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Three Essays on Banking Market Effects on Market Structure in Non-financial Industries

by

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Abstract

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The dissertation studies banking market's repercussions in non-financial industries, focusing on the effects of banking concentration and competition. The first essay is a replication of an existing econometric study of banking concentration effect on product market concentration for a different geographical and time domain. A fixed effects approach is applied to a sample of 25 EU countries in the period 1995-2004. The results contrast the existing findings and show that greater banking concentration leads to more fragmented industry structure in advanced EU countries, but it has no significant effect in transitional countries. The second essay aims further to contribute to the understanding of this relationship by employing theoretical analysis apparatus. Contrary to relevant theoretic studies, firms are not considered only as investment projects for banks, instead the focus is on the determinants of firm entry and product market structure. Building on the more recent bounds approach, the results offer theoretical justification for the relationship identified in the first essay and expose a market size effect on the banking concentration effect. Banking concentration affects medium and small product markets, but not large ones. In small markets, greater banking concentration always leads to more concentrated product markets, whereas in medium markets, it can also lead to less concentrated product markets. The third essay corrects another weakness of existing econometric studies by distinguishing between concentration and competition in banking markets and analyzing their effects on product market structure. Using a recently introduced measure of competition on a sample of transitional EU countries, this essay finds that banking competition indeed has an effect on firm size and entry, but banking concentration *per se* does not. The results show that greater banking competition increases average firm size and decreases entry, which leads to greater concentration in product markets.

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Chapter 1

Overview

The importance of banking markets' repercussions for the real economy has become painfully clear in the aftermath of the autumn 2008 financial and banking crises. Conditions in banking markets affect not only the birth, life, and death of individual firms but also the growth and development of industries and economies (see for example, King and Levine, 1993; Demirgüç-Kunt and Maksimovic, 1998; Rajan and Zingales, 1998; Levine, Loayza, and Beck, 2002). Concentration and competition in banking markets are among the most important characteristics influencing and also reflecting the behavior and performance of banks. Essays in this dissertation focus on the effects that banking concentration and competition have on firms in product markets. Studies by Cetorelli and co-authors (Cetorelli, 2001, 2004; Cetorelli and Strahan, 2006) were the first to reveal a very robust positive relationship between banking and product market structure implying that more concentrated banking markets could lead to more concentrated product markets. These studies were carried out for OECD countries' and U.S. banking and product markets for the period 1987-1997. The proposition that concentration in banking markets could affect market concentration in other non-financial industries might seem questionable at first sight, but the empirical evidence reported by Cetorelli are sufficiently robust, and the potential consequences of a true causal relationship between both market structures are important enough, to have motivated further research presented in this Dissertation.

As a first step, Cetorelli's studies needed further replications for other domains in order to gain confidence in the correctness of hypotheses behind the studies and to obtain valuable contribution to theory-building and generalization to other domains. The first essay in the Dissertation (Chapter 2) thus studies EU member countries in the period 1995-2004, when the consequences of the Second Banking Coordination Directive of 1993 have fully developed and banks from the European Union have branched freely

into other EU countries. The processes of liberalization and disintermediation have affected market structures and competitive conditions in banking markets throughout Europe, including transitional countries, which have experienced periods of rapid entry and subsequent consolidation following the breakdown of command and social economic systems in the early 1990's. Because the evolution of banking and product markets was so different in transitional countries, we were specifically interested in the validity of Cetorelli's findings for them.

Using Bankscope data for banking markets and Eurostat's data for industrial sectors in 25 EU countries, we employed panel data analysis to estimate the effect of banking concentration on product market structure. UNIDO's data for industrial sectors were also used for checking robustness of results. We expected to find confirmation for the positive relationship between banking and product market structure in non-transitional EU countries, but our data revealed a robust negative relationship in these countries. This shows that the positive relationship identified by Cetorelli has turned into a negative one after 1995 in more developed EU countries and suggests that in these countries more concentrated banking markets lead to more fragmented industries. Our study also showed that this relationship is indeed different in transitional countries, but it is not clear if banking concentration affects product market structure at all since the estimates are mostly statistically non-significant and not very robust. Some of the robustness checks have lead us to believe that we should study the effect of banking competition instead of banking concentration since the two are not necessary monotonically related. Also, the results suggest that banking concentration effect depends on economy or banking market size: in large countries there is most likely no effect, in small ones the effect is positive and in medium ones it is negative.

The lack of in-depth theoretical analysis of various aspects of the relationship between banking and product market structures in existing empirical studies motivated the topic of the second essay (Chapter 3). Specifically, the determinants of product market structure were not considered adequately in the existing theoretical models which link banking and product market structures. Thus we develop a model of relationship between banking and product market structure and use comparative static analysis to study the effects that banking market concentration has on product market structure. In industrial organization literature, market power – measured by market share – is traditionally explained either as the cause of firm conduct and performance (SCP theory) or as the result of firm efficiency (efficient structure theory). A synthesis of both approaches was proposed by Sutton (1991, 1998) under the name "bounds approach". In his view, market structure is determined by the toughness of price competition, externalities' effects and escalation effects. We use his Cournot model with perceived quality with free entry to model the product market, while we model the banking market as a Salop circle city

with no free entry and possible information asymmetry. Banking market is considered as an upstream market for the product market, providing firms with funds for entry and enlargement operations. We analyze a three stage symmetric Nash-Cournot game in the product market coupled with a symmetric two stage game in the banking market where banks compete in prices.

The model confirms that banking concentration affects firm entry in product markets, but it is limited to small and medium markets. Market structure in large product markets will not change considerably if banking concentration is increased. Small markets are defined in this setting as markets with exogenous fixed and sunk entry costs, where investments in enlargement operations do not allow firms to increase market shares over their rivals' and firms therefore do not engage in them. In such markets, banking concentration has a positive effect on product market concentration. Medium markets are defined as markets with endogenous fixed and sunk costs of enlargement that follows entry, where the number of firms is low enough not to lead to asymptotic behavior. Firms are encouraged to invest in enlargement since it allows them to increase market share above their rivals'. In such industries, banking concentration can have a positive or a negative effect on product market concentration. The sign of the effect depends on the elasticity of costs and the rate of returns to enlargement if there are no information asymmetries in the banking market; when information asymmetries are present, the sign depends on the relationship between the cost of entry and cost of enlargement. In the latter case, banking concentration has a negative effect in industries where the cost of enlargement exceeds the cost of entry and a positive effect in industries where the reverse is true (but above a critical entry cost level). These results are broadly consistent with empirical findings of the first essay regarding the market (or economy) size effect on the relationship between banking and product market structures.

The third essay attempts to correct another weakness of the existing empirical studies by distinguishing between the effects of banking concentration and banking competition (Chapter 4). Even though theoretical contributions underpinning the empirical studies mostly analyze the effects of banking competition, empirical studies use concentration measures as a proxy for competition. This approach is quite arguable since numerous studies have established that competition and concentration are not always monotonic. In fact, the SCP theory, which provides theoretical justification for monotonicity, did not receive much support for transitional countries (Gelos and Roldós, 2004; Yildirim and Philippatos, 2007; Mamatzakis et al., 2005) and it is controversial also in advanced economies. Therefore in this essay, we first estimate a measure of banking competition and then investigate the effects of baking concentration *and* competition on product markets in 10 transitional EU countries in the period 1997-2004. There have been several approaches proposed to measure competition, most popular being the Panzar-Rosse

(1987) H statistics. We opt against the use of this statistics because values between 0 and 1 (most often results in empirical estimations) indicate only if market conditions are consistent with monopolistic competition or oligopoly and the yearly changes in H are hardly interpreted as a move toward more or less competition. Instead, we use the recently proposed profit elasticity (PE) to changes in cost efficiency as a measure of competition (Boone, 2000). Our study is the first to apply Boone's indicator of competition to transitional banking markets.

The data source and the econometric approach are the same as in the first essay. Our results show that banking competition in transitional countries has been intensifying till around 2001 and then it has started to weaken. Boone's indicator of competition shows a similar general trend of competitive conditions in transitional banking markets as the Panzar-Rosse H statistics reported by other empirical studies (Bikker and Spierdijk, 2008; Yildirim and Philippatos, 2007b) what gives confidence in its use as a competition measure. At the same time, the traditional concentration measures (market share of three largest banks and Herfindahl-Hirschman index) show a tendency to consolidation throughout the whole period in most countries, which traditionally leads to the conclusion that competition was constantly weakening. Beside confirming that competition should not be measured by concentration proxies, the results of this study confirm that it is in fact banking competition that affects product market structure and not banking concentration as it was reported in the literature. Banking concentration effect was not statistically significant in any of the model specifications, while banking competition effect was significant in practically all of them. Banking competition had a positive effect on average firm size in transitional industrial markets and a possible negative one on firm entry; both effects lead to more concentrated product markets when banking competition is increased. When economy size is taken into consideration, the estimations show that banking concentration and competition affect product market structure in small countries, only banking competition has such effects in medium countries and neither of them affects product markets in large countries.

Chapter 2

Banking concentration and industrial sectors' market structure in transitional countries

2.1 Introduction

In this study I investigate whether there is a relationship between market concentration in banking markets and market concentration in industrial sectors. Specifically, I would like to empirically find out if the fact that a country has a more concentrated banking market indicates that the manufacturing sectors in that country are also more monopolized or not. This interesting question has many implications for the banking regulation policy, especially regarding the number of banks allowed to operate in a particular territory, competition policy and the allowed mergers and acquisitions in the banking markets. The effects that banking markets have on product markets should be taken into account also when considering the tradeoff between financial stability and competition in banking markets. Also, there is more and more empirical evidence for the large contribution of firm dynamism (entry and exit), concentration and competition to productivity growth in manufacturing industries (see for example Geroski, 1995; Caves, 1998; Sutton, 1997; Nickell, 1996; Pakes and Ericson, 1998; Bartelsman and Doms, 2000; Davis and Haltiwanger, 1999; Bartelsman, Haltiwanger and Scarpetta, 2004; Aghion and Howitt, 2005). Furthermore, since product market structure and competition also affect innovation (see for example Aghion et al., 2005; Geroski, 1990), banking market structure could be viewed also as an instrument for promoting or abating innovation.

Previous empirical studies of the relationship between product market and banking market concentration have been carried out only for developed countries (Cetorelli, 2001

and 2004; Cetorelli and Strahan, 2006). They have all found a positive relationship between both market concentrations. Taking into consideration the mechanisms that have been offered as explanations for the identified relationship and the specifics of transitional process that created banking and product markets in transitional countries, I believe that this relationship is not the same as in developed countries. Besides, the rapid processes of entry and consolidation in transitional banking markets could help us add to the knowledge about the evolution of the relationship between both market structures, in general.

In the following paragraphs I will first present a review of literature, which is relevant for the research question. The section involves literature on financial and banking markets dealing with relationships between banks and firms, which is divided into two parts. In the first part I present theoretical and empirical findings that try to explain the positive relationship between banking market and product markets structure. The second part is formed by literature explaining the negative relationship. The literature review section is followed by the description of the evolution of banking markets in transitional countries, which is necessary for understanding and interpretation of empirical results. After that, we present the methodology and the econometric model used. We draw on the model developed by Cetorelli (2001 and 2004) and since the scope of this paper is explorative in nature, we aim to see if the results of his studies can be confirmed for a different set of countries and a different time period. Next, we present the data used in the estimation and the results obtained. The discussion section concludes the paper with a commentary on results and points out further research needed to overcome some of the weaknesses of the approach used in this paper.

2.2 Literature review

The literature on the interaction between product and financial markets is very extensive, in general. Since Brander and Lewis (1986) showed the limited liability effect where debt deters entry by promoting tougher behavior in product market, there have been many contributions that study this relationship. The literature has extended in various directions. Papers by Maksimovic (1998) and Spagnolo (2000) analyze the effects of firms' capital structure on incentives for collusive behavior. Poitevin (1989) and Bolton and Scharfstein (1990) focus on financial incentives for incumbents' predatory practices. Aghion, Dewatripont and Rey (1999) show how the firm's need for external finance interacts with their product market behavior. Bhattacharya and Chiesa (1995) explore the potential of lenders to induce and coordinate collusion among innovative firms in product markets. Empirical work by Chevalier (1995), Chevalier and Scharfstein, 1996),

Philips (1995), Kovenock and Philips (1995, 1997) confirm there are indeed financial reasons (especially increased debt) that can influence product market behavior.

Another extensive strand of literature that contributes to the question of relationship between banking and product market structures is concerned with the role of financial markets in explaining economic growth. For example, studies from Demirguc-Kunt and Maksimovic (1998), Rajan and Zingales (1998), Levine, Loayza and Beck (2000) show that more developed financial markets promote economic growth (see also a survey by Levine, 1997). Pagano (1993) theoretically finds that banking market power has a negative effect on economic growth. On the other hand, Petersen and Rajan (1995) empirically confirm their theoretical model where banks with market power are more willing to finance young firms. Similarly, Hellman and DaRin (2002) theoretically and empirically find that to act as catalysts for industrialization and promote new industries, banks have to be large and with market power.

However, there is not much specific literature about the relationship between two market structures, especially one linking two markets as different as banking markets and the markets of manufacturing sectors. The first one to research this question was Cetorelli in his two papers (2001 and 2004). The question appeared as a side branch of the literature dealing with the effects of financial markets on economic growth. Cetorelli (2001) was the first that attempted to collect and interpret the existing scattered literature and historical evidence.

The key to the question "Why should there be any link between product and banking market concentration?" lies in the bank-firm relationship, which is an obvious condition for the existence of such a link. Bank behavior affects firm behavior and can thus have an influence on product market structure. Existing literature, however, does not provide a unified answer about the nature of this relationship nor about the causal mechanisms that drive it. Historical, theoretical and empirical evidence support explanations of a positive as well as a negative relationship.

When the relationship is positive, more concentrated banking markets create more concentrated product markets. Two hypotheses for this direction of causation are offered by Cetorelli (2001, 2004). According to the first one, banks prefer to finance incumbent firms over entrants in order to shield incumbents' profits and thereby increasing their own profits. If banks have more market power, they are supposed to be more inclined to behave in this manner. The contributions that provide theoretical frameworks consistent with this explanation are Cestone and White (2003) and Spagnolo (2000). Both have some important limitations, which are discussed more in detail in the second essay of this Dissertation. The second explanation for a positive relationship is bank manager behavior. Since incumbent firms establish close relationships with bank managers, the

latter grant credit to incumbents based not only on sound financial criteria. Managers in banks with more market power can get away with more "friendly credits" since the competitive pressure is less intense. Evidence for this explanation is historical and includes cases from late nineteenth century in England, Italy, and Mexico (Lamoreaux, 1986, Cohen, 1967, and Haber, 1991, respectively). Rosen (2004) argues that greater financing obstacles are typical for more concentrated banking markets and prevent entry of new firms, which is the third possible explanation for a positive relationship between banking and product market concentration. Empirical evidence for this explanation comes from Beck, Demirgüç-Kunt and Maksimovic (2004) and Cetorelli and Strahan (2006). The latter study the U.S. markets and empirically confirm that more intensive competition (small concentration) in banking markets is associated with greater number of firms and lower average firm size, where the effect of banking competition is particularly strong for the smallest firms and practically nonexistent for large companies.

If the relationship is negative, more concentrated banking markets create more fragmented product markets. The first hypothesis behind the negative relationship is related foremost to information asymmetry between firms and banks, which is larger for unknown entrant firms. Since entrant firms are more risky for banks, they will finance them only if they will be able to recover the cost of greater risk at later stages. This intertemporal smoothing is possible when banks have market power (Petersen and Rajan, 1995). Greater banking concentration (more market power) thus induces more firm entry and more fragmented product markets. The second hypothesis is related to innovation potential of entrants. Entrant firms bring innovative technologies and higher returns on projects, therefore banks in concentrated banking markets which are able to smooth interest rates continuously favor entrant firms over incumbents (Cetorelli, 2004). Empirical studies consistent with the negative relationship between product and market concentration are Petersen and Rajan (1995) and Cetorelli and Gambera (2001). There is also historical evidence provided by Hellman and DaRin (2002) for cases of Belgium, Germany, Italy, Russia and Spain demonstrating that large banks with market power are needed to finance new industry in emerging markets.

2.3 Banking Markets in Transitional Countries

Banking markets in transitional countries differ somewhat from banking markets in developed countries. Their characteristics stem from the process by which they were created. In command economies of most transitional countries there was only one bank (also called the monobank in some cases) which had basically only one purpose in distributing (and printing) money to firms according to production plans. These banks

combined some functions of monetary policy that are typically performed by central banks, but they were also providing firms with credit, where they lacked above all any credit risk assessment. In the process of transition, these banks were transformed, often by breaking them into parts, into banks more similar to the ones in market economies, but with serious deficiencies in tangible and intangible resources. Besides banks that were created in this way, there were also a number of new banks established due to a liberal licensing policy at the beginning of the transition process. This process was most typical in Russia, Bulgaria, Croatia, Serbia, Poland and Hungary. The genesis of banking markets in transitional countries was thus characterized partly by transformation of old state-owned banks, partly by separation of monobanks and formation of individual banks, and partly by market induced formation of newly established banks.

There were several problems with these banks. First, they suffered from bad loans. The transformed banks inherited bad debts, but they also accumulated bad debt by granting loans after restructuring. The inherited bad debt was mainly a consequence of credit given to firms by considering political and production criteria, not performance, investment or any other economic criteria. However, since they did not have proper credit risk assessment skill, the quality of assets was low, business clients often had yet to be privatized, and the system of bank regulation was poorly developed, the problems continued even after initial transformation and also in newly established banks (Berglof and Bolton, 2002). Schnitzer (1999) argues that bad loans situation was likely aggravated by too many banks entering the market. In any case, banks in transitional countries needed to restructure bad debts and clean-up their balance sheets. Different countries choose different ways of dealing with this problem (by transferring bad debt to other institutions or by solving bad debt within banks). Most of transitional countries were able to perform this during the early 1990s, with exception of e.g. Russia, Ukraine, Belarus, Romania, Bulgaria and other southeastern countries which did this later.

Second, the transitional banks lacked proper information technology skills and equipment that were becoming essential in the banking business globally and were also advancing at a rapid pace.

Third, the services offered were bad and expensive, the market for loans did not grow as fast as one would expect given the lack of funds common for firms in these countries. It is a well established fact that the majority of firms finance their projects by using retained earnings first and seek external finance only second to that. The problem faced by transitional countries was that firms did not accumulate enough profits to generate internal funds, while capital markets were (and still are) poorly developed and banks did not manage to overcome hindrances to greater financial intermediation. Rother (1999) believes that financial intermediation is lower in transitional countries because of

concentration in banking sector, while McNulty and Harper (2001) think the deficient legal system is the primary cause for it. Hainz (2003) shows that in more concentrated markets banks demand more collateral if liquidation of collateral is costly and not symmetric –both prominent characteristic of transitional banking markets because of poor legal provisions– and this leads to credit rationing.

Finally, macroeconomic situation was difficult in all transitional countries in the initial period of transition. Inflation, severe credit crunches, unstable fiscal policies, and lack of payment discipline were some of the factors that made banking crises even worse.

Since most of transitional countries aspired to become members of European Union (EU), they had to adopt banking regulation in line with the one prescribed to developed countries already in the EU. After Second Banking Coordination Directive in 1993, there has been a lot of activity in the area of banking regulation in all transitional countries that were aiming for the EU membership. This has certainly helped countries to focus better, advance the reform process and implement the regulation faster than would be done otherwise, as demonstrated by slower processes in countries who joined EU just recently (Romania and Bulgaria) or are not EU members (yet). Mamatzakis et al. (2005) investigate seven Southeastern European countries in the period 1998-2002, among them only Romania and Bulgaria are at present members of EU, and find results that strongly support the view that structural reforms make banking more competitive. They believe potential accession to EU is thus one of the conditions that may enhance market contestability.

Because bank restructuring in transitional countries coincided with a period of big shifts in global banking markets, the restructuring itself became a moving target. Not only had the transitional banks had to restructure and transform themselves into sound banks that can operate in market economies, they had to adapt themselves to the rapidly changing conditions of financial markets which were characterized by financial disintermediation, globalization and increasingly demanding information technology resources. Banks in developed countries had to reinvent and reposition themselves in these new circumstances which saw a rise of capital markets with greater role for securities and derivatives, money market funds and venture capital. Extensive deregulation and liberalization of banking regulation, that was introduced also in transitional countries in the process of EU accession, enabled banks from mainly European developed countries, to actively penetrate credit markets in transitional countries. This was done either by setting up their own subsidiaries or by acquiring domestic banks. Foreign banks accounted for more than 50% of the market in some countries (e.g. in 2000 in Hungary, Czech Republic, Poland, Bulgaria, and Baltic countries). In these circumstances it is difficult to talk about national financial systems and domestic banking markets.

Berglof and Bolton (2002) note that although different transitional countries decided to take different paths towards more market-oriented economies, they ended up with surprisingly convergent basic financial architectures. Countries had different policies with respect to restructuring bad loans, privatization strategies, foreign banks' entry, regulatory barriers to entry, and strategies to develop capital markets. However, they have become characterized by mainly commercial banks, with a large share of them being foreign owned and with government bonds representing a large share of their assets portfolio. Stock markets are not an important source of external finance for firms, since they are highly volatile and illiquid. Instead, long term finance comes mainly from foreign direct investment. Ownership structures are thus in general fairly concentrated.

Turning away from general conditions of banking markets in these countries and moving toward market structure issues, I note that after the initial scarce number of banks (one monobank in extreme cases) transitional countries first saw a huge increase in the number of banks. However, price competition did not strengthen because markets were still dominated by a few large banks (Schnitzer, 1999). Later periods saw a consolidation of the market as many banks were not fit enough to survive in the market economy, and especially not fit enough to survive the conditions faced by banks in general in that period. Consolidation in mature banking markets was encouraged by globalization, information technology advancements, and deregulation. As mentioned before, market consolidation in transitional countries involved much more intensive foreign banks' participation than in developed countries. Gelos and Roldós (2004) report that in Poland, Hungary and Czech Republic consolidation (measured by the number of banks) in the period 1994-2000 did not increase concentration; in fact the standard measures for concentration (concentration ratios and HHI index) were even lower and there was no decline in competitive pressure. They explain this with lower barriers to entry, particularly in the form of foreign banks' entry. Foreign banks increased the competitive pressures in domestic markets which compensated for the higher consolidation. Empirical studies, using the so-called H-statistic (see Panzar and Rosse, 1987), have generally shown that banking markets in transitional countries were mainly characterized as monopolistic competition, where the degree of competitiveness has gradually increased (or at least it did not decrease) (Gelos and Roldós, 2004, for three Central European countries in 1994-2000; Yildirim and Philippatos, 2007, for fourteen Central and Eastern European countries in 1993-2000; Mamatzakis et al., 2005, for seven Southeastern European countries in 1998-2002). Prices (in terms of loan-deposit spreads) have generally decreased, but through the 1990's they remained higher than those in developed financial markets. Yildirim and Philippatos (2007) find that competitive conditions have increased especially after 1996, when privatization was in concluding phases, the presence of foreign banks was

becoming more significant and new banking regulation was being adopted in order to join the European Union.

Empirical evidence demonstrate that the well known and traditionally used structure-conduct-performance (SCP) paradigm does not seem to be confirmed in the case of banking markets in transitional countries in 1990's. SCP postulates that banks with larger market shares have more market power and are more profitable since they can charge higher loan rates and offer lower deposit rates. Consolidation would therefore be associated with increased concentration and less intensive competition. Although transitional countries had more concentrated banking markets than developed countries, it seems that consolidation in transitional countries did not universally increase concentration and the degree of competitiveness generally was not lowered. On the contrary, empirical studies seem to find confirmation for the contestable markets theory (CM). This theory claims that incumbent banks will behave competitively (and will not exercise market power) if new banks can enter the market without large entry costs and can operate in the market with similar cost functions, even if these new potential rivals do not actually enter the market. In other words, a concentrated banking market can be competitive, despite being dominated by a few large banks. Since explanations of the positive link between banking market structure and industry market structure in Cetorelli (2001, 2004) implicitly assume that SCP theory is correct for banking markets, I do not expect to find such a robust positive relation for transitional countries as it was documented for OECD countries. Moreover, some studies show that the relationship between market concentration and market power seems to become weaker in advanced banking markets (Berger et al., 1999, Canoy et al., 2001, Hannan, 1997, Radecki, 1998), while Jansen and DeHann (2003) claim there is no connection between concentration and market competition.

These findings cast some further doubt also on the theoretical explanations for the positive link between both market structures. The theoretical explanations presented in previous section either use banking market competition (not explicitly concentration) as the force that has repercussions for industrial market structures or assume SCP theory works, which is questionable. Furthermore, the rapid processes of entry and consolidation in transitional banking markets could help us increase knowledge about the evolution (or changes in time) of the relationship between both market structures in general.

