markets. In particular, the results in column (1) prove that the young firms in our sample increase their leverage by 1.3% when the CR5 ratio increases by one unit (i.e. 1 percentage point), whereas the effect as measured by the CR5 ratio for all firms is 1.2%. In line with these results, the coefficient of the interaction with the Herfindahl index also confirms the positive impact for the young firms in our sample.

Going further, we consider the group of mature firms (firms older than ten years) in columns (3) and (4). Here, again, the results of the baseline estimations are broadly confirmed, though the interaction terms of the firm age dummy and the banking sector concentration measure are now negative and significant. This implies that mature firms use either cash flow or alternative sources of external financing (i.e. corporate bonds, stocks) when the banking sector is more concentrated, hence supporting the pecking order theory. In addition, we could interpret this result as a demand effect. Due to the information on firm quality disclosed to the public for mature firms, unlike for young (start-up) firms, mature firms can use alternative sources of external finance. When we turn our attention to the magnitude of the impact, we see in table 3 that the interaction terms with one of the bank sector concentration measures (the CR5 ratio) imply that while on average the effect is 1.2% (caused by one unit increase of CR5 ratio), mature firms increase their leverage ratio by only 0.9%. In contrast, the interaction with the Herfindahl index shows an even stronger negative effect for mature firms, namely a decrease in firm leverage of some 4% caused by a one unit increase of the Herfindahl index. Overall, though, the effect remains positive.

In a next step, we focus on the heterogeneity of the results with respect to further firm characteristics, i.e. more profitable firms, foreign-owned firms and firms from different size classes. More profitable firms (column 5) reduce their debt in a more concentrated banking market, implying that investment projects are presumably financed mainly by cash flow, which is in line with the pecking order theory. Accordingly, less profitable firms benefit more from concentrated banking markets, backed by the negative interaction term with the banking sector concentration ratio. Furthermore, most likely on the back of existing relationships of the banks with the parent firms,¹⁹ the debt of foreign-owned firms is increased by the higher banking sector concentration, though the effect is only marginally significant. In particular, the effect on firm leverage increases to 1.8% in the case of foreign-owned firms (in comparison to nearly 1.0% on average for the whole sample of firms). To conclude, the leverage ratio of larger firms in our sample (column 7) is also shown to increase on account of banking sector concentration due to the positive relation between the manufacturing industry and banking sector concentration (Cetorelli and Gambera, 2001), especially in sectors that are

¹⁹ The share of foreign-owned banks in the countries of our sample is more than 60% of total bank assets in the period covered (ECB, 2006; ECB, 2008).

Table 3

Firm Characteristics and the Effects of Banking Sector Concentration

	(1) Young firm	(2) Young firm	(3) Mature firm	(4) Mature firm	(5) Profitability	(6) Foreign firm	(7) Large firm
CR5 ratio _{t-1}	0.010 ** (0.004)		0.010 ** (0.004)		0.008 ** (0.004)	0.010 ** (0.049)	0.010 ** (0.004)
CR5 ratio _{t-1} *young firm (dummy)	0.003 * (0.002)						
Herfindahl index _{t-1}		0.083 (0.078)		0.018 * (0.006)			
Herfindahl index _{t-1} *young firm (dummy)		0.088 * (0.045)					
Young firm (dummy)	-0.236 ** (0.002)	-0.070 ** (0.029)					
CR5 ratio _{t-1} *mature firm (dummy)	-0.003 * (0.001)		-0.003 * (0.001)				
Herfindahl index _{t-1} *mature firm (dummy)				-0.039 ** (0.019)			
Mature firm (dummy)			0.220 ** (0.106)	0.113 *** (0.039)			
CR5 ratio _{t-1} *large firm (dummy)							0.001 *** (0.000)
Large firm (dummy)						0.008 * (0.005)	
CR5 ratio _{t-1} *foreign firm (dummy)						-0.427 (0.283)	
Foreign firm (dummy)							
CR5 ratio _{t-1} *firm profitability _{t-1}					-0.001 *** (0.001)		
Firm size _{t-1}	0.039 ** (0.020)	0.039 ** (0.020)	0.040 ** (0.020)	0.039 ** (0.020)	0.028 (0.018)	0.030 * (0.018)	
Firm profit _{t-1}	-0.047 *** (0.007)	-0.047 *** (0.007)	-0.047 *** (0.007)	-0.047 *** (0.007)	0.032 (0.028)	-0.042 *** (0.007)	-0.042 *** (0.007)
Firm tangibility _{t-1}	0.107 *** (0.017)	0.106 *** (0.017)	0.107 *** (0.017)	0.107 *** (0.017)	0.105 *** (0.107)	0.106 *** (0.017)	0.106 *** (0.107)
Industrial leverage (median) _{t-1}	0.012 ** (0.006)	0.012 ** (0.006)	0.013 ** (0.006)	0.012 ** (0.006)	0.012 ** (0.006)	0.012 ** (0.006)	0.011 * (0.006)
GDP growth rate _{t-1}	-0.006 (0.006)	-0.004 (0.006)	-0.006 (0.006)	-0.004 (0.006)	-0.005 (0.006)	-0.004 (0.006)	-0.005 (0.006)
Inflation rate (CPI) _{t-1}	0.004 (0.005)	0.008 (0.005)	0.004 (0.005)	0.007 (0.005)	0.003 (0.005)	0.003 (0.005)	0.004 (0.005)
EBRD Banking Index _{t-1}	0.187 *** (0.055)	0.148 *** (0.054)	0.185 *** (0.055)	0.145 *** (0.054)	0.179 *** (0.052)	0.193 *** (0.053)	0.172 *** (0.052)
Observations	40,845	40,845	40,820	40,820	44,893	44,893	44,792
R ²	0.081	0.072	0.081	0.081	0.091	0.073	0.073
Firm fixed effects	Yes						
Time fixed effects	Yes						