2.4 Methodology and Econometric Model

I use panel data analysis to empirically estimate the sign and magnitude of the relationship between the banking and product market structures. The scope of research in this phase is explorative in nature thus I follow Cetorelli's (2004) reduced form approach in econometric estimation who in turn follows Rajan and Zingales (1998), to minimize problems of omitted variable bias and other misspecifications. My aim in this paper is to apply this approach on data for transitional countries and compare the conclusions before embarking onto further analysis of the relationship between the two market structures.

The econometric model is identified by exploiting sectoral differences. The idea is that if banking market concentration has an effect on product market concentration, this effect should be larger for industrial sectors that are more dependent on external financing. The panel data structure has three dimensions: sector, country and time. Due to the lack of proper data, concentration in product markets is proxied by average firm size. Cetorelli (2001) defends the benefits of this approach mainly because there is not much other data available at sector level, but also because this has been a frequently used approach in industrial organization empirical work. Larger average firm size indicates more concentrated industries and smaller average firm size indicates less concentrated industries. Banking market concentration is measured yearly for each county and an interaction term with external financial dependency of sectors is used to identify its effect.

A general reduced form econometric model would be of the following form:

$$\begin{aligned} \textit{Average firm size}_{ijt} = \alpha_{ijt}\textit{Bank Conc.}_{jt} \times \textit{External fin. dependency}_i + \\ + \beta_{ijt}\textit{Control variable}_{ijt} + \varepsilon_{ijt} \end{aligned} \tag{2.1}$$

with sector i (i=1...N), country j (j=1...M) and year t (j=1...T), and where the random error term has a three-way structure:

$$\varepsilon_{ijt} = \nu_i + \lambda_j + \tau_t + \eta_{ijt} \tag{2.2}$$

where ν_i, λ_j, and τ_t measure the sector, country and time effect, respectively, while η_{ijt} encaptures a combined effect of all three dimensions. ν_i, λ_j, and τ_t are fixed effects related to specific sectoral, country and year characteristics. Sectoral characteristics that might affect the average firm size are the technical nature of production process and economies of scale. Country fixed effects might be related to its size, the extent of

international trade, tax regulation, conditions for the establishment of firms, economic policies targeting small and medium companies etc. Time fixed effects could be related to general economic conditions which are the same for all industries. As explained below, Cetorelli (2004) does not control individually for time effects, but only as an interaction with country effects. Since merger activities affect concentration and in Europe they often involve companies from different countries, even more so in transitional countries, it would be appropriate to directly control for periods when merger waves happened. This issue brings along also the more complicated question about the suitability of national banking markets as relevant banking markets for firms. I address this aspect of the problem to some extent in the robustness check section of the paper, but I leave a deeper analysis for further research.

Fixed effects models can be estimated either by including dummies for each dimension of the error or by performing the within transformation on data. Cetorelli (2004) combines the country and time effect into one interaction and estimates the following model:

$$\begin{aligned} Average\ firm\ size_{ijt} = \delta_{1jt} Dummy_{1jt} + \delta_{2i} Dummy_{2i} + \\ + \alpha_{ijt} BankConc_{jt} \times EDI_i + \beta_{ijt} ShareVA_{ijt} + \varepsilon_{ijt} \end{aligned} \tag{2.3}$$

where: $Average\ firm\ size_{ijt}$ is measured as the natural logarithm of the value added per firm in sector i, country j and year t. Firm size is measured in value added terms in the benchmark model, but other specifications, using total revenues and employment were also tested.

$Dummy_{1jt}$ is the country-time specific fixed effect.

$Dummy_{2i}$ is the sector specific fixed effect.

$BankConc_{jt} \times EDI_i$ is the interaction term between banking concentration for country j in year t and an indicator for external financial dependency for sector i (EDI_i). Banking concentration is alternatively measured by concentration ratios and Herfindahl's index (HHI). External financial dependency is measured as the fraction of capital expenditures not financed with cash flows from operations for mature U.S. listed companies and it is taken from Cetorelli (2001) who in turn takes it from Rajan and Zingales (1998). Cetorelli notes that the main theoretical conjecture that links both market structures is the "competiton for funding between industry incumbents and new entrants". Therefore he uses external financial dependence of mature U.S. listed companies, arguing that we should expect larger average firm size in industries where "old, incumbent firms are still in need for external finance" for countries with more concentrated banking markets, if the effect of banking concentration is positive (coefficient α positive). If the effect of

banking concentration is negative (coefficient α negative), we should observe smaller average firm size in industries where mature firms need external financing for countries with more concentrated banking markets. The indicator for external financial dependency is equal to 1 for sectors that have above-median level of dependency and equal to 0 for sectors with below-median level of dependency. It is interacted with banking concentration and the coefficient on this interaction term was found to be positive and very robust in Cetorelli (2001, 2004).

$ShareVA_{ijt}$ represents the share of manufacturing sector i in total manufacturing value added. This variable controls for factors that influence the market structure of a particular sector in a particular country. Industry's life cycle theory predicts that a sector that has grown substantially should experience less new firm entry. A larger sector should therefore have larger average firm size and the coefficient β should be positive.

ε_{ijt} is the error term.

In order to distinguish the relationship for transitional countries from the one for non-transitional countries, I use dummies for both and interact them with banking concentration terms. Dummy variable TR equals 1 for transitional countries and 0 otherwise, while dummy variable EU equals 1 for non-transitional (European) countries[1]. Thus, I estimate the following model:

$$\begin{aligned} Average\ firm\ size_{ijt} = {} & \delta^1_{jt} Dummy_{jt} + \delta^2_i Dummy_i + \beta_{ijt} ShareVA_{ijt} + \\ & + \alpha^1_{ijt} BankConc_{jt} EDI_i \times TR + \alpha^2_{ijt} BankConc_{jt} EDI_i \times EU + \\ & + \varepsilon_{ijt} \end{aligned} \tag{2.4}$$

2.5 Data Description

The period effectively studied in this paper is between 1990 and 2004. However, in the benchmark model I use EUROSTAT's data between 1995 and 2004 for industry sectors for 10 transitional European countries[2] and 16 non-transitional European countries[3]. For the robustness check section of the paper, I extend the analysis to a longer period (1987 - 2006) and additional countries. In the robustness check section, I use UNIDO's data for OECD countries (including the same 16 non-transitional European countries and 4 transitional European countries as in the benchmark model) and 11 transitional

[1] *EU* is equal to 1 for *all* analyzed non-transitional countries, *not* only those that are EU members

[2] Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Slovakia, Slovenia, Poland, and Romania (all have TR=1)

[3] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and United Kingdom (all have EU=1)

countries from central Europe and central Asia that are listed on the website of the European Bank of Reconstruction and Development (EBRD) and for which sectoral data on value added were available[4]. The main reason for performing the benchmark analysis on a smaller set of countries and shorter time period is the availability of data: there are many more missing values in UNIDO's dataset than in EUROSTAT's for countries of my interest.

Industrial data in the benchmark model is taken from EUROSTAT's New Cronos database; they range from 1995 to 2004 and include manufacturing sectors at 4-digit NACE Rev 1.1 level. EUROSTAT's data classified by NACE code were matched with ISIC 2 code to allow the use of data on external financial dependency of industrial sectors. Typically, the three digit NACE code corresponds quite accurately to ISIC 3 code and this corresponds relatively closely to ISIC 2. However, there are some cases where it is impossible to accurately translate from NACE code to ISIC 2 code. In general, this problem occurred with less important subcategories which do not alter the magnitude of sector's value added significantly. This procedure produced data for 34 manufacturing sectors[5]. Nominal data for value added were deflated with wholesale/producer prices indices (PPI) taken from IMF's International Financial Statistics database[6] . EUROSTAT's data were converted into millions of US dollars

Cetorelli uses data from UNIDO database for OECD countries and to rule out possible differences in results between this and his studies because of different data collecting (and data transforming) methodologies, I perform robustness checks also by estimating models on UNIDO's data. I use data for value added of manufacturing sectors from UNIDO's Industrial Statistics Database 2006 at 3-digit level of ISIC code (Revision 2) and Industrial Statistics Database 2007 at 4-digit level of ISIC code (Revision 2)[7]. The data range from 1987 to 2003 and include 28 manufacturing sectors at 3-digit ISIC 2 code and 8 manufacturing sectors at 4-digit ISIC 2 code. I deflate the original data by using the same PPI (or CPI in some cases) as above and use them in millions of US dollars.

EUROSTAT's database provides also information about the number of firms in individual sectors which was used to calculate average firm size. UNIDO's database, however, provides only information about the number of establishments[8] in individual sectors. Since companies can have more establishments, there is some measurement error in

[4]In addition to the countries already in EUROSTAT's database, enough data was available only for Croatia, FYR Macedonia, Mongolia, Moldova, and Russia.

[5]Sectors 353 (Petroleum Refineries) and 351 (Industrial chemicals) are not included in this dataset, because it was impossible to identify the necessary data in NACE 1.1. and translate it to ISIC 2

[6]Consumer price indices (CPI) were used for Moldova and Mongolia since there were no available data for PPI.

[7]Downloaded from ESDS International website via Beyond 20/20 WDS in October 2007.

[8]Plant or factory where production occurs.

the dependent variable when using these data. Cetorelli (2001) and Black and Strahan (2002) document strong correlation between the number of establishments and the number of firms, and between the rate of creation of new businesses and the share of new establishments, respectively.

Data for banking markets concentration ratios are taken from BANKSCOPE September 2006 and October 2007 CD's. They range from 1999 to 2006, but only data to 2004 are included in the analysis because there is no data for the dependent variable (average firm size) after 2004. Concentration ratios $CR3$ ($CR5$) are calculated as the share of the three (five) largest banks' total assets. Herfindahl's index (HHI) is calculated as:

$$HHI = \sum_{i=1}^{n} \left(\frac{TA_i}{TA} \right)^2 \tag{2.5}$$

where: n is the number of commercial, savings and cooperative banks in the country,

TA_i is total assets by individual bank i, and

TA is the sum of n individual banks' total assets.

Savings and cooperative banks are included in the concentration measures because in several countries some of the top three (five) largest banks are categorized in BANKSCOPE as savings and cooperative banks. Since they are effectively present also in the market for firm loans and have a significant market share measured in total assets, I include them in the concentration measures. However, I have calculated CR ratios also for commercial banks only and performed estimations based on these measures, but the CR ratios and estimation results do not differ significantly (results are available upon request).

Additionally, I use concentration ratios ($CR3$) from Cetorelli (2004)[9], who in turn uses data from Demirgüç-Kunt and Levine (2004), for the period between 1990 and 1997 in the robustness check section.

The measure of external financial dependence is taken from Rajan and Zingales (1998). They observe that technological differences between industrial sectors generate different need for external funds. Their external financial dependence measures the average share of capital expenditure that is not financed by cash from operations, for mature listed companies[10] in United States in the period 1980 - 1990[11]. Rajan and Zingales measure

[9] I would like to thank Nicola Cetorelli (Federal Reserve Bank of New York) for kindly providing his data.

[10] Mature companies are companies that are present more than 10 years after listing.

[11] External dependence for mature companies in sectors 351 (Industrial chemicals) and 356 (Plastic products) was not disclosed by Rajan and Zingales (1998).

the need for external funds for U.S. manufacturing sectors because demand, rather than supply, of funds is of interest and therefore it had to be estimated in a country with a well developed financial market and small financial constraints. They present four reasons for external dependence of U.S. firms being a good proxy for the demand for external funds in other countries: i) in a steady-state equilibrium, much of the demand for external funds originates from worldwide technological shocks that increase investment opportunities for firms, ii) the ratio of cash flow to capital is determined by factors that are similar worldwide (e.g. demand for a certain product, stage in the product's life cycle, product's cash harvest period), iii) there is a high correlation between external dependence measured for 1980's and 1970's in the U.S., and a high correlation between external dependence measured on Canadian and U.S. data; both imply that sectors in other countries (including less developed countries) have similar needs for external funds, and iv) a significant interaction between external dependence and financial development was found in spite of a noisy measure for external dependency that would create bias against finding such interaction.

For the robustness check section, I use the following institutional variables controlling for general economic and financial markets' conditions: domestic credit provided by banking sector, domestic credit to private sector, market capitalization of listed companies, gross domestic product per capita, and loans to non-banks provided by foreign banks. The data source for the latter is Joint BIS-IMF-OECD-WB External Debt Hub (on www.jedh.org), while data for other variables come from the World Development Indicators database (World Bank, April 2007).

Table 2.1 provides a summary of statistics for main variables while Table 2.6 and Table 2.7 (Appendix) provide data describing the pattern of industry structure and banking concentration across countries and across sectors.

The dependent variable ($LNVA$) in the benchmark model is the logarithm of value added per enterprise. There are 6485 observations for this variable for 26 countries and 10 years (1995 - 2004). Among countries and time periods that are in EUROSTAT's database, most missing observations are associated with Romania, Lithuania and Hungary, with sectors 354, 314 and 361 (Petroleum, Tobacco, and Pottery, respectively), and with years 1995, 1996 and 1997. Missing observations are foremost due to the missing data for value added, rather than missing number of firms. The histogram of the variable shows that it is distributed approximately normally, without prominent outliers.

When UNIDO's dataset is used for measuring average firm size, the dependent variable ($LNVAU$) is the logarithm of value added per establishment. In this case, I have 7495 observations for 31 countries and 17 years (1987 - 2003). Overall, there are more missing values for individual countries, sectors and years than in the EUROSTAT dataset.

TABLE 2.1: Summary Statistics of Main Variables

Variable	Obs	Mean	Std. Dev.	Min	Max	Source	Note
EUROSTAT							
LNVA	6485	-0.262	1.755	-7.396	6.730	EUROSTAT	1995-2004; 26 countries, 34 sectors
SHVA	7116	0.028	0.031	0.000	0.345	EUROSTAT	1995-2004; 26 countries, 34 sectors
TR	9104	0.374	0.484	0	1		
EU	9104	0.626	0.484	0	1		
OECD	9104	0.750	0.433	0	1		
UNIDO							
LNVAU	7495	-0.252	2.007	-10.184	7.793	UNIDO	1987-2003; 31 countries, 36 sectors
SHVAU	9453	0.037	0.043	0.000	0.607	UNIDO	1987-2003; 31 countries, 36 sectors
TR	18888	0.461	0.499	0	1		
EU	18888	0.539	0.499	0	1		
OECD	18888	0.599	0.490	0	1		
ED	17772	0.006	0.308	-1.330	0.394	Rajan and Zingales, 1998	1980-1990; U.S. listed mature firms
EDI	17772	0.500	0.500	0.000	1.000		
CR3	11304	0.620	0.186	0.205	1.000	Bankscope; N. Cetorelli	1999-2005; 1990-1997
CR5	6552	0.725	0.169	0.327	1.000	Bankscope	1999-2004
HHI	6552	0.183	0.120	0.036	0.670	Bankscope	1999-2004
Priv_cre	16452	61.150	37.600	1.679	158.653	WDI World Bank	1987-2004
Dom_cre	16776	77.300	40.026	5.477	170.623	WDI World Bank	1987-2004
Mar_cap	14832	43.281	48.257	0.004	479.743	WDI World Bank	1987-2004
Gdp_pc	18288	13175.4	10798.3	286.5	50536.7	WDI World Bank	1987-2004
Floans	10664	0.105	0.229	0.000	2.088	BIS-IMF-OECD-WB External Debt Hub	1995-2004

Countries with least observations are Croatia, Czech Republic and Moldova (Table 2.17, Appendix), sectors with least observations are the ISIC 4-digit sectors for which only very limited data was available (Table 2.18, Appendix), and years with least observations are 2003, 1995 and 1996 (Table 2.19, Appendix). The histogram of the variable shows that it is distributed fairly normally, without prominent outliers. Standard t-tests for mean equality show the difference in means of average firm size in the two datasets to be statistically insignificant. However, the mean average firm size is significantly larger for non-transitional countries in both datasets. On average, firms in non-transitional countries have value added per enterprise in real terms about 3.6 times larger than firms in transitional countries in EUROSTAT dataset (4.5 times larger in UNIDO dataset). Average firm size was measured alternatively by average turnover and number of employees. Both variables were provided by EUROSTAT database for 26 countries in the period 1995 - 2004. Turnover was deflated and transformed in US dollars in the same manner as value added.

The total market share of the three largest banks ($CR3$) was 21% in the least concentrated country which was Luxembourg in 1999. The highest concentration was in Mongolia in 1999, Czech Republic in 1990, Ireland in 1991, and Sweden in 1991, where

the market share of three largest banks reached close to 100% of the market. On average, between 1987 and 2004, Estonia had the most concentrated banking market of all countries included in the analysis. The average $CR3$ and $CR5$ were 98% and 99%, respectively. The least concentrated country was Luxembourg with an average $CR3$ around 31% of the market in the period 1987 - 2004.

The scatter plot of average concentration ratio $CR3$ against average firm size for the EUROSTAT data set shows Bulgaria having extremely low average firm size and Estonia having extremely high average banking concentration, indicating these countries could be potential outliers. Separate scatter plots for non-transitional and transitional countries show that in this dataset on average transitional countries had smaller average firm size than non-transitional countries and a similar variability in concentration ratios. A possible additional outlier here is Slovakia with extremely high average firm size for transitional countries. T-tests for equality of means show that transitional countries had on average more concentrated banking markets, regardless of concentration measure used. The scatter plot for UNIDO dataset reveals a cluster of countries with lower average firm size: Bulgaria, Romania, Croatia, and Mongolia.

Pairwise correlation coefficients for the EUROSTAT dataset show there is a small negative correlation between average firm size and every one of the three concentration measures, which is statistically significant at 5% (Table 2.3, Appendix). $CR5$ appears to have the strongest correlation and $CR3$ the weakest. This suggests that on average countries with more concentrated banking markets have smaller firms. However, pairwise correlation coefficients for UNIDO dataset show a positive, statistically significant correlation for $CR3$ and slightly stronger, negative, statistically significant correlation for $CR5$ and HHI (Table 2.4, Appendix). This finding is a consequence of the fact that we have more observations for $CR3$ than for the other two concentration measures. The additional $CR3$ observations are for the period 1990 - 1997 (taken from Cetorelli), hence the possible period of study is 1990 - 2004 for the case of $CR3$ (UNIDO dataset), 1995 - 2004 for $CR3$ on EUROSTAT dataset, and 1999 - 2004 for all other combinations ($CR5$ and HHI on UNIDO and EUROSTAT datasets). Since the correlation between $CR3$ and average firm size from UNIDO dataset is negative and statistically significant for the period 1999 - 2004[12], I can say that the positive overall correlation comes exclusively from the previous period, which is 1990 - 1997[13].

The external financial dependency measure is taken from Rajan and Zingales (1998). The sector with mature companies least dependent on external finance was 323 (Leather industry) and the one with most dependent mature companies was 3832 (Radio, TV and

[12]The coefficient is -0.1314, significant at 5% significance level.
[13]We have no observations on $CR3$ for 1998.

Communication equipment). A scatter plot of external financial dependency against average firm size per sector shows there are three candidates for outliers: sectors 323, 324 (Footwear), and 314 (Tobacco) in both, EUROSTAT and UNIDO, dataset. All three sectors have extremely low external dependence with respect to their average firm size. Since we use an indicator variable for external dependency, these outliers do not affect our results. The median value of external financial dependency was 0.0812; the sectors that have larger values are classified as highly dependent on external funds and are indicated in Table 2.5 in the Appendix. The variable EDI is an indicator variable equal to one for those sectors that have their external financial dependence above median (high external dependency), and equal to zero for those with external financial dependency below median (low external dependency).

The control variable $SHVA$ represents the fraction of value added in total manufacturing for individual sectors. There are 7116 observations for this variable. The distribution of $SHVA$ is skewed to the right as the majority of sectors represent only a small fraction of total manufacturing value added. The control variable that measures the same in UNIDO data set is called $SHVAU$. It has a similar distribution to $SHVA$, but with a longer tail at the higher end of the distribution. The mean of the fraction in UNIDO dataset is statistically significantly higher than the mean in EUROSTAT dataset; on average it is one percentage point higher in UNIDO dataset. Pairwise correlation shows there is no statistically significant correlation between the fraction of value added in total manufacturing and concentration ratios, except for the case when $CR3$ and UNIDO dataset are used, where there is a very small, but statistically significant negative correlation. This implies that my explanation variables can be considered as independent.

The variable EU is a dummy variable equal to 1 for European non-transitional countries: 15 countries that were in EU before the transitional countries joined and Norway. These countries represent 63% and 54% of the observations in the EUROSTAT and UNIDO data set, respectively. The variable TR is a dummy variable equal to 1 for transitional countries, which obviously represent 37% and 46% of observations in EUROSTAT and UNIDO dataset, respectively. The variable $OECD$ is a dummy variable equal to 1 for countries that are OECD members from the year they became members.

Additional control variables are included in the robustness check section. I have data from 1987 onward for all variables, except foreign loans to non-banks, where only data from 1995 onward are available. T-tests for mean equality formally confirm that non-transitional countries have more developed financial markets and economies. Pairwise correlation coefficients verify a moderate and statistically significant positive correlation between average firm size and all these institutional variables implying that more developed economies have on average larger firms.

Domestic credit (Dom_cre), domestic credit to private sector ($Priv\_cre$) and market capitalization of listed companies (Mar_cap) are measured as percentages of GDP in constant (year 2000) US dollars. Histograms of the first two variables do not reveal obvious outliers. The distribution of the latter is skewed to the right with outliers Luxembourg and Finland. The institutional variable indicating the amount of foreign loans in the economy ($floans$) is calculated as the ratio of foreign loans to non-banking organizations to gross domestic product (in constant, year 2000 US dollars) and its distribution is heavily skewed to the right. The outliers with extremely high ratios are observations Luxembourg. GDP per capita is also measured in constant (year 2000) US dollars. The histogram of the variable shows outliers with a very high GDP per capita (Luxembourg) and a three-modal distribution roughly marking the division of countries into three groups: non-transitional countries, transitional countries that entered EU in 2004 and other transitional countries. Scatter plots of institutional variables against concentration ratio $CR3$ show no obvious linear relationship between them, but the pairwise correlation coefficients mostly indicate a small, statistically significant negative correlation. As expected, there is a strong positive correlation between domestic credit and credit to private sector.

Pairwise correlations between the share of value added in total manufacturing and institutional variables show mostly a small and statistically negative correlation, implying that in economically more developed countries manufacturing sectors on average represent smaller fractions of total manufacturing value added. T-tests confirm a statistically significant positive difference in mean fractions for transitional countries. This could be either a consequence of greater variety of manufacturing industries or of better data collecting methods in more developed countries. This problem potentially introduces measurement error in my explanatory variable.

2.6 Results

I first present the results of the benchmark model and then perform robustness checks in the next subsection.

2.6.1 Benchmark model

The benchmark model is the same as in Cetorelli (2004), except for the use of dummies for transitional and non-transitional countries as explained before. I use EUROSTAT dataset for the period 1995 - 2004 for this estimation, while Cetorelli (2004) uses UNIDO data for OECD countries in the period 1987-1997. Product market structure (proxied

by average firm size) is measured as the logarithm of value added per enterprise, while banking market concentration is measured by $CR3$. The dummy variables for industry and country-time effects are included, but not reported since their purpose is only to purge the estimation of fixed effects and their own effects are not identified. Standard errors are heteroskedasticity robust. The panel is unbalanced because of missing values.

TABLE 2.2: Benchmark results

Dependent variable = $LNVA$	
$SHVA$	17.124***
	(.581)
$CR3 * EDI * TR$	−0.149
	(.117)
$CR3 * EDI * EU$	−0.244 * *
	(.109)
R^2	0.6684
Number of observations	5394

***, **, * are 1 %, 5 % and 10 % significance levels, respectively

The estimation confirms a statistically and economically significant effect of the share of value added in total manufacturing that was found also in Cetorelli (2001 and 2004), although it has a larger effect here. Sectors with larger shares have larger average firm size.

Contrary to Cetorelli (2001 and 2004) though, my estimation shows a negative effect of banking market concentration on average firm size in sectors where firms are dependent on external finance for transitional and non-transitional countries, but the effect is statistically significant at 5% level only in non-transitional countries. The effect in transitional countries is statistically significant at 20% level of confidence. The average firm size in sectors where mature firms depend on external finance is thus smaller in non-transitional countries with more concentrated banking markets. This implies that more concentrated banking markets lead to less concentrated product market structures in non-transitional countries, while I cannot confirm such association in transitional countries. The magnitude of the interaction effect is also larger in non-transitional countries. Its economic significance can be explained as follows: the country at 75th percentile of banking concentration distribution is Belgium (high concentration), the country at 25th percentile of distribution is Spain (low concentration); if we increase banking concentration from 25th to 75th percentile of distribution, the average firm size in sectors where firms are highly dependent on external finance would decrease by 6% and 3.7% in non-transitional and transitional countries, respectively.

I estimate the same model with different measures for average firm size (logarithm of average number of employees per enterprise, logarithm of average turnover per enterprise) and banking concentration ($CR5$ and HHI) (Table 2.8 in the Appendix). The results from these regressions universally show a positive and significant effect of the share of

value added. Overall, the model shows there is no effect of banking concentration on the product market structure in transitional countries. This result is robust to alternative specifications of banking market structure and to alternative specifications of average firm size measure. It also appears there could be a statistically significant negative effect for non-transitional countries. In four of the nine variations of the model, the negative effect for non-transitional countries is statistically significant an in all nine variations the sign is negative.

These results support to a certain extent the negative explanation for the banking concentration effect in more developed countries. Sectors that are highly dependent on external financial sources, have smaller average firm size and a less concentrated product market structure in non-transitional countries with more concentrated banking markets. These results are in sharp contrast to Cetorelli's (2004) findings for European countries (among OECD members) where he documents a positive, significant effect of banking concentration and a decrease of this effect after countries became members of EU. My results indicate that in the second half of the 1990's this positive relationship turned into a negative one.

2.6.2 Robustness checks

To verify the results of the previous subsection, I perform a number of additional robustness checks for the model. I first check if the estimates are related to individual observations. Then, I check if the results are showing the effect of general economic and financial development of countries instead of banking market concentration effect, as well as if there are any market size effects involved. Since the effect of banking concentration is likely to show with a lag, I check whether our estimates change substantially when I allow for a delayed effect of banking concentration. Given that my analysis differs from Cetorelli's in the dataset used (data source, countries, time-period), I finally check if the results are different when UNIDO database is used for estimation.

2.6.2.1 Outliers

The first observations checked are the so-called leveraged observations from countries with the lowest and highest banking concentration, Luxembourg and Estonia, respectively. Excluding these two countries from estimation does not change results substantially; in fact the coefficients are slightly larger. Excluding three countries with least and most concentrated banking markets (Luxembourg, Italy, France, and Estonia, Finland, Lithuania, respectively) still produces negative coefficients of the interaction terms that become considerably larger and statistically significant at 1% level for both groups of

countries. Then, I check outliers in the average firm size dimension. I first drop Bulgaria and Germany, countries with the smallest and largest average firm size, to find both coefficients for the interaction terms negative, but statistically significant only for non-transitional countries. The magnitudes of the effects are slightly larger than in the benchmark model. When I drop the top and bottom three countries in the average firm size ranking (Germany, Ireland, Austria, and Bulgaria, Lithuania, Latvia, respectively), the interaction coefficients remain negative, their magnitude is increased and they are statistically significant for both groups of countries. These estimates confirm a negative effect of banking concentration in non-transitional countries and suggest there might be a negative effect also in transitional countries.

Next, I check sectors that could represent influential observations. I first drop the two sectors that have the smallest and largest dependence on external funds: 323 (Leather) and 3832 (Radio, TV communication). The results imply again negative, statistically significant relationship between industry market structure and banking market structure. The coefficients are much larger than in the benchmark model. Exclusion of top and bottom three sectors in the external dependency ranking gives similar results as exclusion of the two most extreme sectors in this respect. I obtain similar results also when excluding sectors with smallest and largest average firm size (323-Leather and 314-Tobacco, respectively), as well as when excluding top and bottom three sectors (314-Tobacco, 354-Petroleum and Coal products, 3522-Drugs and Medicines, and 323-Leather, 390-Other manufacturing, 322-Wearing apparel, respectively).

Excluding three years with most of missing data (1995, 1996, and 1997)[14] produces negative coefficients, but statistically insignificant and smaller than in the benchmark model. This result points to the possibility that the negative effect identified for non-transitional countries is a result of particular circumstances in these three years. On the other hand, excluding three countries with most missing data (Romania, Lithuania, and Hungary) gives negative, statistically significant coefficients, which are larger than in the benchmark model. Especially the effect for transitional countries is much larger than in the benchmark model and it is also larger than the effect in non-transitional countries.

Finally, I check observations considering different economic development. Romania and Bulgaria are countries that stand out as outliers at the bottom end of the GDP per capita distribution, while Luxembourg stands out at the top end of the distribution. Dropping these three countries from estimation gives similar results as the benchmark model.

[14]Since we have no data for $CR3$ in 1998, this effectively means restricting the period studied to 1999-2004.

Overall, the model seems fairly robust to outliers. The negative effect of banking concentration is in most cases confirmed also for transitional countries when I control for outliers. The one possibly disturbing conclusion is related to the period studied. When we excluded years 1995-1998, there was no significant banking concentration effect found in either group of countries. This could imply that the observed banking concentration effect is the result of circumstances in the excluded period.

2.6.2.2 Institutional variables

The identified relationship between average firm size and banking market concentration could be picking-up the effect of general economic and financial development of the countries. Therefore I check this possibility by including interaction terms of external dependency and several measures of financial development. The estimates are presented in Table 2.9 in the Appendix.

Sectors that are highly dependent on external funds would have more firm entry and hence, lower average firm size, if banks are more developed. I check this factor of influence by including in the analysis the interaction of external financial dependency with domestic credit provided by banks (column (1)) and with domestic credit to private sector (column (2)). Because these two variables might have different effects in transitional and non-transitional countries, I construct separate interaction terms for these two groups of countries by multiplying them with dummy variables indicating if a country is non-transitional (EU=1) or transitional (TR=1). The coefficients on the interaction terms with domestic credit are very small in both groups of countries. However, only the coefficient for transitional countries has the expected negative sign and it is statistically significant. In non-transitional countries it has a positive sign. This might be because in non-transitional countries developed banking encourages firm growth more than firm entry, since the number of firms in these markets is probably closer to the equilibrium one[15]. The banking concentration effect for non-transitional countries increases, remains negative and even more statistically significant, while the effect for transitional countries becomes positive, but not statistically significant. When I include interaction terms with domestic credit to private sector, I find again that it is significant only for transitional countries (negative and very small, positive in non-transitional countries). As before, the inclusion of this variable makes the coefficient on banking concentration in transitional countries positive, but not significant. Meanwhile, the additional variable does not change much the negative effect of banking concentration in non-transitional countries. Actually, it increases its magnitude and makes it more statistically significant. Again, it

[15] A standard t-test of equality of means confirmed that the mean growth rate of the number of firms in industrial sectors in transitional countries in the period 1995-2004 was considerably higher than in non-transitional countries.

looks like there is no banking concentration effect in transitional countries, the possible negative one would come from financial development and not banking concentration. In non-transitional countries there is evidence of a negative effect of banking concentration.

I consider also the influence of stock market capitalization on average firm size and banking concentration effect (column (3)). The argument is the same as above; there should be more firm entry (smaller average firm size) in highly dependent sectors if firms are able to get funds from the stock market, implying that the coefficient on this interaction term should be negative. I include in the model interaction terms between stock market capitalization and external dependency indicator for the two groups of countries. As expected, the coefficients of these interaction terms are negative, but only the one for non-transitional countries is statistically significant. The coefficients for banking concentration remain negative, of approximately the same magnitude, but only the one for non-transitional countries is statistically significant. This shows that the fact that firms are able to get funds from stock market is important only in more developed countries, while it has no effect on industry concentration, average firm size or banking concentration effect in transitional countries. In more developed countries though, the observed banking concentration effect on average firm size and industry concentration is in fact smaller because part of it was the result of stock market sources of funds available in a country.

Finally, I consider the influence of another possible source of funding: borrowing abroad (column (5)). If firms are able to borrow abroad, there should be more entry into sectors that are highly dependent on external finance in countries that have more foreign loans in the economy. The expected coefficient on the interaction term between foreign loans and external financial dependency indicator is therefore negative. Moreover, a significant effect of foreign banking loans on industry structure would imply that it is actually banking market competition and not banking market concentration that affects industry market structure. I base this conclusion on the assumption that domestic banks are behaving more competitively, if firms are able to borrow abroad than if not. If this is true, borrowing abroad affects domestic banking market competition (or market contestability), but not domestic banking market concentration. Of course, if I could define relevant banking markets for sectors in each country more precisely than just as domestic (national) banking markets, there would be less difference between banking market concentration and competition in this respect.

It turns out that the interaction term with foreign loans for transitional countries is indeed negative, statistically significant and large in comparison to banking concentration and other interaction effects so far included in the model. Also, its addition in the

model turns the coefficient on banking concentration in transitional countries to positive, but statistically not significant. The interaction term for non-transitional countries is, however, positive, small and statistically insignificant. Banking concentration effect in non-transitional countries is, therefore, slightly larger, still negative and statistically significant. These results imply that in transitional countries the extent of borrowing abroad affects industry market structure and average firm size more than banking concentration does. On the other hand, in non-transitional countries industry market structure is not affected by foreign loans, instead it appears there is indeed a negative effect of banking concentration.

Market size can also affect the relationship between product and banking market concentration. I check for differences related to different size effects by grouping observations into three groups: small, medium, and large markets and estimating separately the benchmark model. Observations in the first quartile of the relevant distribution are grouped into small, observations in the last quartile of the distribution into large, and the ones in the middle two quartiles of the distributions into medium. Distributions of Dom_cre and $floans$ proxy for banking market size, while GDP proxies for product market size. Results (Table 2.10 in the Appendix) in general show that small banking and product markets are more likely characterized by a positive effect of banking market concentration than are medium and large ones. Medium banking and product markets are strongly characterized by a negative banking concentration effect. Large banking markets in general show a negative, but not statistically significant effect, whereas large product markets show a statistically significant negative effect.

2.6.2.3 Delayed effects and correlation vs. causation

Rosen (2004) argues that using the same year for banking and industry concentration indicates only correlation between the two concentrations, but not causation. In some cases, the correlation could be explained for example by merger waves. He suggests using preceding three-year average concentration in banking markets as an explanation variable for the concentration in real sectors in a particular year. I check the model with one-year lagged and preceding three-year average banking concentration (Appendix, Table 2.11). In both cases, the results do not change substantially. For non-transitional countries, there is still evidence of a statistically significant, negative banking concentration effect, which is even larger than in the benchmark model. Also the banking concentration coefficient for transitional countries is increased in comparison to the benchmark model, but it remains negative and statistically insignificant. This confirms our previous results and suggests there is indeed a causal relationship between banking concentration and industrial markets concentration in non-transitional countries.

2.6.2.4 UNIDO dataset

Since my result differ substantially from Cetorelli's (2001 and 2004) and the deviation from his studies is in the dataset, I want to check my results also by using UNIDO database as the source for sectoral data on value added. The dataset is described in the previous section and I report here only the results of estimations (see Tables 2.12 through 2.16 in Appendix).

The benchmark model, estimated on UNIDO data for the same countries I have in EUROSTAT's data, confirms a negative and statistically significant coefficient for the effect of banking concentration in non-transitional countries in the period 1990-2003 (column (1)). Also the coefficient for transitional countries is negative, but statistically not significant. Both coefficients have a similar magnitude as in the benchmark model estimated with EUROSTAT's data. The effect of the share of value added in total manufacturing is positive, statistically significant, and smaller than in the benchmark model. Next, I estimate the model in the same time period as with EUROSTAT's data, i.e. 1995-2003[16] column (2)). Both banking concentration coefficients remain negative, but they are statistically not significant. In the period before 1995, these coefficients are also not statistically significant, though the coefficient for transitional countries is positive (column (2a)).

In the next step, I change the measure of banking concentration to $CR5$ and HHI and the period studied is hence 1999-2003. With $CR5$ both banking concentration terms are negative and not statistically significant (column (3)), while using HHI produces a small, positive and insignificant coefficient for non-transitional countries (column (4)). Banking concentration measured with $CR3$ has a negative, statistically not significant effect in both groups of countries in this period (column (5)). Again, if I check the period before 1999, I find these coefficients are not statistically significant, though the coefficient for transitional countries is positive (column (6)).

Additional institutional variables that proxy for financial development in general have theoretically expected negative (statistically significant) coefficients and they make the banking concentration effects not significant. This shows that the negative banking concentration effect found in non-transitional countries in UNIDO data is not very robust. The most interesting result is the effect of foreign loans. The addition of foreign loans in the economy turns the banking concentration effect in both groups of countries to positive, but not statistically significant (column (11)). The effect of foreign loans itself is quite large in comparison, negative and statistically significant in both groups of countries. Not surprisingly, it is five times larger for transitional countries. Similarly

[16] EUROSTAT's data are for 1995-2004, but UNIDO's data stop at 2003.

as in EUROSTAT's dataset, it seems there is no effect of banking concentration on industrial markets' concentration in transitional countries. Besides, the results of this dataset imply there is no such effect even in non-transitional countries. Instead, there might exist a banking competition effect on average firm size as explained before, which is picked-up by the ratio of foreign loans to GDP.

Lagged banking concentration and average banking concentration in preceding three years do not change the implications of benchmark results much. Lagged $CR5$ makes both banking concentration effects negative and statistically significant, with a larger magnitude (column 13)). This result presents some evidence for a negative causal relationship between banking market concentration and industrial market concentration in both groups of countries.

Overall, the estimates on UNIDO dataset again mostly imply there could be at best a negative effect of banking concentration for non-transitional countries and there seems to be no such effect (or it is much smaller) in transitional countries. In any case, I find no evidence of positive and statistically significant effect of banking concentration.

Since so far my study showed no evidence of positive, statistically significant effect of banking concentration, I next check if the results found by Cetorelli are characteristic only for a specific period or set of countries[17]. The dataset used now includes the same countries as EUROSTAT dataset plus additional five transitional countries that had data in UNIDO database (see section on dataset).

I first estimate the model on these data in 1990-1997, which is the period analyzed by Cetorelli (2004). The coefficient for banking concentration is positive in transitional countries and negative in non-transitional countries, but none of them is statistically significant (Table 2.15 in the Appendix, column (18)). Similar results are obtained also when I estimate the model for OECD members among countries in my dataset[18] in the period 1990-1997 (column (19)).

Then I estimate the benchmark model on these extended data in the whole period 1990-2003 and I find again similar results as above (column (20)). Next, I restrict the model to match the time period better with EUROSTAT's data, i.e. 1995-2003. In this setting, banking concentration ($CR3$) has a positive, statistically significant effect on concentration in industrial markets in both groups of countries (column (21)). The magnitude of the effect is practically the same in both groups of countries. When I estimate the model with alternative measures for banking concentration ($CR5$ and

[17]Cetorelli kindly provided me with the dataset used in his 2004 study and I was able to replicate his results fairly accurately, so I can be certain that the difference in results comes purely from the dataset.

[18]The following OECD countries are not included here: Australia, Canada, Iceland, Japan, Korea, Mexico, New Zealand, Switzerland, Turkey, and United States.

HHI), the period studied is 1999-2003. The estimations with $CR5$ and HHI show a positive, yet statistically not significant coefficient for both groups of countries (columns (22) and (23)). The same is true also for estimation with $CR3$ in this (shorter) period (not reported). This analysis gives some evidence of a positive relationship between concentration in banking markets and industrial markets, but the effect seems to be the result of five additional transitional countries included in the dataset.

This is confermed when I split transitional countries into countries that became members of European Union, and others[19] (column (24)). The banking concentration coefficient for the latter is positive and statistically significant. Non-transitional countries have a negative, statistically insignificant coefficient, while transitional countries, members of EU, have a positive and statistically insignificant coefficient.

Next, I check the effects of institutional variables. First, I introduce the effect of foreign loans to non-banks in the model for 1995-2003[20] and I still get positive, statistically significant coefficients for the banking concentration effect in both groups of countries, while the coefficients for the foreign loans interaction terms are both negative and statistically significant (column (25)). As it was the case also with EUROSTAT's data, I get a considerably larger effect for transitional countries. These estimates imply a positive link between banking and industrial markets concentration, which is larger in transitional countries, but its effect is reduced by the presence of foreign loans in the economy in both groups of countries. When I change the period observed to 1999-2003, the signs remain the same, but banking concentration and foreign loans have a statistically significant effect only in transitional countries (column (26)). Then I estimate models with other variables proxying for financial development and the period I study is now 1990-2003. Also the size of domestic credit has a statistically significant negative effect on average firm size, but it is very small (column (27)). The coefficients of banking concentration (positive for transitional and negative for non-transitional countries) decrease and remain statistically insignificant. The same holds when I use private credit and stock market capitalization as percentage of GDP as proxy for financial development (columns (28) and (29) respectively).

2.6.2.5 Structural break

My estimations imply there might be a structural break in the relationship between banking and industrial markets' concentration. I test for a structural break in control and explanation variables by constructing a dummy variable equal to 1 for period after year t^*, and equal to 0 for period before or equal t^*, where t^* denotes the year when

[19] Croatia, FYR Macedonia, Moldova, Mongolia, and Russia.

[20] I have data for foreign loans to non-banks as percentage of GDP only from 1995 onward.

the structural break happens. I interact this dummy variable (DT) with control and explanation variables and add these terms to the benchmark model where they will show the difference between period before and after t^*.

$$\begin{aligned} Average\ firm\ size_{ijt} = {} & \delta^1_{jt} Dummy_{jt} + \delta^2_i Dummy_i + \\ & + \beta_{ijt} ShareVA_{ijt} + \beta^1_{ijt} ShareVA_{ijt} \times DT \\ & + \alpha^1_{ijt} BankConc_{jt} EDI_i TR + \alpha^{11}_{ijt} BankConc_{jt} EDI_i TR \times DT + \\ & + \alpha^2_{ijt} BankConc_{jt} EDI_i EU + \alpha^{22}_{ijt} BankConc_{jt} EDI_i EU \times DT + \\ & + \varepsilon_{ijt} \end{aligned} \tag{2.6}$$

I estimate nine models obtained by moving t^* from 1995 through 2003 on EUROSTAT's data. The results show a positive and statistically significant difference between periods when t^* is set to 1999 and 2000 for transitional countries. This indicates that a structural break in the banking concentration effect happened around these two years in transitional countries. The effect of banking concentration in transitional countries was significantly negative before 2000 (2001) and even larger than in non-transitional countries, but it has then decreased considerably, while non-transitional countries did not experience this change. In fact, the banking concentration effect in non-transitional countries is remarkably stable in magnitude, negative and statistically significant in all models except in the one where t^* is 1995.

Incidentally, 1999-2000 is the period when eight of ten analyzed transitional countries entered the European Union (or were preparing to enter), so it is tempting to simply conclude that the accession process changed the way banking concentration affects concentration in industrial markets in these countries. The accession process demanded changes in banking regulation that liberalized banking markets and changed also the nature of banking business. However, this could be also a result of other events, for example merger waves as pointed out by Rosen (2004), and further research is needed to confirm what was the reason for this structural break.

2.7 Conclusion and further research

The estimations in this paper were conducted mainly to verify the results of Cetorelli (2001 and 2004) for the case of transitional countries and to provide further insight into empirical findings about the relationship between banking market structure and industrial market structure. The analysis of transitional banking markets evolution, based on existing theoretical, descriptive and econometric studies, indicated that his findings could be rejected for the case of transitional countries. Therefore, the aim of

the paper was to estimate the relationship between both market structures by using the same research methodology as in Cetorelli (2004) and find some starting points for further research of this link. The main conclusions from our study are the following:

Our study does not show much confirmation that the effect of banking market structure on product (industrial) market structure is positive in general, as claimed by Cetorelli (2001 and 2004) and Cetorelli and Strahan (2006). I perform a number of robustness checks in order to rule out as much as possible the differences between data sources and time periods studied, yet my analyses generally show much more support for the negative effect of banking market structure. This indicates that the positive effect found by Cetorelli might be circumstantial and linked to some specific countries (OECD) and time periods (around 1995-1997) as well as my results might be linked to specifics of European countries and time period after 1999. Such ambiguity of empirical results points out the weaknesses of the theoretical underpinnings on one side and of the methodological approach on the other. A reduced form econometric model employed in this study is sufficient only to gain some initial orientation of the relationship between both market structures but it would have to be further improved before we can use it to make more elaborate conclusions about the mechanisms that lie behind this relationship or even conceive some policy recommendations.

The relationship between both market structures is clearly different in transitional countries; however it is not clear if banking market structure has an effect on product market structure at all in transitional countries. My results generally show a small and rarely significant negative effect for these countries. This may be a result of two opposite effects cancelling each other out or simply evidence of no such effect present.

If the first case is true, we need a further study aimed at disentangling the two effects. In order to do that, it is essential that we investigate the explanations for the negative and positive effect in-depth and identify factors behind them. For example, Cetorelli (2001) shows that there is a positive effect of banking concentration, but it does not say which explanation of it seems to work behind it: does this happen because of banks' profit maximization rationality or management behavior. Rosen (2004) proposes testing profit maximization against management behavior by examining the degree of interlocking ownership, the degree of foreign ownership, and state ownership of banks. Further analysis of the mechanics behind the relationship between the two market structures would allow the development of a better econometric model that could be used for the estimation of the isolated negative and positive effect.

In the second case, we have two possibilities: either the effect (positive or negative) in transitional countries is delayed and will appear after a certain level of financial development is achieved in the country or there is no such effect (and there never will

be one) because of characteristics of transitional banking markets and their interaction with global financial markets.

My estimations show that less developed transitional countries have a different relationship between banking market structure and product market structure than other countries in the sample. However, if a more balanced sample of these countries would be available, the results would give much more confidence in this explanation.

Cetorelli in his studies assumes that SCP theory is true and therefore argues that a more concentrated banking market has banks that exploit their market power and this behavior has consequences for real market structure in the form of a negative or positive effect. Empirical studies of banking markets generally do not find convincing evidence of SCP being true, instead it appears that banking markets are behaving accordingly to contestable markets theory. This means that even if banking markets are concentrated, banks do not necessary abuse market power because of a constant threat of entry by new competitors. Since it is the abuse of market power (in the form of bank managers behavior or pricing policy) that has effects for product market structure in Cetorelli's explanations, this link between both concentrations does not hold anymore. If there was a credible threat of entry into a banking market, banks in more or less concentrated banking markets would probably react in a similar manner and the effect on product market structure would not be different between them. It is too early to say that there is no link between both market structures (or concentrations), but if this explanation holds it is not via the abuse of market power by banks and we need an alternative explanation.

My results showed a considerate effect of foreign loans to non-banks on the relationship between both market structures, which was especially typical for transitional countries. This variable had a larger and more statistically significant effect on product market structure than banking concentration had in transitional countries. Assuming that the extent of borrowing abroad affects domestic banking market competition (or market contestability), but not domestic banking market concentration, this finding further reassures the conclusion that it is really the competitive (or anticompetitive) behavior of banks that has effects for the real market structure and not concentration *per se*.

Because of globalization, deregulation and liberalization in banking industry, the problem of defining the relevant market is severely aggravated in studies of this industry. The assumption that national banking markets can proxy for relevant domestic banking markets has become much weaker in the last decade than it was before. The significant effect of foreign loans demonstrates that the relevant banking market is in fact broader than national markets for most countries, especially transitional. Further empirical studies need to consider this problem much more carefully and find a feasible solution for a better proxy.

Banking and product market size have an important effect on the relationship between both market structures. The results indicate that small markets are likely characterized by a positive banking concentration effect and medium markets by a negative one. The banking concentration effect is most likely not present in countries with large banking markets, but it can be negative in countries with large product markets.

The product market side of the whole story has not been analyzed as methodically as the banking market side so far. Besides the concern about average firm size being an adequate measure of market structure, there are other questions that might cast light to some unopened issues. Is it plausible that the effect on market structure is the same for all industries that have similar external financial dependence and fraction of the total manufacturing value added? What is the role of other industry characteristics, for example those related to technology used (economies of scale and scope, presence of network externalities and their effects, life-cycle stage, cost curve, simplicity to use, presence of a standard of technical compatibility, degree of appropriability, ease of imitation etc.), market served (power of customers and suppliers, competitors, local or global market), or characteristics of the financial claim (debt, equity)? At least some of these aspects should be incorporated in the future research of the relationship between the two market structures, either theoretically or empirically.