Source: Author's calculations.

Note: Firm fixed effects estimations. Robust standard errors in parentheses. The firm book leverage ratio is the dependent variable. The number of observations in specifications (1)–(4) is lower due to missing data for the firm age variable. All regressions include firm and time fixed effects. The period of estimation is 2002–2007. R² is the within-R². *(**)[***] stands for significance at the 10%(5%)[1%] level.

highly dependent on external finance. Hence, our study shows that bank concentration enhances industries' market concentration.

Next, we turn our attention to the heterogeneity of the results that is due to country-level characteristics. First, we split our countries into two country

samples according to the concentration of their banking sectors and test whether the effect on the leverage ratio of the firms in the countries with the most concentrated banking sectors is different from the baseline results in table 2.²⁰ The mean of the concentration ratio of the five largest banks in the sample of countries in the period from 2002 to 2007 is some 59%. In a next step, we estimate the effect for the group of countries below the mean of the concentration measure (Bulgaria,

Table 4

Banking Sector Concentration and Country-Level Characteristics

	(1) High concentration	(2) Real interest rate	(3) EU dummy	(4) Stock market capitalization
CR5 ratio _{t-1}	0.013 *** (0.004)	0.014 *** (0.004)	0.016 *** (0.005)	0.019 *** (0.006)
CR5 ratio _{t-1} *high concentration (dummy)	-0.028 ** (0.013)			
High concentration (dummy)	2.281 ** (1.058)			
CR5 ratio _{t-1} *real interest rate		-0.009 ** (0.005)		
Real interest rate _{t-1}		0.004 (0.003)		
CR5 ratio _{t-1} *EU dummy			-0.002 ** (0.001)	
EU dummy			0.106 (0.070)	
CR5 ratio _{t-1} *stock market capitalization _{t-1}				-0.001 ** (0.001)
Stock market capitalization _{t-1}				0.006 (0.004)
Firm size _{t-1}	0.028 (0.018)	0.030 (0.018)	0.033 * (0.018)	0.031 * (0.018)
Firm profit _{t-1}	-0.042 *** (0.007)	-0.042 *** (0.007)	-0.043 *** (0.007)	-0.042 *** (0.007)
Firm tangibility _{t-1}	0.106 *** (0.017)	0.105 *** (0.017)	0.106 *** (0.017)	0.106 *** (0.017)
Industrial leverage (median) _{t-1}	0.011 * (0.006)	0.011 ** (0.006)	0.012 ** (0.006)	0.011 * (0.006)
GDP growth rate _{t-1}	-0.005 (0.006)	-0.004 (0.006)	-0.011 * (0.006)	-0.013 ** (0.006)
Inflation rate (CPI) _{t-1}	0.002 (0.005)	-0.000 (0.006)	0.002 (0.005)	-0.000 (0.005)
EBRD Banking Index _{t-1}	0.181 *** (0.053)	0.201 *** (0.054)	0.172 *** (0.052)	0.213 *** (0.054)
Observations	44,893	44,893	44,893	44,893
R ²	0.071	0.091	0.072	0.083
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

Source: Author's calculations.