2.8 References

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2.9 Appendix

Table 2.3: Pairwise Correlations EUROSTAT

	LNVA	SHVA	CR3	CR5	HHI	Dom_cre	Priv_cre	Mar_cap	Gdp_pc	Floans
LNVA	1									
SHVA	0.157∗	1								
CR3	−0.044∗	−0.004	1							
CR5	−0.079∗	0.004	0.969∗	1						
HHI	−0.065∗	0.010	0.882∗	0.806∗	1					
Dom_cre	0.404∗	−0.032∗	−0.088∗	−0.158∗	−0.185∗	1				
Priv_cre	0.389∗	−0.038∗	−0.114∗	−0.177∗	−0.192∗	0.906∗	1			
Mar_cap	0.283∗	−0.024∗	−0.077∗	−0.034∗	0.012	0.429∗	0.521∗	1		
Gdp_pc	0.439∗	−0.041∗	−0.090∗	−0.227∗	−0.142∗	0.630∗	0.730∗	0.584∗	1	
Floans	0.154∗	−0.039∗	−0.290∗	−0.318∗	−0.193∗	0.204∗	0.297∗	0.405∗	0.537∗	1

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

Table 2.4: Pairwise Correlations UNIDO

	LNVAU	SHVA	CR3	CR5	HHI	Dom_cre	Priv_cre	Mar_cap	Gdp_pc	Floans
LNVAU	1									
SHVAU	0.1330∗	1								
CR3	0.0902∗	−0.0392∗	1							
CR5	−0.1114∗	0.0089	0.9690∗	1						
HHI	−0.1106∗	−0.0928	0.8824∗	0.8059∗	1					
Dom_cre	0.4445∗	−0.0230	−0.0875∗	−0.1582∗	−0.1851∗	1				
Priv_cre	0.4624∗	−0.0229	−0.1136∗	−0.1768∗	−0.1922∗	0.9057∗	1			
Mar_cap	0.2011∗	0.0453∗	−0.0772∗	−0.0336∗	0.0118	0.4289∗	0.5209∗	1		
Gdp_pc	0.5376∗	−0.0012	−0.0897∗	−0.2270∗	−0.1419∗	0.6298∗	0.7303∗	0.5839∗	1	
Floans	0.3135∗	0.0748∗	−0.2901∗	−0.3178∗	−0.1932∗	0.2042∗	0.2996∗	0.4049∗	0.5373∗	1

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

TABLE 2.5: External financial dependency (Rajan and Zingales, 1998)

ISIC rev.2		**External financial dependency**
323	Leather	-1.33017
324	Footwear	-0.57282
314	Tobacco	-0.37546
3513	Synthetic Resins	-0.22668
352	Other chemicals	-0.18361
313	Beverages	-0.14638
355	Rubber products	-0.12256
311	Food	-0.05206
390	Other Manufacturing	-0.05130
353	Petroleum Refineries[a]	-0.02171
322	Wearing Apparel	-0.02010
3522	Drugs and Medicines	0.02752
362	Glass and products	0.03103
3841	Shipbuilding and repairing	0.04087
381	Metal Products	0.04370
372	Non-ferrous metals	0.07313
3511	Basic industrial chemicals	0.07534
371	Iron and Steel	0.08709
341	Paper and products	0.10438
3843	Motor vehicles	0.10957
3411	Pulp, paper and board	0.12680
342	Printing and Publishing	0.13582
321	Textiles	0.14100
369	Non-metallic products	0.15193
354	Petroleum and Coal Products	0.16202
384	Transport Equipment	0.16324
361	Pottery, China etc.	0.16338
385	Professional Goods	0.19365
382	Non-Electrical Machinery	0.21660
383	Electrical machinery	0.23002
331	Wood products	0.24919
3825	Office and computing machines	0.26072
332	Furnitures and Fixtures	0.32917
3832	Radio, Tv and Comm. Equipment	0.39350
356	Plastic Products	n.a.

[a]This sector was not included in the benchmark analysis, because it was not possible to accurately translate it from NACE.

NOTE: Shaded sectors have above median external financial dependency.

TABLE 2.6: Pattern of Industry Structure and Banking Concentration across Countries

Country	**mean(CR3)**	**mean(LNVA)**	**mean(Nbanks)**	**mean(Nfirms)**
AT	48.56	0.70	177.67	26042.67
BE	77.00	0.52	56.50	29667.33
BG	49.00	−2.24	25.17	20605.33
CZ	64.75	−1.60	24.67	134914.30
DE	38.08	1.16	509.83	206569.50
DK	79.68	0.20	92.50	18847.67
EE	98.34	−1.35	5.33	3913.00
ES	49.96	−0.10	147.83	217909.00
FI	87.66	0.21	8.33	25114.67
FR	34.84	0.47	319.17	245777.50
HU	49.66	−0.90	25.33	49867.17
IE	61.56	1.28	31.67	3937.67
IT	29.27	−0.36	394.00	532855.30
LT	82.56	−1.88	9.00	7729.83
LU	23.72	0.32	108.33	784.50
LV	53.96	−1.78	21.33	6063.17
NL	81.15	0.12	41.83	44716.67
NO	65.42	0.71	51.17	11200.50
PL	43.66	−0.95	100.75	197445.00
PT	67.91	−0.44	41.83	73305.34
RO	59.99	−0.98	26.83	38462.00
SE	78.09	−0.30	68.83	43880.00
SI	59.84	−0.93	17.17	19761.67
SK	63.21	−0.24	15.50	4983.67
UK	39.47	0.70	144.33	156644.50
Transitional	62.50	−1.29	27.11	48374.51
Non-transitional	57.49	0.35	146.26	109150.19

NOTE: CR3 is the concentration ratio of three largest banks in the banking market. It is measured as the market share of three largest banks in terms of total assets. The mean (CR3) refers to the average CR3 in the period 1999-2004. LNVA is the logarithm of value added per enterprise and the mean is calculated as the simple average LNVA in the period 1999-2004 by country. Mean (Nbanks) and Mean (Nfirms) denote the average number of banks and firms, respectively, in the period 1999-2004 by country.

TABLE 2.7: Pattern of Financial Dependence and Industry Structure across Sectors

ISIC 2		**mean(Ext_dep)**	**mean(LNVA)**
311	Food products	−0.0521	−0.7379
313	Beverages	−0.1464	0.5486
314	Tobacco	−0.3755	2.9109
321	Textile	0.1410	−0.8936
322	Apparel	−0.0201	−1.7898
323	Leather	−1.3302	−2.1445
324	Footwear	−0.5728	−1.1999
331	Wood products	0.2492	−1.6619
332	Furniture	0.3292	−1.5347
341	Paper and products	0.1044	−0.0058
342	Printing and publishing	0.1358	−1.1872
352	Other chemicals	−0.1836	0.0315
354	Petroleum and coal products	0.1620	2.8109
355	Rubber products	−0.1226	0.0903
361	Pottery	0.1634	−1.8129
362	Glass	0.0310	−0.1677
369	Nonmetal products	0.1519	−0.5284
371	Iron and steel	0.0871	0.3029
372	Nonferrous material	0.0731	1.2573
381	Metal products	0.0437	−1.3529
382	Machinery	0.2166	−0.5371
383	Electric machinery	0.2300	−0.1442
384	Transportation equipment	0.1632	0.7313
385	Professional goods	0.1937	−0.9819
390	Other industries	−0.0513	−2.0775
3411	Pulp, paper	0.1268	1.6888
3511	Basic industrial chemicals, excluding fertilizers	0.0753	1.3728
3513	Synthetic resins	−0.2267	1.2632
3522	Drugs	0.0275	1.9947
3825	Office and computing	0.2607	−0.6641
3832	Radio	0.3935	−0.2945
3841	Ship	0.0409	−0.8775
3843	Motor vehicle	0.1096	0.7836

NOTE: Mean (Ext_dep) is the average external financial dependency for American mature firms in the 1980's. The measure is taken from Rajan and Zingales (1998). LNVA is the logarithm of value added per enterprise and the mean is calculated as the simple average LNVA in the period 1999-2004 by sector.

TABLE 2.8: Estimation results for benchmark model (EUROSTAT dataset)

	Dependent variable=Average firm size; measured in		
	Value added	Turnover	Num. employees
SHVA	17.124***	15.957 * **	11.056***
	(0.581)	(0.606)	(0.652)
CR3*TR*EDI	−0.149	−0.067	−0.066
	(0.117)	(0.123)	(0.104)
CR3*EU*EDI	−0.244 * *	−0.270 * *	−0.100
	(0.109)	(0.115)	(0.100)
Observations	5394	5391	5366
R^2	0.6684	0.9267	0.4206
SHVA	16.959***	15.637 * **	10.654***
	(0.638)	(0.668)	(0.715)
CR5*TR*EDI	−0.061	−0.001	0.035
	(0.137)	(0.145)	(0.121)
CR5*EU*EDI	−0.148	−0.182	−0.001
	(0.139)	(0.146)	(0.126)
Observations	4316	4313	4324
R^2	0.6855	0.936	0.444
SHVA	16.976***	15.662 * **	10.670***
	(0.638)	(0.667)	(0.716)
HHI*TR*EDI	0.050	0.077	0.092
	(0.212)	(0.225)	(0.184)
HHI*EU*EDI	−0.388 * *	−0.551 * **	−0.172
	(0.201)	(0.209)	(0.182)
Observations	4316	4313	4324
R^2	0.6856	0.936	0.4442

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

NOTE: The benchmark model is indicated by the shaded area. The period analyzed in the models with CR3 is 1995-2004, in all other models it is 1999-2004.

TABLE 2.9: Institutional variables

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
SHVA	17.184***	17.187***	17.145***	17.117***	17.156***
	(0.583)	(0.582)	(0.580)	(0.581)	(0.580)
CR3TR * EDI	0.274	0.232	−0.230	−0.063	0.104
	(0.193)	(0.177)	(0.165)	(0.166)	(0.168)
CR3EU * EDI	−0.327***	−0.334***	−0.189*	−0.220*	−0.286***
	(0.110)	(0.111)	(0.112)	(0.115)	(0.109)
Dom_cre *TR * EDI	−0.005 * *				
	(0.002)				
Dom_cre *EU * EDI	0.001				
	(0.001)				
Priv_cre *TR * EDI		−0.007***			
		(0.003)			
Priv_cre *EU * EDI		0.001			
		(0.001)			
Mar_cap *TR * EDI			0.000		
			(0.004)		
Mar_cap *EU * EDI			−0.001***		
			(0.000)		
Gdp_pc *TR * EDI				0.000***	
				(0.000)	
Gdp_pc *EU * EDI				0.000***	
				(0.000)	
Floans *TR * EDI					−3.734 * *
					(1.579)
Floans *EU * EDI					0.013
					(0.155)
R^2	0.669	0.669	0.669	0.670	0.669
Observations	5394	5394	5394	5394	5394

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

TABLE 2.10: Size effects

		Dom_cre	**Floans**	**GDP**
Large	SHVA	17.839***	18.975***	17.868***
		1.339	1.203	1.129
	CR3TR*EDI		−0.243	
			0.413	
	CR3EU*EDI	−0.063	−0.227	−0.360*
		0.183	0.219	0.190
	R^2	0.4829	0.4626	0.4867
	Observations	2080	1563	1758
Medium	SHVA	16.683***	17.017***	17.413***
		0.685	0.668	0.786
	CR3TR*EDI	−0.470***	−0.260*	−0.784***
		0.146	0.149	0.256
	CR3EU*EDI	−0.528***	−0.284*	−0.591***
		0.138	0.153	0.200
	R^2	0.6131	0.6798	0.6252
	Observations	2272	2893	2980
Small	SHVA	18.327***	15.657***	16.869***
		1.303	1.066	1.329
	CR3TR*EDI	0.553*	0.563*	0.272
		0.291	0.308	0.267
	CR3EU*EDI	0.121	0.669*	0.202
		0.447	0.379	0.910
	R^2	0.5925	0.7240	0.6672
	Observations	1011	938	656

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

TABLE 2.11: Lagged and average concentration measures

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
SHVA	17.296***	17.382***	16.935***	16.675***	16.957***	16.704***
	(0.616)	(0.779)	(0.708)	(0.962)	(0.708)	(0.963)
Lagged CR3TR * EDI	−0.107					
	(0.120)					
Lagged CR3EU * EDI	−0.259 * *					
	(0.113)					
Average CR3TR * EDI		−0.196				
		(0.147)				
Average CR3EU *EDI		−0.350***				
		(0.132)				
Lagged CR5TR * EDI			0.001			
			(0.147)			
Lagged CR5EU * EDI			−0.132			
			(0.152)			
Average CR5TR * EDI				−0.003		
				(0.191)		
Average CR5EU * EDI				−0.140		
				(0.198)		
Lagged HHITR * EDI					0.175	
					(0.223)	
Lagged HHIEU * EDI					−0.389*	
					(0.218)	
Average HHITR * EDI						0.106
						(0.285)
Average HHIEU * EDI						−0.427
						(0.272)
R^2	0.650	0.618	0.683	0.671	0.683	0.671
Observations	5149	3661	3634	2168	3634	2168

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

TABLE 2.12: Estimations UNIDO 1

Variable	**(1)**	**(2)**	**(2a)**	**(3)**	**(4)**	**(5)**	**(6)**
SHVA	11.635***	10.968***	12.137***	10.003***	9.883***	9.972***	13.882***
	0.834	1.109	0.684	1.158	1.181	1.166	0.720
CR3*TR*EDI	−0.156	−0.160	0.157			−0.239	0.174
	0.130	0.162	0.175			0.180	0.168
CR3*EU*EDI	−0.251 * *	−0.080	−0.092			−0.220	−0.033
	0.116	0.154	0.149			0.196	0.138
CR5*TR*EDI				−0.280			
				0.183			
CR5*EU*EDI				−0.276			
				0.193			
HHI*TR*EDI					−0.296		
					0.283		
HHI*EU*EDI					0.081		
					0.327		
R^2	0.714	0.688	0.719	0.693	0.693	0.693	0.709
Observations	4443	2835	1608	2050	2050	2050	2393

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

Table 2.13: Estimations UNIDO - institutional variables

Variable	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
SHVA	11.725***	11.800***	11.704***	11.795***	10.991***
	0.825	0.824	0.873	0.820	1.108
CR3*TR*EDI	−0.191	0.049	0.002	0.174	0.150
	0.212	0.203	0.158	0.209	0.229
CR3*EU*EDI	−0.164	−0.166	−0.280 **	−0.147	0.015
	0.105	0.108	0.116	0.111	0.157
Dom_cre *TR * EDI	−0.004 **				
	0.002				
Dom_cre *EU * EDI	−0.003***				
	0.001				
Priv_cre *TR * EDI		−0.015***			
		0.004			
Priv_cre *EU * EDI		−0.004***			
		0.001			
Mar_cap *TR * EDI			−0.012***		
			0.004		
Mar_cap *EU * EDI			−0.001		
			0.000		
Gdp_pc *TR * EDI				0.000***	
				0.000	
Gdp_pc *EU * EDI				0.000***	
				0.000	
Floans *TR * EDI					−5.343 **
					2.488
Floans *EU * EDI					−1.147 **
					0.500
R^2	0.715	0.717	0.714	0.716	0.689
Observations	4430	4430	4331	4443	2835

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

Table 2.14: Estimations UNIDO - lagged and averages

Variable	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**
SHVA	11.684***	9.746***	9.622***	11.911***	9.480***	9.329***
	0.930	1.255	1.288	1.269	1.680	1.743
Lagged CR3TR * EDI	−0.191					
	0.140					
Lagged CR3EU * EDI	−0.237*					
	0.128					
Lagged CR5TR * EDI		−0.366*				
		0.209				
Lagged CR5EU * EDI		−0.339				
		0.231				
Lagged HHITR * EDI			−0.355			
			0.307			
Lagged HHIEU * EDI			0.067			
			0.430			
Average CR3TR * EDI				−0.241		
				0.203		
Average CR3EU *EDI				−0.122		
				0.181		
Average CR5TR * EDI					−0.525	
					0.324	
Average CR5EU * EDI					−0.403	
					0.399	
Average HHITR * EDI						−0.454
						0.456
Average HHIEU * EDI						0.253
						0.864
R^2	0.702	0.674	0.673	0.683	0.639	0.638
Observations	3879	1612	1612	2189	700	700

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

Table 2.15: Estimations UNIDO 2

Variable	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**	**(24)**
SHVA	13.882***	13.346***	11.640***	10.926***	9.942***	9.875***	11.695***
	0.720	0.733	0.841	1.122	1.184	1.188	0.803
CR3*TR*EDI	0.174	0.145	−0.122	0.257*			
	0.168	0.433	0.112	0.146			
CR3*EU*EDI	−0.033	−0.017	−0.059	0.255*			
	0.138	0.145	0.103	0.147			
CR5*TR*EDI					0.268		
					0.185		
CR5*EU*EDI					0.221		
					0.200		
HHI*TR*EDI						0.162	
						0.260	
HHI*EU*EDI						0.307	
						0.328	
CR3*TR1*EDI						0.061	
							0.114
CR3*TR2*EDI							0.845***
							0.327
CR3*EU*EDI							−0.034
							0.103
R^2	0.709	0.644	0.714	0.688	0.693	0.693	0.715
Observations	2393	2156	4443	2835	2050	2050	4443

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

Table 2.16: Estimations UNIDO 3

Variable	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**
SHVA	10.971***	9.989***	11.695***	11.765***	11.643***	11.809***
	1.115	1.181	0.846	0.846	0.885	0.812
CR3*TR*EDI	0.544 * *	0.489 * *	0.093	0.217	0.105	0.422
	0.222	0.231	0.203	0.188	0.143	0.194
CR3*EU*EDI	0.294*	0.184	−0.097	−0.124	−0.098	−0.082
	0.154	0.220	0.103	0.104	0.105	0.107
Floans*TR*EDI	−5.436 * *	−5.484 * *				
	2.533	2.597				
Floans*EU*EDI	−0.980 * *	−0.776				
	0.494	0.688				
Dom_cre*TR*EDI			−0.005***			
			0.002			
Dom_cre*EU*EDI			−0.002 * *			
			0.001			
Priv_cre *TR * EDI				−0.015***		
				0.004		
Priv_cre *EU * EDI				−0.003***		
				0.001		
Mar_cap *TR * EDI					−0.001	
					0.004	
Mar_cap *EU * EDI					0.000	
					0.000	
Gdp_pc *TR * EDI						0.000***
						0.000
Gdp_pc *EU * EDI						0.000***
						0.000
R^2	0.689	0.694	0.715	0.716	0.713	0.716
Observations	2835	2050	4430	4430	4331	4443

*** 1 % significance level, ** 5 % significance level, * 10 % significance level

TABLE 2.17: Breakdown of observations by country (UNIDO)

Country code	**Frequency**	**Percent**	**Cumulative**
AUT	432	5.76	5.76
BEL	194	2.59	8.35
BUL	213	2.84	11.19
CRO	28	0.37	11.57
CZE	48	0.64	12.21
DEN	164	2.19	14.40
EST	89	1.19	15.58
FIN	492	6.56	22.15
FRA	207	2.76	24.91
GER	151	2.01	26.92
GRC	96	1.28	28.21
HUN	400	5.34	33.54
IRE	346	4.62	38.16
ITA	492	6.56	44.72
LAT	259	3.46	48.18
LIT	108	1.44	49.62
LUX	98	1.31	50.93
MAC	81	1.08	52.01
MOL	51	0.68	52.69
MON	68	0.91	53.60
NET	235	3.14	56.73
NOR	423	5.64	62.37
POL	405	5.40	67.78
POR	252	3.36	71.14
ROM	225	3.00	74.14
RUS	322	4.30	78.44
SLK	210	2.80	81.24
SLO	199	2.66	83.90
SPA	424	5.66	89.55
SWE	284	3.79	93.34
UK	499	6.66	100
Total	7,495	100	

TABLE 2.18: Breakdown of observations by sector (UNIDO)

ISIC code	**Frequency**	**Percent**	**Cumulative**
311	280	3.74	3.74
313	251	3.35	7.08
314	206	2.75	9.83
321	288	3.84	13.68
322	269	3.59	17.26
323	254	3.39	20.65
324	233	3.11	23.76
331	288	3.84	27.61
332	256	3.42	31.02
341	290	3.87	34.89
342	270	3.60	38.49
351	254	3.39	41.88
352	223	2.98	44.86
353	201	2.68	47.54
354	111	1.48	49.02
355	274	3.66	52.68
356	254	3.39	56.06
361	251	3.35	59.41
362	251	3.35	62.76
369	214	2.86	65.62
371	268	3.58	69.19
372	218	2.91	72.10
381	278	3.71	75.81
382	266	3.55	79.36
383	280	3.74	83.10
384	263	3.51	86.60
385	254	3.39	89.99
390	269	3.59	93.58
3411	65	0.87	94.45
3511	65	0.87	95.32
3513	49	0.65	95.97
3522	65	0.87	96.84
3825	57	0.76	97.60
3832	59	0.79	98.39
3841	56	0.75	99.13
3843	65	0.87	100
Total	7,495	100	

TABLE 2.19: Breakdown of observations by year (UNIDO)

Year	Frequency	Percent	Cumulative
1987	415	5.54	5.54
1988	412	5.5	11.03
1989	421	5.62	16.65
1990	441	5.88	22.54
1991	463	6.18	28.71
1992	473	6.31	35.02
1993	488	6.51	41.53
1994	413	5.51	47.04
1995	405	5.4	52.45
1996	408	5.44	57.89
1997	452	6.03	63.92
1998	486	6.48	70.41
1999	473	6.31	76.72
2000	504	6.72	83.44
2001	484	6.46	89.90
2002	423	5.64	95.54
2003	334	4.46	100
Total	7,495	100	

Chapter 3

A Model of Relationship Between Banking and Product Market Structure

3.1 Introduction

This paper aims to further contribute to the knowledge of the specific relationship between two market structures: product and banking market structure. Recently, Cetorelli (2001, 2004) has began to research the question whether is it possible that banking market structure has an effect on real markets' structure. In these two studies he finds very robust empirical evidence for a positive relationship between the two market structures for OECD countries. This finding implies that countries with more concentrated banking markets should have also more concentrated product markets. On the other hand, my empirical study of this relationship (Chaper 2 of this Dissertation) shows a negative relationship between banking and product market concentration in advanced European countries and no such relationship in European transitional countries. These results suggest that in the former countries more concentrated banking markets lead to less concentrated product markets and that there seems to be no such effect in transitional countries.

One of my main objections to Cetorelli's work is a lack of in-depth theoretical analysis into various aspects of the link between both markets, most notably the determinants of market structure, which are crucial for understanding, explaining and modelling the relationship between both markets and consequently market structures. The focus of this paper is therefore the development of a theoretical model that is able to explain why should the two market structures be linked at all and in what is their relationship.

Specifically, I would like to explain existing empirical evidence by building a theoretical model that incorporates insights from industrial organization and banking literature to understand better the mechanisms that are supposedly behind this relationship and circumstances in which they might operate.

The existence of a relationship between the market structures in banking and product markets would have many important implications. Most obvious, the regulation or deregulation policies of this area could be considerably different if there is in fact such a relationship. For example, banking regulation of mergers and acquisitions in banking and licensing policy would have to take into account also the effects that banking market has on product markets' concentration. Also, when analyzing the market in a broader scope, for example global or regional markets, we would have to consider the possible feedback effect of the product markets concentration on banking market concentration (the feedback effect is not studied in this paper and remains part of the future research agenda). A link between both market structures would bring new fuel in the debate on the trade-off between financial stability and competition, as well as in the century old debate of product market structure effect on innovations and financing of start-up firms. Finally, this relationship should be taken into account when studying the dynamics of firm entry and exit and the effect on productivity growth.

In what follows, I first explain why some researchers believe there should be a link between banking and product market structure and critically evaluate the evidence they present for such claims. Next, I briefly review and present the findings of industrial organization and banking literature that contribute to understanding of the relationship between both market structures better. Then, I build a model that incorporates these results, discuss its implications for the research question and wrap up with an analysis of its implications for empirical testing.

3.2 Literature Review

In theory, banking sector's market structure could have a positive, a negative or a non-existant effect on the product market structure. The alternative hypothesis about the nature of this relationship take into perspective different characteristics of the bank-firm relationship. However, no comprehensive theory or formal model attempts to explain the link between the two market structures by consolidating all proposed hypotheses. The existing explanations can be divided in two groups: one group consists of explanations for the positive relationship between market structures, while the other has an explanation for the negative link between market structures. The difference in the two lines of reasoning can be boiled down to two questions: 1) in a situation where the entrant firm

asks for bank credit, who will get the credit: the entrant, the incumbent or both, and 2) how does banking market structure affect this decision by the bank. The explanations for the positive relationship argue that banks with market power will decide to finance incumbents instead of entrants, while explanations of the negative relationship argue the entrants would get credit. In this section, I explain why these explanations are not sufficient for the study of this question.

3.2.1 Explanations for the Positive Relationship

A positive relationship between market structures implies that product markets in countries with more concentrated banking markets will be more concentrated. There are two causal explanations considered by Cetorelli (2001 and 2004): the first one is based on profit maximization by banks while the second one is a behavioral explanation. The third explanation is proposed by Rosen (2004) and involves financing obstacles.

3.2.1.1 Profit maximization

The main hypothesis behind "profit maximization " explanation is that banks shield their old clients by not giving credit to new entrants because this guarantees higher profits for the bank. In his comment of Cetorelli (2004), Rosen (2004) calls this explanation cannibalization, since banks effectively renounce a part of their potential revenue in favor of allegedly more profitable relationship with the incumbent firm. However, Cetorelli (2001 and 2004) does not explicitly explain why this kind of bank behavior should differentiate between banks with more or less market power. To put it differently: if we accept the hypothesis that banks do in fact behave like this, then every bank would find it advantageous to behave like this, no matter how large its market power. Instead, Cetorelli (2004) relies on the theoretical findings of Cestone and White (2003) and Spagnolo (2000) who show theoretical frameworks where banks with market power tend to favor their established borrowers over new borrowers.

Cestone and White's model focuses on the financial entry deterrence effect, which is supposed to be important mostly in countries and industries where financial sources are relatively scarce (e.g. transitional countries). Their reasoning is the following: investors that take part in the surplus generated by an entrepreneur's investment are tempted not to finance entrants to limit competition in product markets and secure profits of their client (and thus their own profits too). On the other hand, investors that hold a safe debt in this firm will be tempted to finance another firm entering the industry, since they have gained information about industry and possible returns, and their return is not dependent on the financed firm's profitability. Knowing this, the incumbent firm will not

be prepared to accept the same terms ex ante, and the investor's profits will be smaller because of his lack of commitment. Because the form of the financial contract between the investor (equity- or debt-holder) and the firm will affect the sensitivity of investor's profits to the profits of the financed firm (hence to the product market competition), the willingness to finance an entrant will also depend on it. Their main claim is that when investors hold equity claims in financed firms, this is more entry-deterring than the case of debt claims.

The authors then show how imperfect credit market competition affects entry. When alternative sources of funding are available to new entrants, the incumbent firm has less power to deter entry. The incumbent would have to propose to its lender a financial contract that would give no incentive to finance new entrants to its current lender, nor to other credit market competitors. When the competition in the credit market is weak, the incumbent sells a riskier claim to the lender in order to prevent large entry. As the competition toughens, the incumbent must allow enough entry that the lender's competitors will be discouraged to finance the rejected entrants because of low quality. Therefore the incumbent must sell a safer claim to its lender to induce a more accommodating attitude towards entering firms. When the competition is very strong, there is no way that the incumbent could prevent entry, so the optimal claim is debt.

Cestone and White (2003, p. 2132) conclude that "as financial markets become more competitive, there is more entry into product market, and so product markets too become more competitive." Their empirical predictions are then i) the competitiveness of financial and product markets should be positively correlated both across countries and over time, ii) the correlation is smaller in industries where product market competition comes from foreign firms and domestic entrants are able to borrow abroad and iii) the correlation is mediated via large equity stakes, so the more concentrated credit markets are, the larger are the stakes that incumbent lenders have in incumbent firms. Financial regulation must be taken in consideration in this latter respect, as well as the origin of law (civil law vs. common law).

In my view, the problem of this framework is that its result depends on the assumption that banks can have equity stakes in firms. I object to this assumption mainly on empirical grounds. Some countries do not allow banks to have equity claims and even in the countries where this practice is allowed (for instance, Germany) the extent of equity financing by banks is negligible. A study of German banking market (which has a reputation for being bank-ownership friendly) by Dittmann, Maug and Schneider (2008) showed that the average equity stake by German banks in 1994 was about 4 percent and it decreased to 0.4 percent by 2005. Besides, the same study showed that banks, which had a representative in the board of a company, increased the financing in

the same industry, but not by financing the same firm, what is clearly the opposite of Cestone and White's prediction for banks holding equity stakes but it is consistent with banks behaving as debtholders in their model.

Another objection to Cestone and White's logic is related to the validity of the traditional structure-conduct-performance (SCP) paradigm, which is inherent in their reasons. Consistent with this paradigm, they treat the relationship between competition and concentration as linear: more concentrated markets are less competitive; more entry means less concentration and therefore more competition. Their analysis is in fact more focused on the effects of banking competitive behavior on product market entry which is fine, but they should qualify their conclusions with respect to competition or concentration in product markets and with respect to concentration in banking markets only as valid if SCP is valid. The problem is that the traditional SCP is being attacked as theoretically too simplistic and empirically not convincingly supported (e.g. for transitional banking markets Gelos and Roldós, 2004, Yildirim and Philippatos, 2007, and Mamatzakis et al., 2005 do not find support for SCP; for developed banking markets Berger et al., 1999, Canoy et al., 2001, Hannan, 1997, Radecki, 1998 do not find support for SCP).

Spagnolo's (2000) model explains how concentrated (or more precisely, collusive) credit markets transmit collusion in otherwise competitive product markets. The reason for that lies foremost in the lender's interest for cautious, conservative strategies that are supposed to reduce the shareholder-debtholder problem, are linked to debt covenants and inherent in managers' incentive schemes. If banks have the power to choose a conservative manager and/or ensure that commitment to prudent strategies is credible, the incentive for coordinating and enforcing collusion in product markets is greater, and more collusion agreements become sustainable. Spagnolo shows that even when credit markets are competitive, it suffices to have at least one common lender for oligopolistic firms to stick to collusion agreements that would not be sustainable otherwise. If there are no common lenders, independent banks can still ensure similar result by exploiting the "information network composed of indirectly interlocking directors, where each monitors a borrower of a competing bank". When there is little credit market competition, the lender has more bargaining power and can extract a larger share of the collusive rent. Therefore, its incentive to set up these "conservative governance structures" is greater when credit markets are less competitive. Spagnolo also considers the financial entry deterrence effect in his setup. However, he finds this effect to be limited to either very concentrated or underdeveloped credit markets. In both cases the effect disappears when the second lender is present in the market.

From this last claim, we see that Spagnolo (2000) in fact finds that there is no effect of banking market collusion on entry (and therefore concentration) in product markets unless we are in a perfect monopoly. Besides, what Spagnolo in fact analyses is the effect of banking market collusion on product market collusion. Here again, it is not warranted to generalize this result as the effect of banking market concentration (or competition) on product market concentration since this relationship is not necessarily linear.

3.2.1.2 Behavior of bank managers

The main premise behind this explanation is that bank managers have close relationships with incumbent firms and their strategic decisions about granting credit are not necessarily related to bank's profitability. Banks prefer to make less profitable loans to related companies than to lend more profitably to non-related companies. Cetorelli (2001) backs this explanation with some historical evidence from Mexico (Haber, 1991) and England (Lamoreaux, 1986). Rosen (2004) calls this crony capitalism. Although Cetorelli (2001) offers no explicit explanation how is this behavior different when a bank has more market power, I assume banks with more market power do not face such competitive pressure for profit maximization and can afford to finance (sometimes) firms on other grounds, for instance because of good long-term relationships or bank managers' personal motives.

3.2.1.3 Financing obstacles

Financing obstacles explanation by Rosen (2004) maintains that a more concentrated banking market is associated with more financing obstacles and less new firms or smaller firm size. This was empirically demonstrated by Beck, Demirgüç-Kunt and Maksimovic (2004). Cetorelli and Strahan (2004) include financing obstacles as a possible explanation and provide also the link with banking market structure which is missing in the first explanation: banks with more market power tend to reduce the amount of available credit, generally. Less credit supply and higher prices affect potential entrants more than incumbents, so there will be less entry in the industry.

Some historical evidence support the explanations of the positive relationship between both market structures: Cohen (1967) for the Italian industrialization era in late nineteenth century, Capie and Rodrik-Bali (1982) for Britain in the early 1890s, and Haber (1991) for Mexican banking and textile industry in the late nineteenth century. Besides, Cetorelli (2001 and 2004) finds empirical evidence that bank concentration leads to higher average firm size in manufacturing sectors, and evidence that a process of bank deregulation has led to lower average firm size. Cetorelli and Strahan (2004) empirically

confirmed that more intensive competition (small concentration) in banking markets is associated with greater number of firms and lower average firm size, where the effect of banking competition is particularly strong for the smallest firms and practically nonexistent for large companies.

3.2.2 Explanations of the Negative Relationship

The explanation for the negative effect of banking market structure on industrial market structure considered by Cetorelli (2001 and 2004) is based on the arguments of Petersen and Rajan (1995). Petersen and Rajan believe that banking market power leads to more industry entry because banks can sustain the cost of initiating a risky relationship with an entrant only if market power allows them to recoup the cost at later stages if the entrant is successful. Banks with market power are able to smooth interest rates intertemporally, and are therefore more willing to finance firms entering an industry, which are often financially poor. They charge a lower-than-competitive interest rate early in the firm's life, and later compensate that by charging an above-competitive interest rate.

Petersen and Rajan have empirically confirmed that more concentration in banking markets increases the credit available to younger firms and that banks in concentrated banking markets do in fact smooth interest rates. The authors find the decline in interest rate paid as firm ages significantly steeper in competitive markets. This means that banks in a competitive market are more actively seeking new clients among older, well-known firms than banks in a concentrated market. The value of a lending relationship that a bank has with a firm is therefore smaller in a more competitive banking market, since both banks and firms are faced with a greater probability of exiting the lending relationship. The situation is somewhat different for younger firms, which are approached by banks less often since they are riskier and not that well-known. Younger firms have to seek financial service by themselves and are apparently more able to get credit in concentrated banking markets. Banks in more competitive markets are reluctant to finance and invest in a lending relationship with younger, risky firms that will be offered credit by other banks as soon as they become profitable and better known.

Cetorelli (2004) extends the arguments of Petersen and Rajan to conclude that since banks with market power charge on average higher prices, young firms will not grow as large as they would in a competitive banking industry. Furthermore, he thinks that this implies banks continuously favoring new entrants because having higher returns on projects and more innovative technologies, they may replace incumbents and guarantee

higher profits for the bank. The result is then more industry entry, lower average firm size and larger prevalence of smaller firms (Cetorelli and Strahan, 2004).

Hellman and DaRin (2002) propose a theoretical model which shows that large banks with market power are needed to finance new industry in emerging markets. They back their theory with historical evidence from Belgium, Germany, Italy, Russia and Spain. Their finding is consistent also with Cetorelli and Gambera (2001) who empirically confirm that higher concentration in banking markets is associated with higher growth rates in sectors with younger firms, but with lower growth rates in sectors with mature firms.

3.2.3 Problems with existing approaches

One main objection to the approaches taken so far in order to answer the question of relationship between market structures is that they do not consider the determinants of product market structure at all and they do not take into account the industrial characteristics that might affect the banking concentration effect. For example, the central question in modelling the relationship between both market structures is whether banks prefer to finance the entrant or the incumbent firm. In order to see, that the answer must consider at least some characteristics of the product market, think about a case where the entrant is a big firm entering a fragmented industry versus a case where a small entrant wants to enter a highly concentrated industry. Not one of these studies considers in the analysis the determinants of banking or product market structure with the required attention and only empirical studies do control for some industry-specific effects although in a very ad hoc manner.

Contrary to the work presented above, my analysis is based on the product market and the determinants of its market structure. The link between banking and product market is via cost of financing and bank-firm relationship. Both are affected by banking market characteristics such as concentration and competition.

Another problem of the studies on this topic is the confusion between competition, concentration and market structure. Often concentration is interpreted as the inverse of competition, which is not necessary the case. Concentration is not only the number of firms, although it is affected by it; it is not the same as competition, although it is closely related to it. Concentration could be conceptually defined as the distribution of market power in the market. The less symmetric is the distribution of market power, the more concentrated is the market. However, market power is difficult to define and measure, if it is not operationalized. The industrial organization literature relates concentration mainly to firm size, configuration of market shares and the degree of vertical integration.

These are all imperfect measures of concentration. For example, activity restrictions imposed by national banking regulation authority may diminish the market power of banks compared to other countries, however they do not affect the distribution of market shares per se. In spite of this example, market concentration is typically measured by concentration ratios indicating the combined market shares of n largest firms in the market. A market structure is called concentrated where there is a few large firms and fragmented where there are many small firms. Competition, on the other hand, is a complex term reflecting the price level or price-cost margins, the number of firms in the market, the degree of concentration, regulation, the possibilities of collusion, the competition policy, the openness of an economy and other characteristics of the economy.

I do not study the difference in competition and concentration effect in this paper as I deal with this question in Chapter 4. Instead, I study the effect of market structure, which I define in terms of the number of firms in the market and the share of the largest firm. Market structure is measured by market concentration which is measured by the market share of the largest firm. Also, I do not study the effects of competition explicitly, but since concentration and competition are related to a certain extent, the results are relevant also for inference about competition effects.

Since the current body of research lacks a model that would clearly show the link between banking and product market concentration, our paper tries to contribute to the knowledge about this relationship by building a theoretical model that is i) able to explain the ambiguous empirical findings within one framework, ii) is based on determinants of product market structure, and iii) is focused on the effect of concentration.

3.2.4 Determinants of market structure

I draw from relevant industrial organization and banking literature in order to identify the determinants of market power and structure in product and banking markets. In general, the sources of market power can be: technological characteristics of the industry, a high market share itself (e.g. in network industries), spatial distribution of firms or banks, product differentiation by advertising or R&D, or asymmetry of information about customers (e.g. banks).

First I consider the factors and mechanisms that affect product market structure. Traditional industrial organization theory offers more than one explanation for market structure. The most recognized is the SCP paradigm that explains market structure by different entry conditions that are technologically determined (presence of economies of scale and scope - see e.g. Panzar, 1989). Another established explanation for market

power and consequently market structure involves factors related to the degree of competition, most notably horizontal and vertical product differentiation - see e.g. Dixit and Stiglitz, 1977 for horizontal product differentiation. Market structure can also be established endogenously when efficient firms gain larger market shares. This explanation is usually called the efficient structure (ES) hypothesis. More recently Sutton (1991) has successfully combined these partial explanations and proposed a "bounds" approach where it is more important to identify the type of competition than the intensity of price competition. The bounds approach builds the theory around empirical relations that are robust across a range of models and not dependent on particular assumptions of a chosen game-theoretic model (e.g. entry process, type of competition). It tries to define a bound on the outcomes that are possible and therefore represents the solution by a region and not a single point.

According to Sutton (1998) there are three mechanisms that affect market structure: 1) the toughness of price competition, 2) externalities' effect, and 3) escalation effects.

The term "toughness of price competition" should be understood as "the form of price competition". A fall in concentration will reduce prices and price-cost margins. But, if price competition becomes tougher (not necessarily related to fall in concentration!), the profits of the firms are reduced and entry in the industry is less profitable. A firm entering this industry must reach a greater market share in equilibrium in order to recoup its initial investment in set-up costs and the outcome is a more concentrated market. Also, because of intensive competition there is more exit and more consolidation (mergers and acquisitions) leading toward more concentrated market structure, which is similar to what ES claims. In this sense, the term "toughness of competition" is not limited to the level of prices and price-cost margins, but it is a functional relationship between market structure, prices and profits. It is indeed a form of price competition, which results from market characteristics such as transportation costs and institutional features.

The externalities' effect can be best seen when the entry process permits some firm to obtain a first-mover advantage (e.g. sequential entry). In this case there is tendency toward greater concentration in equilibrium. On the other hand, if this effect runs in the opposite direction it produces only outcomes with highly fragmented markets with identical firms of minimal size.

The idea of the escalation mechanism lies in the responses of the firms to escalating markets by increasing fixed and sunk costs such as R&D and advertising spending . The increases in R&D and advertising spending induce greater market concentration in some industries, but have an opposite effect in other industries. Sutton (1998) calls the former high alpha industries and the latter low alpha industries. Alpha is an escalation

parameter and tells us what is the market share that an entrant can obtain in equilibrium by outspending the incumbents by K. Alpha depends on the pattern of technology and tastes and on the price competition in the industry. A high alpha industry is one where increased R&D and advertising spending increases the willingness of consumers to pay for the firm's products (can be regarded also as increases in the quality of the product), where there are scope economies in R&D or a high degree of substitution on the demand side. A low alpha industry is one where buyers put different values to product attributes (each buyer values different things), there are many alternative technologies available and the focus of R&D is therefore directed towards greater product variety not towards escalating effects stemming from the increased willingness of consumers to pay for the firm's products.

Sutton therefore distinguishes between two types of industries: the ones with exogenous and the ones with endogenous fixed and sunk costs. In the first case, the set-up costs are exogenously determined by technology, there is a high level of product homogeneity and variety. The only mechanism that operates is the toughness of competition mechanism. Market concentration in such industries is limiting to zero as market size increases (more entry, less concentration) and increasing with the toughness of competition (aggressive competitive behaviour, more concentration). I call this type of industries "markets in non-enlargement regime" in further analysis. In the second case, the fixed and sunk costs are endogenous and the escalation mechanism is also present. Firms pay first some sunk cost when entering the market and later invest in R&D and advertising in order to gain market share by increased willingness-to-pay of consumers (or greater product quality originating from investment). I call this group of industries "markets in enlargement regime" in further analysis and it can be split further into high and low alpha industries. In high alpha industries, we observe greater concentration when market size increases because firms that do not offer the higher quality of products do not survive, while in low alpha industries the concentration is still limiting to zero since consumers are not prepared to pay for higher quality of products.

Turning to the banking market structure, we first find that similar factors determining product market structure operate also in the case of banking markets. E.g. Dick (2007) believes that banking markets are characterized by endogenous sunk costs. Gianetti (2008) finds evidence that Italian retail banking belong to the "exogenous sunk and fixed costs" type of industry, but believes that banking industry as a whole should be regarded as the "endogenous sunk and fixed costs" type. Since only the size of the market, the number of firms, and costs and returns to advertising or R&D matter in Sutton's model of market concentration, I use it only to model the product market. Banking markets are specific and differ from product markets in two important aspects. The first one is the existence of extensive regulation and licensing policy which affect entry, mergers

and acquisitions, capital requirements, and foreign operations thus affecting also market structure and market concentration. Because of this, I assume no free entry in my theoretical model and I ignore a potential effect of product market concentration on banking market concentration. The second aspect is the importance of asymmetric information in bank-firm relationship which affects the behavior of banks towards their clients and therefore affects entry, growth and exit in the "downstream" product markets. I include the effect of asymmetric information in the theoretical model.

There is already a vast literature that tries to answer the Schumpeterian question: is banking market concentration good or bad for firms? Since the body of evidence is somewhat ambiguous on this, there is no ultimate answer to the question. In fact, there are two main alternative hypotheses to this question. The first one accepts the traditional SCP paradigm and therefore claims that market concentration is bad for firms. Banks in concentrated markets have more market power, which is exercised to the detriment of firms by lowering the supply of credit and rising prices. The recent studies that support this argument are Bertrand et al. (2007), Black and Strahan (2002), Beck et al. (2004), Cetorelli (2004), Cetorelli and Strahan (2006).

The alternative hypothesis is information-based and claims that banks with more market power have incentives to get more information about potential creditors and therefore are more willing to lend to less transparent creditors (e.g. start-up firms) which is good for firms. Incumbent banks, however, obtain important information about the creditworthiness of firms and have therefore an informational advantage that increases incumbent's market power and may yield lock-up or hold-up problems for firms (Sharpe, 1990, Rajan, 1992). Petersen and Rajan (1995) provided theoretical and empirical evidence that banking market power leads to more industry entry because banks can sustain the cost of initiating a long-term relationship with an entrant only if market power allows them to recoup the short-term losses at later stages if the entrant is successful. Banks with market power are able to smooth interest rates intertemporally, and are therefore more willing to finance firms entering an industry which are often financially poor and informationally opaque. Kim, Kristiansen, and Vale (2005) show that because of this asymmetric information problem, the life-cycle pattern of interest rate mark-up is U-shaped which means that young firms pay a low interest rate mark-up, when the lock-in effect appears the mark-up increases, and finally when the firm is mature and well-known to banks the mark-up decreases again. But contrary to Petersen and Rajan (1995), this effect comes from informational advantage of incumbent banks and not from banking market concentration *per se*.

Recently, another feature of banking market emerged in relevant literature: relationship

banking. Relationship banking refers to offering more valuable services to firms (like ex-post management advice) by using "soft" information about firms that can be obtained only through sequential or multiple transactions. Boot and Thakor (2000), Degryse and Ongena (2007) and Dell'Ariccia and Marquez (2004) show that increased competition has an important impact on the relationship between banks and firms. Since more intensive bank competition encourages banks to engage in relationship banking and firms are willing to pay a higher interest rate for that, it is argued that more competitive banking markets can result in higher interest rates paid by average borrower. Kim, Kristiansen and Vale (2005) empirically confirmed this hypothesis for the case of small Norwegian firms. On the other hand, it can be argued that banks in competitive markets do not find it profitable to invest in relationship banking to entrants because there is greater possibility that the firm will go to the rival bank when it becomes better known or profitable. Theory does not make a clear prediction whether an increase in the number of operating banks promotes or abates relationship banking, but it does support the view that relationship banking increases the credit availability to new firms. Ogura (2007) studies the case of banking market in Japan and finds that banks are less likely to engage in relationship banking the greater the number of banks in the local market which in turn diminishes credit availability to new firms and consequently entry.

Other empirical studies that also find evidence for a positive effect of banking market concentration on entry are Dick (2007), Claessens and Laeven (2004), Demirgüç-Kunt et al. (2004), Bonaccorsi di Patti and Dell'Ariccia (2004), Cettorelli and Gambera (2001).

Similarly to Kim, Kristiansen and Vale (2005), I consider the traditional banking market concentration effect and information asymmetry in bank-firm relationship in our model, but leave out potential influences of relationship banking.

3.3 Theoretical Model

To the best of my knowledge there are only two contributions that study the relations between upstream and downstream product markets and allow for free entry and endogenous market structure (Hendricks and McAfee, 2007; Reisinger and Schnitzer, 2008). Both deal with product markets. My theoretical model involves an economy with a product market and a banking market. The theoretical framework for the product market is based on Sutton's theory of market structure (1991, 1998). I use his Cournot model with perceived quality to study the product market. The banking market is modeled as a Salop circle city (1979). There is no free entry in the banking market since the entry is regulated by the national banking authority. The number of banks m depends only on decisions of the national banking authority. The banking market is considered as an

upstream market providing services to the downstream product market. Entry in the product market is free and simultaneous, however firms must pay a fixed set-up cost $\sigma > 0$ to enter the market and then pay additional fixed outlays $R \geq 0$ to enlarge operations in the market. The fixed cost can be modelled as exogenous or endogenous sunk costs. Exogenous costs (σ) are related to characteristics of technology, endogenous costs (R) are related to advertising and R&D, which are the outcomes of firm's decisions and are therefore determined jointly with concentration. The number of firms that enter n is endogenous. I treat n and m as continuous numbers. The size of the product market is S. I define market concentration as the market share of the biggest bank or firm (C_1^b and C_1^p) and consider a symmetric game ($C_1^b = 1/m$ or $C_1^p = 1/n$).

The banks are located equidistantly from each other on a Salop circle. In order to avoid discontinuities in the demand curve for banks, I assume banks do not know the exact location of firms, but they expect each point on the circle to be equally likely a location for a firm (uniformly distributed over the circle). This assumption is adequate for a banking market where there is only "homogenous" credit and a bank is ex-ante uncertain if a firm will choose financing with this bank or its rival. I also assume that firms do not know the exact location of other firms and expect the location to be uniformly distributed on the circle. This reflects the idea that firms usually do not know the conditions under which their rivals got financing from the bank.

I have a three-stage game. In the first stage firms decide whether to enter or not. I model the entry process as simultaneous entry in order to simplify the analysis. In this stage, banks compete in prices and set the interest rate i_0. Banks are prepared to finance the entry cost σ of prospective entrants at lower prices because they count on the possibility to recoup investment in later stages by exercising their market power. Therefore the competition in the first stage is a fierce price competition for the new client-entrant. The cost of financing σ (i_0) is considered a part of fixed and sunk costs for firms.

In the second stage, successful entrants decide how much to invest in product quality enhancement. Above average product quality u can help the firm to enlarge its business operations and gain a larger market share. Firms can increase the perceived product quality u by investing a fixed outlay $R(u)$ in advertising or R&D. The level of $R(u)$ depends on the possibilities for gaining a larger market share, market size and on the cost of financing i. Banks compete in prices and set interest rate i, which can be the same as in first stage or different (higher). In the third stage, firms compete à la Cournot.

I first look at the product market, then at the banking market and finally I analyze the interaction between them.

3.3.1 Product Market

Firms differentiate their products by product quality attribute u, which can be typically enhanced by advertising, product-oriented R&D outlays or a combination of both. Consumers perceive products with higher u as better and prefer to buy them *ceteris paribus*. Their utility function is represented by $U = (ux)^{\phi} z^{1-\phi}$, where x is the "quality" good and z is the "outside" good[1]. Consumers maximize their utility function with respect to x and subject to their budget constraint. They choose the product that maximizes the quality-price index u_i/p_i and their total demand for good x is S, which equals ϕ fraction of their budget.