Note: Firm fixed effects estimations. Robust standard errors in parentheses. The firm book leverage ratio is the dependent variable. All regressions include firm and time fixed effects. The period of estimation is 2002–2007. R² is the within-R². *(**)[***] stands for significance at the 10%(5%)[1%] level.

²⁰ The nonlinear effect of the CR5 ratio was already shown in table 2.

Hungary, and Poland) and above it (the Czech Republic, Estonia, Latvia, Lithuania and Slovakia). It is evident that on average, banking sector concentration is favorable for corporate indebtedness, which strongly contradicts the results of studies with Western European firm-level data (e.g. Baert and Vander Vennet, 2009). This implies that in the oligopolistic setting of the banking sector in Eastern Europe with several dominating banks, relationship lending tends to prevail. Hence, the private sector debt level is on average not restrained. Interestingly, though, for the countries with the most concentrated markets, the impact of the interaction variable on corporate leverage turns out to be negative and significant. Consequently, support for the market power hypothesis can be found for the most concentrated markets (e.g. Lithuania and Estonia with a CR5 concentration ratio of more than 59%). This result suggests that a higher degree of banking market concentration lowers firm debt. In particular, the effect is negative (−1.5% for a one percentage point increase of the CR5 ratio).

Column (2) in table 4 shows the estimations of the impact of the overall interest rate level on corporate leverage in a country. The results are intuitive and show a negative effect on average, as the higher interest rate reduces firm book leverage. Overall, though, the impact of the CR5 ratio remains positive. In a next step, we included a dummy variable set at 1 after a country signed the EU Accession Treaty and at 0 before this date to test whether an EU accession perspective impacted corporate leverage. Consequently, the announcement of EU membership has a dampening effect on the positive impact of corporate leverage, implying that firms resorted more heavily to alternative sources of external financing and that the financial deepening process intensified in the run-up to the crisis in 2008. Finally, in column 4, we tested the impact of the market capitalization ratio on leverage. It turned out to be negative, which again reflects access to external finance on the stock market. Hence, firms with access to stock markets consider alternative sources of external capital, even more so if banking markets are concentrated.

7 Concluding Remarks and Policy Implications

The entry of foreign banks in the financial sectors of the CESEE countries and mergers between banks in the 1990s and 2000s fundamentally changed the structure of CESEE banking sectors and increased sector concentration. This paper analyzed the impact of the banking sector structure on firm leverage in selected CESEE countries in the period up to 2007 based on firm-level data.

Based on a sample of manufacturing firms in eight CESEE countries, we determined that increasing concentration in the banking market is associated with a larger amount of corporate credit in most countries. This result contradicts the empirical evidence on bank corporate debt in Western Europe and the U.S.A. We trace these findings back to the relationship (i.e. information-based) theory, which states that banks in concentrated markets are able to invest more in the reduction of information asymmetries and hence can compensate the higher risk of certain projects by sharing the future profit streams of the firm. As a consequence, banking sector concentration does not have a negative impact on corporate debt or economic growth, as the traditional theory of industrial organization per se would predict, and in fact it could even be positive. Furthermore, this paper showed that young firms (i.e. usually financially constrained firms) benefit from more concentrated banking markets, which is in line with previous empirical contributions

using Western European or U.S. data. In addition, mature firms have a lower leverage ratio when banking markets are more concentrated, which could be interpreted as a demand effect: Such firms' demand for bank credit may be lower, as they have better access to other forms of external finance. Our results on the differentiation of the impact according to further firm-level characteristics indicate that less profitable firms, larger firms and foreign-owned firms show higher leverage in more concentrated banking markets.

In addition, our results indicate that the sample of CESEE countries used here is not fully homogeneous. Consequently, in countries where the banking sector concentration of the five largest banks in a country exceeds 80% on average (Estonia and Lithuania), the effect on corporate leverage is negative. Further results of the paper on firm-level characteristics show that the positive impact of banking sector concentration on firm leverage is reduced by the improved availability of alternative sources of external finance, the interest rate level in the country as well as EU membership, the latter suggesting the development of financial markets and an increasing complexity of the financial markets in the region.