3.3.1.1 Stage Three

Firms compete in quantities in the third stage of the model. The equilibrium of this stage is a Cournot-Nash as in Sutton's Cournot model with perceived quality (1991, 1997). The quality of product x_i is chosen by firm i ($i \in 1, ..., n$) in stage 2, when firms decide whether and to what extent to invest in product "improvements". Unit variable cost (marginal cost) c is assumed to be constant, equal for all firms and not dependent on the quality of the product. In equilibrium all n firms with positive sales offer the same price-quality relationship $p_i/u_i = p_k/u_k$ where $i, k \in 1, ..., n$ and $i \neq k$. Assuming that all firms but one offer a "standard" level of quality $\bar{u}$, a deviant firm offering quality u has a net profit

$$\Pi\left(\frac{u}{\bar{u}}\right) = S\left\{1 - \frac{1}{\frac{1}{n-1} + \frac{u}{\bar{u}}}\right\}^2. \tag{3.1}$$

3.3.1.2 Stage Two

In the second stage, successful entrants n (from N potential entrants) decide whether to extend their operations by investing in "greater" product quality. Examples of such investing are advertising and R&D activity. Both enable firms to enhance the perceived quality of their products in the eyes of their customers. I will call both types of activities aimed at enhancing perceived product quality "enlargement operations" because their ultimate purpose is to enlarge a firm's market share. Firms must choose the level of quality u (or the level of enlargement) they will offer at additional fixed and sunk cost $R(u)$. Sutton (1991) models the additional sunk costs as

[1]The "outside" good can be considered as a composite good of all other goods.

$$R(u) = \frac{a}{\gamma}(u^{\gamma} - 1), \tag{3.2}$$

where a is per unit cost of advertising (in the original model) but we can think of it more generally as a per unit cost of enlargement, γ is greater than 1 and reflects the rate of diminishing returns to enlargement activities. Firms borrow the necessary funds $R(u)$ in banks, which charge interest rate i. In order to study the effects of banking markets, I incorporate the interest rate i that firms pay for funds $R(u)$ as following

$$R(u) = \frac{a}{\gamma}(u^{\gamma} - 1)(1 + i). \tag{3.3}$$

The total sunk costs of enlargment for a firm are therefore:

$$TC(u) = \sigma(1 + i_0) + R(u) = \sigma(1 + i_0) + \frac{a}{\gamma}(u^{\gamma} - 1)(1 + i). \tag{3.4}$$

The elasticity of total sunk costs $TC(u)$ with respect to increases in the quality of product u is then equal to

$$\varepsilon_{TC(u)} = \gamma \left(1 - \frac{\sigma(1 + i_0) - \frac{a}{\gamma}(1 + i)}{TC} \right). \tag{3.5}$$

This expression is always positive and shows the following:
i) when $u \to \infty$, $TC(u) \to \infty$ so the elasticity tends to γ regardless of the cost of entry σ, the unit cost of enlargement a, interest rates i_0 and i;
ii) when u and $TC(u)$ are finite, the elasticity is constant and equal to γ if the ratio $\sigma/\frac{a}{\gamma}$ equals $(1 + i)/(1 + i_0)$. When the ratio $\sigma/\frac{a}{\gamma} > (1 + i)/(1 + i_0)$, the elasticity will be smaller than γ and when $\sigma/\frac{a}{\gamma} < (1 + i)/(1 + i_0)$, the elasticity will be greater than γ. Product markets with $\varepsilon_{TC} > \gamma$ are "high alpha" industries, product markets with $\varepsilon_{TC} < \gamma$ are "low alpha" industries.

If the interest rate is the same in both periods, the elasticity equals γ when entry cost σ equals the ratio $\frac{a}{\gamma}$; the elasticity is smaller than γ when $\sigma > \frac{a}{\gamma}$ and it is greater than γ when $\sigma < \frac{a}{\gamma}$. A change in banking market that induces banks to charge different interest rates (lower i_0 and higher i) would increase the elasticity of total sunk costs.

In equilibrium all firms will chose the quality of product $u = \bar{u}$ and enlargement outlays that maximize their profits. The marginal gain from enlargement is exactly offset by the marginal cost of enlargement. The first order condition for this is:

$$\left.\frac{d\Pi}{du}\right|_{u=\bar{u}} = \left.\frac{dTC}{du}\right|_{u=\bar{u}}. \tag{3.6}$$

The equilibrium solution for enlargement outlay $R(u)$ is obtained from solving (3.6) and it is given implicitly by

$$2S\frac{(n-1)^2}{n^3} = \gamma[TC^* - (\sigma(1+i_0) - \frac{a}{\gamma}(1+i))], \tag{3.7}$$

where TC^* denotes the level of total sunk costs $TC^*(n,S)$ at optimal product quality $\bar{u}^*$ and corresponding enlargement outlay $R(u)^*$. To ensure the existence and uniqueness of solution, $\gamma > \underline{\gamma}$, where $\underline{\gamma} = max\{1, \frac{2}{3}\frac{a(1+i)}{\sigma(1+i_0)}\}$[2].

3.3.1.3 Stage One

In the first stage, N firms decide whether to enter the market or not taking into account the level of enlargement outlay needed in second stage in order to secure a larger market share. The fixed and sunk cost of entry is σ. Assuming firms borrow this amount from banks at interest rate i_0 the total cost of entering the market is $\sigma(1+i_0)$. In equilibrium, only n firms succeed in entering the market. They all set equal u at stage 1 and will have the same level of total sunk cost $TC^*(n,S)$, which is greater or equal to $\sigma(1+i_0)$, depending on the potential of the enlargement project to increase market shares. When there are no deviant firms (with respect to product quality u), the profit of each firm (3.1) reduces to $\frac{S}{n^2}$. Only firms which can obtain profits greater than the total cost of entry and enlargement will find market entry lucrative. The entry condition is thus:

$$\frac{S}{n^2} \geq TC^*(n,S), \tag{3.8}$$

and the equilibrium number of entering firms n^* is the largest number of firms that satisfies this condition.

The solution of the model is obtained by setting (3.8) to equality (zero profit condition) and inserting it into (3.7) instead of S, giving the implicit solution for the equilibrium number of firms n^* in (N, TC) space:

$$n + \frac{1}{n} - 2 = \frac{\gamma}{2}[1 - \frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC}] = \frac{1}{2}\varepsilon_{TC(u)} \tag{3.9}$$

[2]See Sutton (1991), Appendix 3.1. for a proof of this condition for existence and uniqueness of solution in his original model.

Product market concentration thus depends on the elasticity of total sunk costs, which in turn depends on the market size. The locus (3.9) is upward sloping, vertical or downward sloping, depending on the relationship between $\sigma(1+i_0)$ and $\frac{a}{\gamma}(1+i)$. Total sunk costs $TC(u)$ are then found by intersecting the locus with zero profit condition $S/n^2 = TC$, which is represented by a set of downward sloping curves in (N, TC) space, parametrized by market size S. Depending on the relationship between $\sigma(1+i_0)$ and $\frac{a}{\gamma}(1+i)$, the relationship between total outlays and market concentration can be monotonic or not.

Now I can inspect the equilibrium structure and the effects of interest rates. When markets are large ($S \to \infty$), the right-hand side of (3.9) approaches $\frac{\gamma}{2}$ for any n. Following Sutton (1991) I denote the solution for equilibrium number of firms $\tilde{n}(\frac{\gamma}{2})$ which equals n_∞ in this case. Since interest rates do not affect the equilibrium number of firms, banking concentration has no effect on the product market concentration.

For a sufficiently small market, enlargement operations via R&D or advertising are not justified and firms invest only the initial fixed and sunk cost of entry $\sigma(1+i_0)$. The zero profit condition is thus $S/n^2 = \sigma(1+i_0)$ and the equilibrium number of firms n^* increases (concentration C_1^p decreases) monotonically when S increases. The interest rate i_0 does not affect this relationship, but it does affect the level of equilibrium number of firms n^*: at each market size S, n^* falls (concentration increases) with higher i_0. Assuming for the moment that higher banking market concentration produces higher interest rates, I can thus show that a higher banking market concentration causes higher product market concentration in small markets (positive relationship).

By increasing market size S to some "medium" size, we eventually reach a number of firms n when it becomes profitable to engage in enlargement operations. This switch point between non-enlargement and enlargement regime is determined by the condition (3.6) evaluated at $u = \bar{u} = 1$ as in equilibrium all firms offer the same quality u which is also equal to 1 when in no-enlargement regime. This gives the critical value n^c:

$$n + \frac{1}{n} - 2 = \frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)} \tag{3.10}$$

I denote the solution to this equation $n^c = \tilde{n}(\frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)})$. This is the maximum number of firms in the no-enlargement regime; if the market size then increases, firms start to engage in enlargement operations in order to secure a greater market share.

Let us first examine the case where $\sigma(1+i_0) = \frac{a}{\gamma}(1+i)$. This is equivalent to saying elasticity ε_{TC} equals the rate of diminishing returns to enlargement γ. The locus (3.9) is vertical and the solution $\tilde{n}(\frac{\gamma}{2})$ coincides with the asymptotic limit when $S \to \infty$ and also to the switch point $\tilde{n}(\frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)})$ (Figure 3.1). This means that once the market size

is large enough to accomodate this number of firms in no-enlargment regime, further increases in market size will not enable firms to change market structure by investing in enlargement. Enlargement operations will have no effect on product market structure.

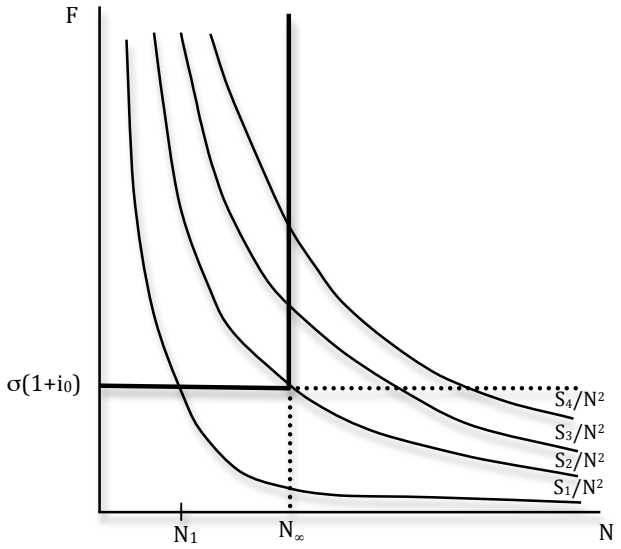

FIGURE 3.1: Equilibrium configuration when $\varepsilon_{TC} = \gamma$

In the case where $\sigma(1 + i_0) < \frac{a}{\gamma}(1 + i)$ (elasticity ε_{TC} is greater than γ), the switch point between no-enlargement and enlargement regime is still $\tilde{n}(\frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)})$, but this is now greater than $\tilde{n}(\gamma/2) = n_\infty$ (Figure 3.2). Beacuse of restrictions on a, σ and n, the locus is downward sloping and cuts the S/n^2 schedule from below and asymptotically converges to the vertical at n_∞ (Sutton, 1991). By increasing market size S in the enlargement regime, the number of firms will decrease and concentration will increase. Enlargement operations will increase product market concentration.

The remaining case of $\sigma(1 + i_0) > \frac{a}{\gamma}(1 + i)$ (elasticity ε_{TC} is smaller than γ) gives a switch point $\tilde{n}(\frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)})$ smaller than $\tilde{n}(\gamma/2) = n_\infty$ and an upward sloping locus. The relationship between market size and market concentration is monotonic: when market size increases, market concentration decreases. Enlargement operations will decrease product market concentration.

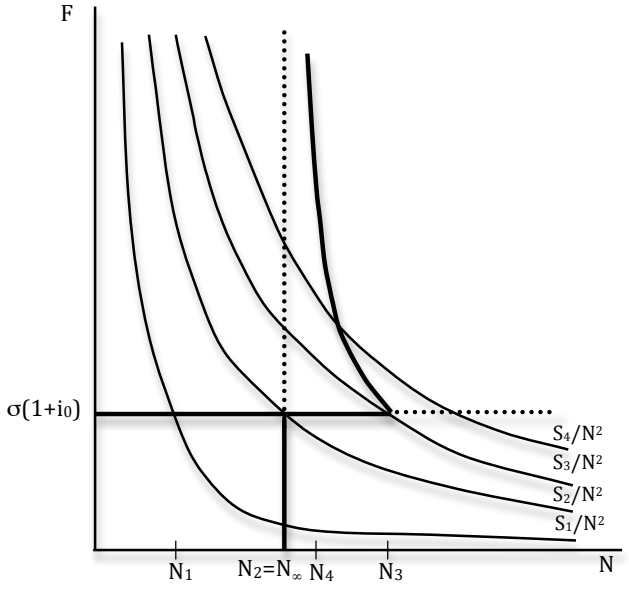

FIGURE 3.2: Equilibrium configuration when $\varepsilon_{TC} > \gamma$

3.4 Banking Market

Now I turn to the banking market analysis. We saw that interest rates do affect product market concentration when these markets are not large. In this section, I study the effect of banking market concentration on interest rates. I model the banking market by using Salop's idea of the circular city (Salop, 1979) with quadratic transportation costs. In this setting, m banks are located equidistantly from each other on a circle with unit circumference and offer homogenous product (i.e. credit) to firms. This implies that no location is *a priori* better in the first stage of the game. The number of banks m is determined by a national banking regulation body such as a central bank and it is thus exogenous to the model (no free entry). Firms are also located uniformly on the circle and all travel occurs along the circle.

In order to avoid discontinuities in the demand curve for banks because of a finite number of firms n, I assume banks do not know the exact location of firms, but they expect each point on the circle to be equally likely a location for a firm so that the expected location is uniformly distributed over the circle (Reisinger and Schnitzer, 2008). This assumption is adequate for a banking market where credit is a homogenous good that can be used by any firm and a bank is therefore *ex-ante* uncertain if a firm will choose financing with this bank or its rival. I also assume that firms know their own location, but do not know

the exact location of other firms and expect their location to be uniformly distributed on the circle. This reflects the idea that firms usually do not know the exact production technology of their rivals nor the conditions under which their rivals got financing from banks.

Firm i ($i \in (1, ..., n)$) that wants credit from bank j ($j \in (1, ..., m)$) has transportation cost td_{ij}^2 where t is unit transportation cost ($t > 0$) and d_{ij} is the shortest distance on the circle between firm i's location x_i and its selected bank j's location x_j (i.e. arc length $x_i - x_j$). The total cost of credit that firm i wants to borrow from bank j is $i_j + t(x_i - x_j)^2$, where i_j is interest rate at bank j.

The cost $t(x_i - x_j)^2$ reflects the idea that banking market power can originate from spatial distribution of banks in the local or regional market (e.g. Petersen and Rajan, 1995). Monitoring and transaction costs are lower for banks that are geographically closer to a firm and this gives closer banks more market power. On the other hand, the search cost of finding a suitable bank is lower for a firm if there are more banks in the region. Thus, the higher the number of banks m in the circular city, the shorter are distances between them and the smaller is banks' market power. I measure the concentration in the banking market in the same way as in the product market as $C_1^b = 1/m$ thus assuming that banking market concentration is a good measure for banking market power.

Firms want to finance the entry cost σ and the enlargement cost R^* in the first and second period of the game, respectively. I assume banks compete by setting strategic prices[3]. Banks can charge the same interest rate i' in both periods or opt for different interest rates and charge i_0 in the first period and i in the second period - I inspect effects for each case separately. There are no capacity constraints in the banking market (each bank can serve the entire demand). Firm i's individual demand for credit in order to finance enlargement operations R^* is elastic with respect to the interest rate whereas the individual demand for credit to finance entry cost σ is inelastic to the interest rate. Firms do not need to borrow σ and R^* in the same bank i.e. they can change their bank in second period. Without loss of generality in our analysis I normalize bank j's marginal cost $c_{bj} = 0$, its fixed cost $F_j = 0$ and the discount rate $\delta_j = 0$ for all j. I solve the game in the banking market for a symmetric Nash equilibrium in i_0 and i by employing backward induction.

[3]By this assumption and the assumption of no capacity limits, I neglect the problems of credit constraint.

3.4.1 Stage Two

In stage two, $n^*(S, TC)$ firms decide on optimal enlargment outlay $R^*(u)$ and the latter is implicitly given by (3.7). For convenience I will write these only as n^* and R^*. Firms want credit to finance R^* and banks decide what interest rate i to set to maximize their profit.

A marginal firm that is located at the distance $x \in (0, 1/m)$ from bank j (Figure 3.3) is indifferent between getting credit in bank j and getting credit in j's closest neighbor bank $j+1$ if:

$$i_j + tx^2 = i_{j+1} + t(\frac{1}{m} - x)^2, \tag{3.11}$$

giving me the location of the marginal firm x_m:

$$x_m = \frac{m(i_{j+1} - i_j)}{2t} + \frac{1}{2m} \tag{3.12}$$

and the demand for bank j:

$$D_j = 2x_m = \frac{m(i_{j+1} - i_j)}{t} + \frac{1}{m}. \tag{3.13}$$

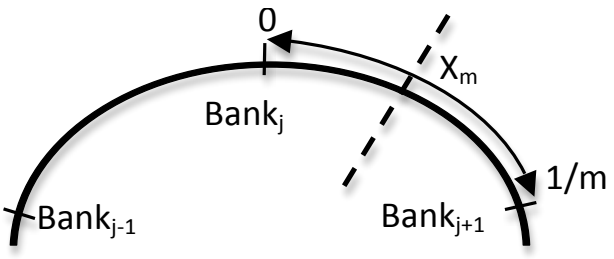

FIGURE 3.3: Banking market - Salop circle

In stage two, firms will decide between staying with the bank chosen in stage one and approaching a new bank. To reflect the market power that incumbent banks gain from private information they posses about their clients, I assume the distance between firm

i and its incumbent bank is zero ($x = 0$) in the second period. The distance to the nearest rival $j+1$ or $j-1$ is $\frac{1}{m}$ and reflects switch costs for firm i. Since the competition is in prices and there is no capacity constraints, a bank that sets the lowest price gets the total demand in the market, which is n^*R^*. However, due to market power gained by financing the firm in stage one, the incumbent bank can charge to existing client i a higher interest rate i_j than its closest rival would (i_{j+1}):

$$i_{ij} = i_{ij+1} + t\frac{1}{m^2}, \tag{3.14}$$

The difference between interest rates that a firm gets at its incumbent bank and other banks decreases when there are more banks. Since the equilibrium is symmetric, all banks would have set the same interest rate i_0 in the first stage and each of them would get n/m clients. So each bank would charge interest rate i to their existing clients, thus keeping them, and i^n to potential new clients. Without any private information about the latter, the marginal new client and demand from potential new clients for rival banks are the same as above (3.12) and (3.13) and the profit from potential new clients for each bank j is then given by

$$\Pi^n_{bankj} = \rho i^n_j D + (1-\rho)(-D) \tag{3.15}$$

where ρ is the the probability that the bank finances successful firms and $(1-\rho)$ is the probability that the financed firms default. By using (3.13) as D in the above expression and maximizing Π^n_{bankj} with respect to i^n_j I get

$$i^n_j = \frac{t}{m^2} + \frac{1-\rho}{\rho} \tag{3.16}$$

and therefore

$$i_j = \frac{2t}{m^2} + \frac{1-\rho}{\rho} = i. \tag{3.17}$$

The first interest rate (i^n_j) is charged to new potential clients and the second one (i_j) is charged to existing clients. Since the game is symmetric $i_j = i$. Note that the derivative $\frac{\partial i}{\partial m} = \frac{-4t}{m^3}$ is always negative. A change in the banking market towards lower concentration (greater number of banks) would therefore decrease interest rates in the second period. The fall will be bigger in less concentrated markets, which is consistent with theoretical and empirical findings by Petersen and Rajan (1995) and Kim et al. (2005).

3.4.2 Stage One

The competition for clients in the first period is a fierce price competition since banks can exercise market power in the second period and charge a higher interest rate to existing clients. A bank that sets the lowest price would get the total market demand in this period and a chance to charge higher interest rates in the second period to existing clients. A bank that charges the same interest rate i' in both periods would have in both periods its marginal firm at location x_m as in (3.12) and demand (3.13); by maximizing its profit with respect to interest rate, I get

$$i' = i^n = \frac{t}{m^2} + \frac{1-\rho}{\rho}. \tag{3.18}$$

Banks find it profitable to charge different interest rates instead of charging the same interest rate in both periods[4] if $\Pi^{i_0,i}_{bank} > \Pi^{i'}_{bank}$. The total profits are:

$$\Pi^{i'}_{bank} = \frac{n}{m}[\sigma(\rho * i' - (1-\rho)) + R^*(\rho * i' - (1-\rho))] \tag{3.19}$$

$$\Pi^{i_0,i}_{bank} = \frac{n}{m}[\sigma(\rho * i_0 - (1-\rho)) + R^*(\rho * (i' + \frac{t}{m^2}) - (1-\rho))]. \tag{3.20}$$

By equating (3.20) to (3.19) I get the equilibrium interest rate in the first period i_0:

$$i_0 = \frac{t}{m^2}(1 - \frac{R^*}{\sigma}) + \frac{1-\rho}{\rho} \tag{3.21}$$

where i_0 is charged by all banks since it is lower than i'. This is consistent with Kim et al. (2005), but contrary to Petersen and Rajan (1995).

The derivative $\frac{\partial i_0}{\partial m} = \frac{-2t(1-\frac{R^*}{\sigma})}{m^3}$ is positive when $R^* > \sigma$ and negative when $R^* < \sigma$. This implies that firms in sectors where entry cost σ is smaller than enlargement outlays R, will be charged a higher initial interest rate i_0 in less concentrated banking markets. This result is consistent with Petersen and Rajan (1995) and Kim et al. (1995). On the other hand, firms in sectors where entry cost σ is larger than enlargement outlays R will be charged a higher initial interest rate i_0 in more concentrated banking markets.

The difference $i - i_0 = \frac{t}{m^2}(1 + \frac{R}{\sigma})$ shows that the spread between the interest rates for existing and new clients will be smaller when banking market is less concentrated.

Kim et al. (2005) find that interest rate markup follows a life-cycle pattern: young firms pay a small or even negative markup, later the mark-up is increased and when firms get

[4]This can be interpreted equivalently as a condition for banks to charge different interest rates to new and existing clients.

older the mark-up falls again. My model is consistent with this result when $R^* > \sigma$. We can imagine there is a third stage or period, where information about firms is known also to rival banks and not exclusively to incumbent banks. As long as there is still information asymmetry in favor of incumbent banks, the marginal firm in third stage is located between 0 and first stage x_m. The distance to the rival bank is shorter than it was in the second stage. From the analysis above it is clear that the interest rate in the third stage will be above but closer to i' than interest rates in second stage.

3.4.3 Analysis of interaction

Product market analysis showed that interest rates and banking market concentration do not affect the concentration in large product markets. Product markets that are small enough to inhibit enlargement operations are affected only by interest rate in the first period (i_0). Assuming that banks know the market size, they will charge the "base" interest rate i' to firms in small product markets since there will be no opportunity for charging a higher interest rate in the later period ($i_0 = i'$). Reduced banking concentration will increase this interest rate, which will reduce the equilibrium number of firms. The relationship between banking and product markets is therefore positive for small product markets and non-existant for large product markets. Empirical findings from my study in Chapter 2 are generally in line with these theoretical predictions.

Now I study more in detail how a change in banking market concentration affects concentration in "medium"[5] product markets. I assume first a base setting where banks charge the same interest rate to new and existing clients (i.e. $i_0 = i = i'$) and then a setting where banks charge different interest rates (i_0 and i) because of information asymmetry.

One interest rate

The switch point between non-enlargement and enlargement regimes is given by (3.10) and it is easy to see that a change in interest rate i' will not change the critical number of firms that are necessary for the enlargement regime to be viable (n^c). A change in banking market concentration will therefore not have an effect on the critical number of firms that involve enlargement operations. To put it differently, it will not turn a small market into a medium one.

However, banking market concentration will affect the equilibrium number of firms in the medium product market (n^*) under certain conditions. For that I need to inspect

[5]Product markets in enlargement regime, but too small for asymptotic behavior are called medium markets.

two relationships: the effect of interest rate i' on TC^* and on n^*. Since solutions for n^* and TC^* are given implicitly, I assume n^* is determined in the first stage of the model and find the derivatives (see Appendix 3.7.1.)

$$\frac{\partial TC^*}{\partial i'} = \sigma - \frac{a}{\gamma} \tag{3.22}$$

$$\frac{\partial n^*}{\partial i'} = \frac{1}{2}\frac{\gamma(-\frac{\sigma-\frac{a}{\gamma}}{TC^*} + \frac{(1+i')(\sigma-\frac{a}{\gamma})\frac{\partial TC^*}{\partial i'}}{TC^{*2}})}{1-\frac{1}{n^2}}. \tag{3.23}$$

The combined effect is thus:

$$\frac{\partial n^*}{\partial m} = \frac{\partial n*}{\partial i'}\frac{\partial i'}{\partial m} = \frac{\varepsilon_{TC}}{(1-\frac{1}{n^2})}\frac{2t}{m^3}\frac{1}{TC}(\sigma - \frac{a}{\gamma}) \tag{3.24}$$

First, let us look at the case where $\sigma = \frac{a}{\gamma}$ (i.e. the elasticity ε_{TC} is equal to γ). Since both derivatives are zero the change in interest rate will not affect the equilibrium level of enlargement outlays and the equilibrium number of firms. In this case a change in banking market concentration will not have an effect on product market concentration.

When $\sigma < \frac{a}{\gamma}$, the elasticity ε_{TC} is larger than γ. This means that total costs of entry and enlargement are increasing faster than returns to enlargement, implying that enlargement becomes more and more expensive relative to the cost of entry. In this case, the first of the derivatives above is negative and the second one is positive (Appendix 3.7.2). Since greater banking concentration increases the interest rate ($\frac{\partial i'}{\partial m}$ is negative, see (3.18)), the combined effect $\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i'}\frac{\partial i'}{\partial m}$ is negative. A greater concentration in banking market will rise the interest rate i' which will reduce the equilibrium enlargement outlays and increase the equilibrium number of firms. This happens because the costs of enlargement will increase even faster when interest rate is higher and firms will decide to invest less in enlargement operations in equilibrium. A smaller enlargement is viable for more firms, which is why I have a larger number of firms in the equilibrium. A greater banking concentration will result in a lower product market concentration (negative relationship).

Finally, when $\sigma > \frac{a}{\gamma}$, the elasticity ε_{TC} is smaller than γ. The entry cost, which is inelastic to interest rate, is large relative to enlargement cost and its effect dominates. The total costs are growing at a slower pace than the returns to enlargement, implying that enlargement becomes cheaper relative to the cost of entry. Thus, the first derivative (3.22) is positive and the second one (3.23) is negative (Appendix 3.7.2). The combined effect $\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i'}\frac{\partial i'}{\partial m}$ is now positive. A greater concentration in banking market will rise the interest rate i' which will increase the equilibrium enlargement outlays and decrease

the equilibrium number of firms. Firms will invest more in enlargement, even if interest rate rises, because the costs of enlargement will not increase as fast as the returns, but less firms will be able to stay in the market and support this level of enlargement in the equilibrium. A greater banking concentration will result in a greater product market concentration (positive relationship).

Two interest rates

If banks charge two interest rates, the switch point n^c will react to changes in interest rates which was not the case when one interest rate was charged in both periods. Taking derivatives of n^c with respect to i and i_0 (Appendix 3.7.3) shows that the maximum number of firms in non-enlargment regime will increase with i and fall with i_0.

Recall that the derivative $\frac{\partial i}{\partial m}$ is always negative and the derivative $\frac{\partial i_0}{\partial m}$ is positive for $R > \sigma$ and negative for $R < \sigma$. This means that greater banking market concentration will increase i and decrease or increase i_0 depending on whether $R > \sigma$ or $R < \sigma$.

For $R > \sigma$ the effect of greater banking concentration is clear: higher i and lower i_0 will increase the critical number of firms (n^c) needed for enlargement regime to become profitable. When $R < \sigma$ the change of n^c depends on the magnitude of effects of i and i_0 and also on the magnitude of effects banking concentration has on i and i_0. Analysis of these effects shows that the combined effect of banking concentration on the critical number of firms is negative also for this case (Appendix 3.7.4). This implies that increased banking concentration may hinder the growth of small product markets. Fewer markets will reach the critical firm number for enlargement regime and will stay small because of this.

The equilibrium number of firms in medium product markets will also react to changes in both interest rates. Let us inspect the derivatives:

$$\frac{\partial n^*}{\partial i} = \frac{\gamma}{2} \frac{\frac{a}{\gamma * TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2} \frac{\partial TC^*}{\partial i}}{1 - \frac{1}{n^2}} \tag{3.25}$$

$$\frac{\partial n^*}{\partial i_0} = \frac{\gamma}{2} \frac{-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2} \frac{\partial TC^*}{\partial i_0}}{1 - \frac{1}{n^2}} \tag{3.26}$$

The analysis in Appendix 3.7.5 shows that the first derivative is positive and the second is negative . An increase in i will increase the equilibrium number of firms, while an increase in i_0 will decrease the equilibrium number of firms. I will check now, how banking market concentration affects product market concentration by analyzing the

signs and magnitudes of $\frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m}$ (effect via i) and $\frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m}$(effect via i_0):

$$\frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} = \frac{\gamma}{2}\frac{\frac{a}{\gamma * TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i}}{1-\frac{1}{n^2}}(-\frac{4t}{m^3}) \tag{3.27}$$

$$\frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = \frac{\gamma}{2}\frac{\frac{-\sigma}{TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i_0}}{1-\frac{1}{n^2}}(-\frac{2t(1-\frac{R}{\sigma})}{m^3}) \tag{3.28}$$

It is easy to see that (3.27) is always negative and (3.28) is positive for $R < \sigma$ and negative for $R > \sigma$. The combined effect is thus:

$$\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} + \frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{\varepsilon_{TC}}{(1-\frac{1}{n^2})}\frac{t}{m^3}\frac{1}{TC}[(R-\sigma)+2\frac{a}{\gamma}]. \tag{3.29}$$

The effect of banking concentration on product market concentration in medium markets depends on the elasticity of total costs, the number of firms and banks in the market, the level of total costs (which depends on the market size), and the relationship between entry cost and enlargement cost. It is clear from above expression that whenever enlargement outlays exceed entry cost ($R \geq \sigma$), the effect of m is negative: greater banking concentration will increase the equilibrium number of firms in the product market and reduce the concentration. The relation between banking and product market concentration is negative. This happens when elasticity $\varepsilon_{TC} \leq \gamma$, because the effect of enlargement operations is then greater than the effect of entry cost.

The effect is less clear in sectors where enlargement outlays are smaller than entry cost ($R < \sigma$) and it depends on the magnitudes of (3.27) and (3.28). Only if the difference between σ and R is greater than $2\frac{a}{\gamma}$, the effect of m is positive; otherwise this effect is negative. This implies that in product markets where entry cost exceeds enlargement cost for at least $2\frac{a}{\gamma}$, the relationship between banking and product market concentration is positive: greater banking market concentration will increase product market concentration. If the difference is not big enough, the relationship is negative. The difference will be big enough only in markets with elasticity $\varepsilon_{TC} > \gamma$ and where $\sigma \geq 2\frac{a}{\gamma}$.

Further inspection shows that the effect of banking market concentration is larger when there are less banks and firms (lower m and n), the elasticity of total costs is higher, transport costs are higher, and the level of total costs is lower.

3.5 Conclusion

The focus of this paper is the building of a theoretical model that allows us to study the link between product and banking market structure and thereby enhance our understanding of this specific relationship. The existing body of literature on this topic was hitherto mainly empirically oriented and lacked adequate theoretical analysis. One of the main problems of the existing theory is lack of consideration for the determinants of product market structure. My approach departs from other contributions precisely in this aspect; I build the model by considering first the determinants of product market structure and then study the effects of banking market concentration on them, rather than viewing the firm solely as an investment project for the bank.

Using Sutton's theory on product market structure and linking it with a simple model of banking market, I am able to confirm there is indeed an effect of banking market concentration, but it is limited to small and medium product markets (industries). Large product markets will not experience significant changes in entry and structure when banking concentration is increased. Small product markets are those industries that are characterized mainly by exogenous fixed and sunk entry costs. Investments in higher product quality and enlargement do not allow firms to gain market share over their rivals. In such industries, greater banking concentration increases product market concentration (positive link).

Medium markets are those industries that are characterized by endogenous fixed and sunk cost of enlargement that follow the initial entry cost. Firms are encouraged to invest in enlargement since it allows them to increase market share above their rivals'. Such industries can exhibit a positive or a negative link between both market concentrations. When I study only the effect of banking market concentration (one interest rate), the direction of the relationship depends on the elasticity of costs and the rate of returns to enlargement. If costs increase faster than returns diminish, greater banking concentration will decrease product market concentration (negative link) and vice versa. Including the effect of asymmetric information (two interest rates) gives similar results: industries where the cost of enlargement operations exceeds the initial (exogenous) entry cost will demonstrate a negative link between both market concentrations greater banking concentration reduces product market concentration. Industries where the cost of enlargement is lower than the cost of entry will demonstrate a positive link, but only if entry cost is above a critical level.

These results are generally consistent with empirical estimations in Chapter 2 of this Dissertation and give us new inputs for further empirical investigation. For example, econometric models should control for product market size, for industry characteristics

related to the nature of fixed and sunk set up costs (low and high alpha industries), and for banking market characteristics related to asymmetry of information and bank switch costs. Since the effect of banking market concentration is larger the smaller the number of banks and firms, it could reinforce itself if industries or banking markets experience longer periods with constant net entry or exit. This is particularly relevant for transitional economies which have experienced high rates of entry and subsequent intensive consolidation at certain points of transition process in both, product and banking markets. This might call for a dynamically specified econometric model in such cases. Possible future extensions of the theoretical model include allowing for free entry and capacity constraints in banking market, distinguishing the effect of concentration from competition, and introduction of relationship banking.

In summarizing the specific results of the model, I would like to make the following remarks regarding the tentative policy implications of our results. Particularly small and medium countries' banking authorities should take into consideration the effects that banking concentration has in product markets. My results confirm the hypothesis that banking concentration is not necessarily bad, especially not in medium size countries, therefore policy regarding mergers and acquisitions in banking need not be a priori restrictive or licensing policies permissive. Supervision of banks should involve careful monitoring of potentially detrimental competitive pressures that could result from an excessively fragmented banking market.

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3.7 Appendix

3.7.1 Derivatives of TC^* and n^*

The solution for TC^* is given as

$$TC^* = \frac{2S(n^*-1)^2}{\gamma n^{*3}} + \sigma(1+i_0) - \frac{a}{\gamma}(1+i) = \frac{2S(n^*-1)^2}{\gamma n^{*3}} + (\sigma - \frac{a}{\gamma})(1+i'), \quad (3.30)$$

where n^* is the result of the first stage (we assume the feedback effect of TC on n is zero). The derivative $\frac{\partial TC^*}{\partial i'}$ is therefore

$$\frac{\partial TC^*}{\partial i'} = \sigma - \frac{a}{\gamma}. \quad (3.31)$$

The solution for n^* is given as

$$n + \frac{1}{n} - 2 = \frac{\gamma}{2}[1 - \frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC}] = \frac{1}{2}\varepsilon_{TC(u)}. \quad (3.32)$$

The derivative $\frac{\partial n^*}{\partial i'}$ is therefore:

$$\frac{\partial n^*}{\partial i'} = \frac{1}{2}\frac{\gamma(-\frac{\sigma-\frac{a}{\gamma}}{TC^*} + \frac{(1+i')(\sigma-\frac{a}{\gamma})\frac{\partial TC^*}{\partial i'}}{TC^{*2}})}{1-\frac{1}{n^2}}. \quad (3.33)$$

3.7.2 Effect of i' on n^*

The sign of derivative $\frac{\partial n^*}{\partial i'}$ when $\sigma < \frac{a}{\gamma}$ or $\sigma > \frac{a}{\gamma}$:

$$sign\frac{\partial n^*}{\partial i'} = sign[-\frac{\sigma - \frac{a}{\gamma}}{TC^*} + \frac{(1+i')(\sigma-\frac{a}{\gamma})\frac{\partial TC^*}{\partial i'}}{TC^{*2}}] \quad (3.34)$$

When $\sigma < \frac{a}{\gamma}$, $\frac{\partial TC^*}{\partial i'}$ is negative and $\frac{\partial n^*}{\partial i'}$ is positive.

When $\sigma > \frac{a}{\gamma}$, $\frac{\partial TC^*}{\partial i'}$ is positive and the sign of the derivative depends on the relationship:

$$(1+i')(\sigma - \frac{a}{\gamma}) \lessgtr TC^* \quad (3.35)$$

Since $TC^* = (\sigma + R^*)(1+i')$, we get the condition $-\frac{a}{\gamma} \lessgtr R^*$ and because $R^* \geq 0$ and $\frac{a}{\gamma} > 0$, only $R > -\frac{a}{\gamma}$ can hold true. Therefore the derivative $\frac{\partial n^*}{\partial i'}$ is negative.

3.7.3 Effects of i and i_0 on n^c

$$\frac{\partial n^c}{\partial i} = \frac{1}{2}\frac{a}{\sigma(1+i_0)(1-\frac{1}{n^2})} \tag{3.36}$$

$$\frac{\partial n^c}{\partial i_0} = -\frac{1}{2}\frac{a(1+i)}{\sigma(i+i_0)^2(1-\frac{1}{n^2})} \tag{3.37}$$

(3.36) is positive and (3.37) is negative.

3.7.4 Effect of m on n^c

The effect of banking concentration on the critical number of firms n^c is the sum of the following effects:

$$\frac{\partial n^c}{\partial i}\frac{\partial i}{\partial m} = \frac{1}{2}\frac{a}{\sigma(1+i_0)(1-\frac{1}{n^2})}\frac{-4t}{m^3} = -\frac{2at}{\sigma(1+i_0)(1-\frac{1}{n^2})m^3} \tag{3.38}$$

$$\frac{\partial n^c}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{1}{2}\frac{a(1+i)}{\sigma(i+i_0)^2(1-\frac{1}{n^2})}\frac{-2t(1-\frac{R}{\sigma})}{m^3} = \frac{at(1+i)(1-\frac{R}{\sigma})}{\sigma(1+i_0)^2(1-\frac{1}{n^2})m^3}. \tag{3.39}$$

This gives us the total effect of banking concentration on the critical number of firms n^c:

$$\frac{\partial n^c}{\partial m} = \frac{\partial n^c}{\partial i}\frac{\partial i}{\partial m} + \frac{\partial n^c}{\partial i_0}\frac{\partial i_0}{\partial m} = \frac{at}{\sigma(1+i_0)(1-\frac{1}{n^2})m^3}[\frac{1+i}{1+i_0}(1-\frac{R}{\sigma}) - 2]. \tag{3.40}$$

The sign of this effect depends on expression in the square brackets; taking into account that $i_0 = i' - \frac{R}{\sigma}\frac{t}{m^2}$ and $i = i' + \frac{t}{m^2}$, we see that the sign depends on whether $\frac{R}{\sigma} \lesseqgtr -1$. Since $\frac{R}{\sigma}$ is positive or zero, the sign must be negative.

3.7.5 Effect of i and i_0 on n^*

The sign of the derivative $\frac{\partial n^*}{\partial i}$:

$$sign\frac{\partial n^*}{\partial i} = sign[\frac{a}{\gamma TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i}]. \tag{3.41}$$

Since $\frac{\partial TC^*}{\partial i} = -\frac{a}{\gamma}$, we have:

$$sign\frac{\partial n^*}{\partial i} = sign[1 - \frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC}]. \tag{3.42}$$

Because $TC = \sigma(1+i_0) + R(1+i)$, the sign of the derivative $\frac{\partial n^*}{\partial i}$ is positive.

The sign of the derivative $\frac{\partial n^*}{\partial i_0}$:

$$sign\frac{\partial n^*}{\partial i_0} = sign[-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i_0}]. \tag{3.43}$$

Since $\frac{\partial TC^*}{\partial i_0} = \sigma$, we have:

$$sign\frac{\partial n^*}{\partial i} = sign[\frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC} - 1]. \tag{3.44}$$

Because $TC = \sigma(1+i_0) + R(1+i)$, the sign of the derivative $\frac{\partial n^*}{\partial i}$ is negative.

3.7.6 Effect of m on n^*

The effect of banking concentration on the equilibrium number of firms is the sum of the following effects:

$$\frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} = -\frac{2t\gamma}{m^3}[\frac{\frac{a}{\gamma * TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2}\frac{-a}{\gamma}}{1 - \frac{1}{n^2}}] = -\frac{2t}{m^3}\frac{a}{\gamma TC}\frac{\varepsilon_{TC}}{(1 - \frac{1}{n^2})} \tag{3.45}$$

$$\frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{t(1 - \frac{R}{\sigma})\gamma}{m^3}[\frac{-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2}\sigma}{1 - \frac{1}{n^2}}] = \frac{t(\sigma - R)}{m^3}\frac{1}{TC}\frac{\varepsilon_{TC}}{(1 - \frac{1}{n^2})} \tag{3.46}$$

Since the elasticity ε_{TC} is positive, the first derivative is always negative, while he sign of the second one depends on the relationship between σ and R. When $R > \sigma$ it is negative, when $R < \sigma$ it is positive.

This gives the combined effect of banking concentration on product market concentration:

$$\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} + \frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{\varepsilon_{TC}}{(1 - \frac{1}{n^2})}\frac{t}{m^3}\frac{1}{TC}[(R - \sigma) + 2\frac{a}{\gamma}]. \tag{3.47}$$

It is clear from this that whenever enlargement outlays exceed entry cost ($R \geq \sigma$), the effect of m is negative: greater banking concentration will increase the equilibrium

number of firms in the product market and reduce the concentration. The relation between banking and product market concentration is negative.

Chapter 4

Banking Competiton or Banking Concentration Effect?

4.1 Introduction

Concentration and competition in banking markets have important effects on real markets. The relationship between conditions in the banking markets and macro- or microeconomic development has been extensively studied. Many contributions have analyzed the effects of financial markets and banking industry on economic growth (e.g. King and Levine, 1993), productivity (e.g. Nickell, 1996), innovation (e.g. Aghion et al., 2005), and product market structure (Cetorelli, 2001, 2004; Cetorelli and Strahan, 2006; Chapter 2 in this Dissertation). This paper further contributes to the study of banking market effects on product market structure.

Studies by Cetorelli and co-autors have discovered a robust positive relationship between market concentration in banking and manufacturing industry, which indicates that countries with more concentrated banking markets have likely also more concentrated industries. My study (Chapter 2) showed that this relationship turned to a negative one in developed European countries in the period 1997-2004 and that banking concentration did not affect product market structure in transitional European countries in the same period. However, the existing studies of the effects of banking markets on product market structure suffer from the common problem of treating concentration and competition as one being just the reverse of the other. Although the theoretical contributions underpinning the empirical studies mainly analyze the effects of competition in banking or financial markets on real markets (Spagnolo, 2000; Cestone and White, 2003), empirical studies use concentration measures as explanatory variables and investigate the effect of concentration. Some of the results in Chapter 2 indicate that the concentration effects

revealed (or not revealed) might be the effects of banking competition and not banking concentration *per se*.

I add to this literature in three ways. Firstly, believing that it is in fact banking competition (and not banking concentration) that affects product market structure, I investigate explicitly the effects of banking competition on product market structure. Secondly, by applying a recently proposed "Boone's" indicator of competition as a measure for competition, I provide an alternative and possibly more accurate description of competitive development of transitional banking markets. Additionally, our study contributes to the body of evidence related to the performance of Boone's indicator vis-à-vis traditional concentration and competition measures such as concentration ratios and price-cost margin. Finally, by focusing our analysis on a sample of transitional countries I extend the knowledge about transitional processes and of economies and markets which are not covered as extensively as more advanced ones.

In the following sections, I first present the related literature discussing mainly the measuring of competition. Next, I describe the methodology, data sets used and results of empirical estimations. Finally, a conclusion wraps up the paper.

4.2 Literature review

Theories explaining the relation between concentration and competition have converged into three main alternatives: the structure-conduct-performance theory (SCP), the efficient market shares theory (EMS) and the contestable markets theory (CM). The traditional SCP theory by Bain (1951) argues that firm behavior depends crucially on market structure. If there are a few firms with large market shares, they have market power that enables them to charge prices above marginal costs and earn extra profits. Incumbent firms engage in entry deterring activities to prevent entry from new potential competitors and preserve their market power (Bain, 1956). Higher concentration thus monotonically translates itself into less competitive markets. SCP has been a target of many critiques exposing, for example, the possibility of a reverse link (performance-conduct-structure) and the endogeneity of barriers to entry as shortcomings. Empirically, numerous studies have produced ambiguous results about the validity of this theory.

The SCP is a fairly static theory, relating the contemporary distribution of market shares to firm behavior. Contestable markets and efficient market shares theories are more dynamic in this sense. The contestable markets theory argues that firms consider also the effects of potential entry of new competitors when choosing their strategic behavior (Baumol et al., 1982). It is therefore possible to have highly competitive behavior in

highly concentrated markets if the threat of entry is credible and large enough. If contestable markets theory suffers from lack of generality and can be attacked as relevant for relatively few specific cases, the theory of efficient market shares is much more general. Originated by Demsetz (1973, 1974) its main proposition is based on the reversed logic of the SCP: observed market shares are a result of firm cost efficiency and their past strategic actions and not the cause of its profit efficiency. Firms which are more cost efficient outperform – or even outlive – their competitors, grow faster and as a result gain larger market shares (Jovanovic, 1982). Intensive competition forces inefficient firms out of the market thus increasing concentration ex-post. Concentration and competition in the CM and EMS settings are not monotonically related and approximations of competition via concentration become questionable.

For banking markets, Dell Ariccia (2001) shows that asymmetric information about clients in incumbent and entrant banks increase market concentration and lead to lower interest rates. Banking markets can thus have only a few banks but they are more aggressively competitive. Angelini and Cetorelli (2003) provide an empirical example where consolidation in banking market did not decrease competition which can be explained by banks passing on the benefits from cost efficiency – brought by consolidation – on the consumers (Berger et al., 2000). Moreover, Claessens and Laeven (2004) for a worldwide sample of 50 countries, Coccorese (2005) for large Italian banks, and Corvoisier and Gropp (2002) for savings and time deposits in 10 European countries find evidence that more concentrated banking markets are more competitive. Contestability (Claessens and Laeven, 2004) and institutional framework (Bikker et al., 2007) affect competition in banking markets more than market structure. On the other hand, Bikker and Haaf (2002) for 23 European and Non-European countries and Corvoisier and Gropp (2002) for loans and demand deposits in 10 European countries report a positive effect of concentration on market power.

In spite of strong arguments offered by the CM and EMS, competition in academic, and even more in practical applications, has traditionally been estimated by proxies of concentration. The same holds also for the literature on banking markets. Concentration ratios (CR) calculated as market shares of n largest firms in the market and Herfindahl-Hirschman index have long been probably the most dominant measures of "competition". Alternative methodologies to measure competition empirically have been proposed within the concept of "New Empirical Industrial Organization". These approaches aim to directly or econometrically estimate price-cost margins (PCM) which are seen as a more accurate measure of competition. Aghion et al. (2005) and Nickell (1996) are examples of studies that calculate PCM directly from accounting data. Bresnahan (1989) systematically lists the econometric approaches for estimating PCM or the degree of competitiveness into four categories.

The structural approach involves structural equations for supply, costs and demand which include a parameter θ that measures the deviation from marginal cost pricing (firm's conduct). The parameter θ is therefore a measure of market power and can be stated in various forms (e.g. constant, time-varying, average). When θ=0, there is perfect competition, and when θ=1, we are in a situation of perfect collusion or monopoly. Alternatively, the parameter describing firm's conduct can be stated in terms of "conjectural variation" which is the expectation about the competitor's reaction to an increase in quantity. This is the approach first taken by Bresnahan (1982) and Lau (1982). Applications of this model in banking are rather limited and include Shaffer (1989, 1993) and Bikker (2002). Corts (1999) shows that the conduct parameter does not measure market power accurately in a dynamic setting.

The second approach was pioneered by Panzar and Rosse (1987) who estimate a reduced form revenue equation with factor prices as explanatory variables. They propose the Panzar-Rosse (PR) or H statistic, which is the sum of elasticities of the reduced form revenues with respect to all input prices. It gives the percentage change in equilibrium revenues that would follow a 1 percent increase in all of the firms input prices. Monopoly theory tells us that a monopolists optimal revenue will always fall when costs rise, therefore H is negative, if the market studied is a monopoly. If the market is characterized either by long-run competitive equilibrium or by perfect contestability, H=1. If the market is monopolistically competitive or oligopolistic, H is between zero and 1. Because revenue is more likely to be observed than prices and quantities, this approach is very popular in applied work. Studies that use the PR approach to measure competition in banking are for example, Molyneux et al. (1994), Coccorese (1998), DeBandt and Davis (2000), Bikker and Haaf (2002), Bikker and Spierdijk (2008). For transitional countries, it is used in Gelos and Roldós (2004), Drakos and Konstantinou (2005), Mamatzakis et al. (2005), Yildirim and Philippatos (2007b), while a similar model is used in Fries et al. (2006). Most of the studies find that countries have some degree of monopolistic competition in their banking markets (H between 0 and 1). The difficulty with PR approach is that it is hard to interpret a yearly change in the H statistic as a move either toward more or less competitive market because values between 0 and 1 are consistent with monopolistic competition and oligopoly and we have no orientation as to what exactly e.g. H=0.5 means (Boone et al., 2007).

The aim of the third approach is basically to identify from data when firms are colluding and when they deviate from cartels. Porter (1983) is an example of this approach. The market can be in two regimes (e.g. regime one is price wars and regime two is collusion) and the variable describing the regime is taken to be unobservable. The nature of inference comes from identifying a component that enters in the system as a

supply shock. Switching regressions method is one of the techniques that can detect the presence of two modes.

The fourth approach attempts to estimate marginal costs from cost data or factor demand data. An example of this is Hall (1988) where marginal costs are estimated from annual variations in cost and then compared to variation in output. When variations in output are high in relation to variations in labor input, this shows that marginal costs are well below price and PCM's are high. Bresnahan (1989) says this is in fact average incremental cost being revealed by data and taken to be the estimate of marginal cost.

The latest attempt to develop a better measure of competition is by Boone (2000) who argues that PCM is actually not a good measure of competition. More intensive competition forces firms that are not cost efficient out of the market and concentration consequently increases. The surviving efficient firms have higher PCM's not because their prices are higher but because their costs are lower. Providing that the increased cost efficiency is at least partially passed on to consumers, greater competition is consistent with greater concentration, but this is not shown by PCM. Instead, Boone proposes to measure the responsiveness of profits to changes in cost efficiency as an indicator of competition: the more profits react to a change in cost efficiency, the more competitive is the market. This approach is applied to manufacturing industries by Boone et al. (2007), to the life insurance industry by Bikker and Van Leuvensteijn (2007) and to major banking markets by Van Leuvensteijn et al. (2007). Based on convincing theoretical justification and lack of good data on factor prices which are needed to estimate the popular H statistics, my study is the first to apply Boone's indicator of competition to measuring banking competition in transitional countries.