In conclusion, as shown by our analysis, banking sector concentration does not hamper the availability of bank finance, which was a key factor for economic growth and corporate investment projects in CESEE countries in the precrisis period, at least up to a certain threshold of concentration. More specifically, the probability of higher loan costs coupled with a lower amount of debt could rise if banking sectors are very concentrated. As lending to new innovative firms could suffer in an oligopolistic setting, a tradeoff between the quantity of the credit and the quality of the borrowers could emerge over time, which, looking forward, could be a risk to financial stability. In addition, shifting our attention to the impact on the real economy, high corporate leverage could precipitate an economic downturn by triggering a sharp contraction of investment. Therefore, from a policy perspective, on the one hand, it would be desirable to keep a cautious stance on mergers in the banking sector that threaten to raise banking sector concentration to very high levels. In such a situation, competition policy would have to play a role in preventing the banking market from becoming overly concentrated and potentially having a negative impact on firm leverage. On the other hand, though, against the background of high private sector debt levels in the CESEE countries, policymakers need to be able to assess the sustainability of private sector debt, given that excessive leverage amplifies macroeconomic downturns and poses a threat to macroeconomic recovery after the crisis.

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Annex I

Coverage of Firm Leverage in the Amadeus Database

A key issue for our analysis is the representativeness of the Amadeus database. To obtain an indication of the representativeness of the Amadeus database, we compared the coverage of corporate leverage in Amadeus with leverage data from Eurostat's Financial Accounts Statistics. Unfortunately, the validity of this comparison is limited, as corporate leverage data from Eurostat are available only for nonfinancial corporations at the aggregate level, whereas our study deals only with firms in the manufacturing sector. Nonetheless, the unweighted corporate debt-to-total-assets ratio amounts to 0.25 in the period from 2002 to 2007, a value close to that obtained from our computation (0.204). However, large country-specific differences can be detected. This can most likely be traced to the somewhat different industry composition of the two samples. In Hungary and Estonia, for example, the leverage ratio at the aggregate level is some 10 percentage points higher than the leverage ratio obtained from Amadeus, while in Poland, the Czech Republic and Slovakia, which account for over 50% of the total number of firms in our sample, the average leverage ratio differs by less than 3 percentage points.

Annex II

Table A1

Description of Variables

Variable	Definition	Data source
Firm-level data		
Firm book leverage	The ratio of the sum of short-term debt and long-term loans to total assets, in logarithm	Amadeus
Firm size	Total firm sales, in logarithm	Amadeus
Firm profit	The ratio of earnings before interest and taxes to firm total assets, in logarithm	Amadeus
Firm tangibility	The ratio of firm fixed assets to total assets, in logarithm	Amadeus
Industrial leverage (median)	The median book leverage of an industry at the four-digit level	Amadeus
Mature firm (dummy)	The dummy is 1 if a firm was established for more than ten years before 2007 and 0 otherwise	Amadeus
Young firm (dummy)	The dummy is 1 if a firm was established up to nine years before 2007 and 0 otherwise	Amadeus
Foreign firm (dummy)	The ownership stake of a foreigner is at least 10%	Amadeus
Large firm (dummy)	The dummy is 1 if a firm has a number of employees above the mean of our sample (i.e. 150 employees)	Amadeus
Country-level data		
CR5 ratio	Market share of the largest five banks in a country	ECB
Herfindahl index	The sum of the squared market shares of banks in a country	ECB
EBRD Banking Index	Index measuring reforms in a country's banking sector. It ranges between 1 and 4+; 4+ corresponds to the standards of an industrialized market economy	EBRD
GDP growth rate	Year-on-year change in a country's real GDP in percentage points	Eurostat
Inflation rate (CPI)	Change in a country's CPI in percentage points	wiiw, Eurostat
Interest rate	Lending interest rate adjusted for inflation as measured by the GDP deflator in a country, in percentage points	World Bank
Stock market capitalization	Share price times the number of shares outstanding of listed companies at the end of the year, as a percentage of GDP	World Bank
EU dummy	The dummy is 1 after the year in which a country signs the EU accession treaty and 0 before this date	
Deposits-to-GDP ratio	Deposits of other resident sectors	national central banks
EBRD Competition Index	Index measuring a country's competition policy reforms. It ranges between 1 and 4+; 4+ corresponds to the standards of an industrialized market economy with effective enforcement of competition policy and unrestricted entry in most markets	EBRD