When we come to the question of how exactly does banking competition affect product market structure, there is no unique answer. On one hand, Cetorelli (2001) argues that banks with market power are inclined towards financing their existing borrowers at the expense of entrant firms, because they wish to protect the profitability of their existing clients and thus also their own profitability. Existing long-term borrowing relationships with incumbent firms can also lead to sub-optimal lending decisions by bank managers favoring incumbents despite inferior investment projects. Both types of behavior are punished in more competitive banking markets, but are viable if banks have market power. I call this the "positive" explanation because it suggests that a more competitive banking market will stimulate firm entry and lead to smaller firms (i.e. a more fragmented product market).

On the other hand, as pointed out by Petersen and Rajan (1995), banks are more inclined to lend to risky, unknown entrant firms if they have more market power. The latter can originate e.g. from information asymmetries or geographical location and enables them

to smooth interest rates and recover the cost of engaging in a risky relationship in later periods if the entrant firm becomes successful. When competition in banking markets is more aggressive, it is more likely that a successful entrant changes its bank in a later period; banks are therefore less willing to lend to entrant firms. However, because banks with market power may restrict credit availability and charge a higher interest rate in later period, firms will grow faster in more competitive banking markets. I call this the "negative" explanation since it suggests that a more competitive banking market will produce less entry and larger firms (i.e. a more concentrated product market).

4.3 Methodology

Since the direct effect of changes in concentration and competition is difficult to identify because of simultaneous dependence of conditions in product and banking markets, I build on the idea of differential effects and empirical approaches of Rajan and Zingales (1998), Cetorelli (2004), and Cetorelli and Strahan (2006). Rajan and Zingales (1998) demonstrate that industrial sectors differ in their dependence on external funds to finance business operations because of different sector-specific technological characteristics which influence entry and set-up costs, generation and distribution of cash flows and reinvestment. The idea of Cetorelli (2004) and Cetorelli and Strahan (2006) is that the effect of changed banking competition should be more pronounced in industrial sectors that are more dependent on external financial funding. In the absence of any causal relationship between both market structures, a change in banking competition should have the same effect on dependent and non-dependent sectors. They interpret a significantly different banking effect on dependent sectors as evidence of a causal relationship between both market structures. However, banking competition in these studies is measured with measures of concentration and not competition.

I develop this idea and estimate both effects: banking competition and banking concentration effect on the product market structure. To facilitate comparison with previous results for banking market effects on product market structure, I adapt the reduced form model developed in Cetorelli (2004) and Cetorelli and Strahan (2006) of the following general form:

$$\begin{aligned} \textit{Product market structure}_{ict} = f(&\textit{Banking concentration}_{ct} \times \textit{Ext. fin. dependency}_i, \\ &\textit{Banking competition}_{ct} \times \textit{Ext. fin. dependency}_i, \\ &\textit{Control variables}_{ict},\ \textit{Sector-specific characteristics}_i, \\ &\textit{Time-and-country-specific characteristics}_{ct}), \end{aligned}$$

where product market structure is characterized by average firm size or the number of firms in industry i, country c, and year t, banking concentration is measured by traditional concentration ratio (CR), and banking competition is measured by Boone's indicator of competition. The expected signs of banking concentration and competition are *a priori* ambiguous. If the positive explanation is true, we should see a negative effect of banking competition on average firm size and a positive effect on entry. If the negative explanation is true, we should see the a positive effect of banking competition on average firm size and a negative effect on entry. Assuming SCP holds, we should observe the reverse signs for banking concentration when competition measures are not present; otherwise SCP can be rejected in favor of CM or EMS theory.

In the first stage, I estimate the Boone indicator of competition for transitional banking markets and investigate its relationship to traditional concentration and competition measures, CR and PCM. In the second stage, I estimate the effects of banking concentration and competition on product market structure using the above model.

Boone's measure of competition is defined as profit elasticity with respect to marginal costs. Several studies by Boone and co-authors develop the idea that in a more competitive market inefficient firms, which have higher marginal costs, face a greater reduction in profits and/or market shares (Boone, 2000; 2001; 2004; Boone et al. 2007). In this argument, competition can increase in two ways: either because new firms enter in the market (following a fall in entry barriers, for instance) or because incumbents engage in more aggressive behavior (tougher price competition, for instance). When competition increases because of more entry, concentration measures correctly show the change in competition. In contrast to that, tougher price competition among incumbents reduces profits of less efficient firms and forces some of them out of the market or encourages consolidation via mergers and acquisitions; in this case concentration measures are increased, which is commonly interpreted as a decrease in competition, but the conclusion is wrong.

An increase in aggregate PCM – the traditional measure of competition – is commonly interpreted as a deterioration of competitive conditions in the market. However, PCM can be higher because firms are more cost efficient (marginal costs are lower) or because firms have gained market power (prices are higher). When competition intensifies because of more aggressive behavior, the cost-efficient firms survive in the market. But ceteris paribus these firms have lower marginal costs and higher PCM's *and* their market shares increase. The latter effect is called the "reallocation effect" in Boone's theory. Both effects increase the aggregate PCM which incorrectly indicates a decrease in competition. Boone et al. (2007) show that PCM is an inconsistent measure of competition mainly due to the inherent reallocation effect. Based on theoretical analysis, simulations,

and empirical estimation, they propose measuring competition by using profit elasticity (PE) instead of other competition (concentration) measures. PE correctly indicates the change in competition regardless of the cause of change (more entry or more aggressive behavior), but conditional on the linear relation between log profits and log costs.

Theoretical justification of PE as a measure of competition in Boone et al. (2007) comes from the application of the standard Cournot model. Tailoring this model to banking industry as Van Leuvensteijn et al. (2007) do, I consider a bank i which produces one banking product q and has an inverse demand curve of the form:

$$p(q_i, q_{-i}) = a - bq_i - d\sum_{j \neq i} q_j \tag{4.1}$$

and constant marginal costs c_i. As usual, the parameter a indicates market size, the parameter b is market demand elasticity and parameter d is the substitution rate between products in the market. Bank i sets q_i to maximize profit $\pi_i = p_i q_i - c_i q_i = (a - bq_i - d\sum_{j \neq i} q_j)q_i - c_i q_i$. Assuming $a > c_i > 0$ and $0 < d \leq b$, the first order condition for a Cournot-Nash equilibrium is:

$$a - 2bq_i - d\sum_{j \neq i} q_j - c_i = 0 \tag{4.2}$$

In a market with N banks, N first order conditions apply and the solution for q_i is:

$$q_i(c_i) = \frac{(\frac{2b}{d} - 1)a - (\frac{2b}{d} + N - 1)c_i + \sum_{j=1}^{N} c_j}{(2b + d(N-1))(\frac{2b}{d} - 1)} \tag{4.3}$$

Since variable profits are defined as $\pi_i = (p_i - c_i)q_i = (a - bq_i - d\sum_{j \neq i} q_j)q_i - c_i q_i$, there is a quadratic cost term in the profit equation besides a linear one. Boone et al. (2007) study a log-linear approximation of this relationship, which gives a more straightforward explanation of the PE:

$$ln(\pi_i) = \alpha + \beta ln(c_i), \tag{4.4}$$

where PE is β and its expected sign is negative. I follow this approach, but consider also a model with the quadratic cost term as a robustness check in empirical estimation:

$$ln(\pi_i) = \alpha + \beta_1 ln(c_i) + \beta_2 (ln(c_i))^2, \tag{4.5}$$

where $PE = \beta_1 + 2\beta_2 ln(\bar{c})$ and $\bar{c}$ is market average marginal cost.

I have attempted to estimate marginal costs for transitional banking markets via a standard translog function, but due to poor data on factor prices in our data source I have opted to follow the Boone et al. (2007) approach using average cost as a proxy instead. Theory states that an increase in competition will increase profits of more efficient firms relative to less efficient firms. To capture the spread between more and less efficient firms, I use normalized profits and costs, where the normalization factors are median profit and costs. Thus I estimate the following equation:

$$ln(\frac{\pi_{it}}{\bar{\pi}_t}) = \alpha_i + \alpha_t + \beta_t ln\frac{c_{it}}{\bar{c}_t} + \varepsilon_{it}, \tag{4.6}$$

and the non-linear version for robustness check:

$$ln(\frac{\pi_{it}}{\bar{\pi}_t}) = \alpha_i + \alpha_t + \beta_{1t} ln\frac{c_{it}}{\bar{c}_t} + \beta_{2t}(ln\frac{c_{it}}{\bar{c}_t})^2 + \varepsilon_{it}, \tag{4.7}$$

where α_i is bank fixed effect, α_t is time fixed effect, $\bar{\pi}_t$ and $\bar{c}_t$ are median profit and median average cost, respectively. The coefficient β_t in the linear model is the Boone measure of competition. Bank fixed effects capture time-invariant bank-specific characteristics that affect the profitability of bank relative to median bank profitability and possible measurement errors that are time-invariant or change in the same way for all banks. I estimate the linear and non-linear model for each country separately to get yearly estimates of PE.

4.4 Data

I use two datasets: the first one is the dataset used for estimating competition in transitional banking markets, the second one is used for estimating effects of banking concentration and competition on product market structure.

The dataset for the first stage is composed from Bankscope (September 2007 CD) database of financial statements for commercial banks in ten transitional countries: Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia, and Slovakia. I use balance sheet and income statement items running from 1991 to 2005. I have focused only on commercial banks in order to exclude the effects of different business policies (i.e. asset management, funding mix) among different types of banks on the measures of competition. Since most banks in transitional countries are classified as commercial banks, this covers a large part of the total banking market in most countries.

The Bankscope database does not necessarily include all banks that are present in the banking market, since the decision to report annual accounts in Bankscope database is left at the discretion of banks. Since the majority of large and important banks that influence competitive conditions does report in Bankscope database, I can still regard the sample as representative of the markets. Another source of sample selection bias related to Bankscope data is the fact that data for active banks are reported for the last seven years preeceding the latest annual account (typically for periods 1997-2004 or 1998-2005), while data for banks that do not exist anymore run from different years (the earliest is 1991) to typically a year before a bank stopped operating either because it was overtook, it has merged, its license was revoked or it went bankrupt. Estimations on data prior to 1997 are thus biased and mostly reflect the conditions in inefficient or overtaken banks.

To check whether entry and exit pattern of banks causes selection bias, we follow Fries et al. (2006), Verbeek and Nijman (1992) and Wooldridge (2002) in testing for presence of selection bias. We add four dummy "selection" variables to the model: the first one is the number of years the bank is included in the sample ("count"), the second is a variable indicating if the bank has been absent for at least one year ("abs"), the third is a variable indicating if the bank was absent in the previous year ("entry") and the fourth is a lead of the selection indicator ("no exit") indicating if a bank is present in the next period (i.e. zero indicates exit). Significant coefficients on these added variables indicate a possible selection bias. Since my interest is in the estimation of yearly PE's, I interact selection variables with year dummy variables to detect years when estimated PE's are affected by selection bias. Generally, the estimates are robust to selection bias in all but two countries[1]. Only the "no exit" variable is significant for Bulgaria in three years (1998, 2000, and 2002), and the "entry" variable is significant for Romania in four years (1992, 1994, 1998, and 2000). To check consistency of PE estimates in these countries, I test the effect of selection bias on the coefficients of interest by interacting the significant selection variable with the explanatory variable. Insignificant coefficients on these interaction terms show that selection bias does not compromise the consistency of estimates in a meaningful manner, therefore I do not use other methods for correcting sample selection bias.

However, I point out that although estimates of Boone's competition indicator are reported for the whole period 1991-2005, only estimates after 1996 can be seen as reliable and representative of the commercial banking markets. Only the latter are therefore used in the second stage of our empirical investigation.

[1]Results are not reported and are available upon request

In order to exclude irrelevant and unreliable observations, I have followed this elimination strategy: i) banks with negative equity and total operating income were eliminated, and ii) banks with total income-to-assets ratio above 0.415 and with equity-to-assets ratio above 0.6 were eliminated (both cut-off values represent the upper 1 percentile of the respective distribution). The restrictions produced a sample of 1429 observations. Table 4.1 shows the composition of the sample and presents some characteristics of the banking markets by country. The characteristics are presented as shares of total assets. Costs are defined as the sum of interest expenses, personnel expenses and other non-interest expenses; income is defined as the sum of interest income and other operating (non-interest) income. The shares of loans and securities in total assets indicate the average asset mix, while deposits and equity indicate the average funding mix in commercial banks by country. Overall, loans, securities, deposits and equity represent, respectively, 46 %, 16 %, 78 %, and 13 % of total assets. Costs and income typically represent 9 % and 12 % of total assets.

Table 4.1: Bank sample characteristics

Country	Mean (as share of total assets)						N
	Loans	Securities	Deposits	Equity	Costs	Income	
BG	0.49	0.15	0.72	0.17	0.07	0.10	148
CZ	0.42	0.16	0.76	0.09	0.07	0.08	163
EE	0.48	0.09	0.76	0.12	0.07	0.09	54
HU	0.50	0.13	0.78	0.12	0.11	0.14	159
LT	0.48	0.14	0.80	0.13	0.08	0.10	68
LV	0.38	0.11	0.84	0.12	0.07	0.08	167
PL	0.49	0.17	0.77	0.13	0.11	0.13	298
RO	0.42	0.09	0.78	0.17	0.15	0.19	129
SI	0.54	0.24	0.79	0.12	0.07	0.10	136
SK	0.42	0.23	0.86	0.09	0.08	0.10	107
Total	0.46	0.16	0.78	0.13	0.09	0.12	1,429

Source: Bankscope 2007.

The descriptive statistics of variables used in bank-level estimations are presented in Table 4.2. Profits are calculated as the difference between income and costs, both defined as above, and normalized by median profit. Marginal costs are proxied by average costs, measured as cost-to-income ratio and normalized by median cost-to-income ratio. Control variables are the shares of loans, securities, deposits, and equity in total assets (TA).

The second dataset is used for estimation of banking concentration and competition effects on product market structure. Sample characterstics are presented in Table 4.3. The data for this estimation come from Eurostat New Cronos database, Bankscope, WDI World Bank, the Joint BIS-IMF-OECD-WB External Debt Hub, and my first stage estimations. I analyze the same ten transitional countries as in the first stage,

TABLE 4.2: Summary statistics for the sample of banks

Variable	Mean	Std. Dev.	Min.	Max.	N
Ln profit	0.441	2.143	-17.389	17.717	1429
Ln average costs	-0.048	0.181	-1.348	1.154	1429
Loans-to-TA	0.463	0.196	0	0.98	1429
Securities-to-TA	0.156	0.128	0	0.692	1423
Deposits-to-TA	0.783	0.136	0	0.964	1427
Equity-to-TA	0.126	0.085	0.006	0.588	1429

but the unit of observation is here an industrial sector and the period under observation is 1997-2004. Market structure in industrial sectors is measured by average firm size and the number of firms. Data for both come from Eurostat's database. Average firm size is measured as real value added per firm (in millions USD). There are 2,321 sector-year-country observations in the sample. The unweighted average number of entities in transitional countries is close to 1,830 for firms and almost 29 for banks. In this period domestic credit represented on average around 40 % of GDP, private credit around 30 %, market capitalization less than 15 % and foreign loans less than 5 % of GDP.

TABLE 4.3: Sector sample characteristics by country (1997-2004)

Country	Mean								N
	VA per firm	Firms	Banks	Domestic credit	Private credit	Market cap.	Foreign loans	GDP pc	
	mil. USD			% of GDP				USD	
BG	0.35	743.22	25.16	30.93	22.67	5.39	3.06	1614.39	248
CZ	0.48	4842.86	24.63	54.01	49.54	22.12	5.32	5592.08	259
EE	0.36	197.07	5.56	45.97	29.80	36.96	5.78	4495.98	138
HU	2.75	1455.94	25.32	55.82	34.82	25.08	6.88	4828.87	220
LV	0.28	213.02	21.34	30.60	23.48	7.95	2.07	3567.30	204
LT	1.31	296.87	9.00	18.97	15.55	15.04	3.45	3645.56	199
PO	5.38	6702.97	100.88	33.44	25.21	15.49	3.51	4398.53	275
RO	1.10	1359.95	27.07	15.39	10.87	7.78	4.90	1861.52	191
SK	2.30	127.22	15.50	54.41	43.62	7.57	7.22	3780.12	302
SI	0.98	758.39	17.19	42.45	34.73	14.40	5.52	9513.62	285
Total	1.66	1829.51	28.75	39.19	30.24	14.79	4.83	4482.05	2,321

Source: Eurostat, Bankscope, World Bank, and BIS-IMF-OECD-WB External Debt Hub.

Variables that are used in the second stage estimation are presented in Table 4.4. External financial dependence is used as a sectoral characteristic that enables me to identify the effects of banking concentration and competition. It is taken from Rajan and Zingales (1998) and it is calculated for mature US companies in the 1980's. This measure is admittedly not optimal, since the situation of firms in transitional manufacturing sectors is hardly the same as it was for reference companies. However, Rajan and Zingales defended its use for non-US countries (including less developed ones), among others, on the following grounds: the financial dependency on external funds is determined by factors that are similar worldwide (e.g. product and technology characteristics), when in equilibrium it is affected by worldwide shocks affecting similarly firms in all countries,

and estimates confirm that it is fairly stable across time and space. In the absence of other suitable industry characteristics and to enable comparison of results, I use this measure of external financial dependence.

TABLE 4.4: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Ln average firm size	-1.323	1.601	-7.396	5.238	2321
Ln number of firms	5.733	1.975	1.099	10.498	2321
Ext. fin. dependence	0.021	0.313	-1.33	0.394	2244
Concentration measure					
CR3	0.685	0.171	0.42	1	2272
Competition measures					
PE	5.027	2.308	-0.317	15.181	2272
PCM	0.232	0.061	0.124	0.438	2272
PENL	9.379	8.706	-4.05	66.904	2272
Control variables					
Share of VA in total manufacturing	0.03	0.03	0	0.272	2321
Domestic credit	39.193	17.614	11.585	108.692	2321
Private credit	30.241	14.958	7.169	70.788	2321
Market capitalization	14.788	10.146	0.019	55.19	2316
Foreign loans	4.83	2.367	0.948	11.997	2321
GDP per capita	4482.05	2275.572	1351.733	11008.84	2321

Concentration in banking markets is measured by concentration ratio ($CR3$), calculated from Bankscope data and subject to the same limitations as described above. $CR3$ is calculated based on shares in total market income for each country j and year t and it is defined as:

$$CR3_{jt} = \sum_{i=1}^{3} \frac{I_{it}}{\sum_{k=1}^{n} I_{kt}}, \text{for each } i \text{ and } t \tag{4.8}$$

where i is the rank of bank with respect to income and I_{it} is the income in bank ranked i in year t.

Ideally, it should be based on balanced panel data for all banks in the market. Since this measure is affected more by larger banks, which typically report annual accounts in Bankscope database regularly, it is assumed to be an adequate measure of concentration. On average, the share of three largest banks was almost 69 percent.

The competition measure PE is estimated in the first stage as explained above, while PCM is calculated for each year t and country j from Bankscope data as total market profit divided by total market income (Boone et al., 2007):

$$PCM_{jt} = \frac{\sum_{i=1}^{n}(I_{it} - C_{it})}{\sum_{i=1}^{n} I_{it}}, \text{for each } i \text{ and } t \tag{4.9}$$

where I_{it} denotes bank i's income in year t and C_{it} denotes bank i's costs in year t.

The average PE for the whole period is around 5, indicating that a 1 percente increase in costs reduces profits by 5 percents. I use the nonlinear profit elasticity (PENL) as an alternative measure of competition and include it in estimations as a robustness check. On average, it was almost twice as large as PE. Control variables are used to capture other time-varying effects that can influence product market structure. I use the share of value added in total manufacturing value added to include the sector size (growth) effects in the econometric estimation, and a number of institutional variables that describe general banking and financial markets' effects as well as general economic conditions (domestic credit as percentage of GDP, private credit as percentage of GDP, market capitalization as percentage of GDP, foreign loans as percentage of GDP and GDP per capita).

4.5 Results

I present first the estimation results for the Boone indicator (PE) and then the results for banking concentration and competition effects on product market structure.

4.5.1 Estimation of Boone indicator

The estimated benchmark model is the following:

$$ln(\frac{\pi_{it}}{\bar{\pi}_t}) = \beta_t ln\frac{c_{it}}{\bar{c}_t} * DY_t + \gamma_1 LTA_{it} + \gamma_2 STA_{it} + \\ + \gamma_3 DTA_{it} + \gamma_4 ETA_{it} + \alpha_{1t} * DY_t + \alpha_{2i} + \varepsilon_{it}, \tag{4.10}$$

where LTA, STA, DTA, and ETA are the ratios of loans, securities, deposits and equity to total assets normalized by their median values, respectively.

The variable DY_t denotes year dummy variables. Other variables in the model are explained in the Data description section. The model is estimated for each country separately. The expected sign of PE (β_t) is negative.

I use the within transformation (fixed effects) approach to estimate the model thereby purging the estimates of all time constant individual effects that might influence normalized profits. To exclude time effects, I include a time dummy variable, but I do not report the coefficients due to their inconsistency. Since my interest is in estimating yearly PE's, I interact normalized average costs with the time dummy variable. Heteroskedasticity-robust standard errors are used for inference.

Control variables are included in the model to account for other possible time-varying effects on the relationship between normalized costs and profits, thus avoiding (or at least reducing) the problem of omitted variables. Preliminary investigation confirmed that β_t coefficients generally did not change much in their magnitude or statistical significance when control variables were added to the model.

Since profits are derived from income and costs and not the other way around, logically there is no endogeneity problem in estimation when we think in terms of a possible reverse causation, i.e. the dependent variable affects the explanatory variable in time period t. However, there might be a "technical" endogeneity problem, which is a more general case where an explanatory variable is contemporaneously correlated with the idiosyncratic error term ε_{it}. If this happens, average costs could still be an endogenous variable. The sources of this problem are typically an omitted time-varying variable or a measurement error in explanatory variables. I account for the omitted variable possibility by including control variables. Robustness of β_t coefficients to the inclusion of control variables indicates that estimates are not biased. Boone et al. (2007) argue that the major part of the measurement error is constant over time or change in the same way for all firms, so it is absorbed by the bank or time fixed effects.

As a robustness check, I estimate also the non-linear version of the benchmark model which includes the quadratic costs term:

$$\begin{aligned} ln(\frac{\pi_{it}}{\bar{\pi}_t}) = \beta_{1t} ln\frac{c_{it}}{\bar{c}_t} * DY_t + \beta_{2t}(ln\frac{c_{it}}{\bar{c}_t})^2 * DY_t + \gamma_1 LTA_{it} + \\ + \gamma_2 STA_{it} + \gamma_3 DTA_{it} + \gamma_4 ETA_{it} + \alpha_{1t} * DY_t + \alpha_{2i} + \varepsilon_{it}. \end{aligned} \tag{4.11}$$

The expected sign of β_1 is negative while the expected sign of β_2 is a priori ambiguous.

Both models, linear and non-linear, produce a significant negative coefficient β or β_1, respectively, in most country-year cases (Tables 4.8 and 4.9 in the Appendix). In the linear model there are five cases with a positive, but mostly insignificant sign and in the non-linear model there are ten such cases. Also the quadratic cost term in the non-linear model is negative in most cases, but it is significant in fewer country-year cases. The inclusion of control variables does not change the signs and significance of the β coefficients, but some of them have a statistically significant effect on the normalized profits. In the linear model, the share of loans to total assets is significant in half of the countries in the sample, but its effect is positive in some cases and negative in other. Similar results hold also for the non-linear model. The ratio of equity to total assets, on the other hand, has a significant negative effect in four countries in both models.

The share of securities in total assets has mostly positive coefficients, but it is never significant in the linear model and in only one country in the non-linear model. The ratio of deposits to total assets is significant in four countries in the non-linear model, but only in two countries in the linear model. The signs are not consistent: they are positive in half of the cases and negative in the other half.

Turning to the dynamics of competition in the sampled countries, I note that there are no cases where the changes to more or less intense competitive behavior are consistent through the whole period (Figure 4.1 in the appendix). In Hungary and Slovenia, the competition was becoming generally less intensive after 1996 and 1997, respectively. In Poland and Slovakia, the competition was becoming generally more intensive after 1996 and 1998, respectively.

TABLE 4.5: Linear PE

Country Year	BG	CZ	EE	HU	LT	LV	PL	RO	SI	SK
1991		4.45***								
1992				-25.00***			2.57			
1993		-7.84***		-2.83			-2.44***		-2.26***	
1994		-5.40***	-2.35	-6.97***	-7.01**		-2.69***		-6.56***	
1995		-7.27***	-5.06**	-7.24***		-4.42**	-2.61**	1.08	-7.87***	-2.93
1996		-7.76***	-2.95*	-8.50***		-5.36	-2.18***	-6.41*	-9.06***	-1.42
1997		-4.07**	-3.33***	-14.52***	-6.76***	-4.21	-3.63***	0.32	-5.74***	-2.52
1998	-3.90***	-2.23**	7.19	-6.85***	-5.47***	6.43*	-3.88***	-4.05*	-5.27***	-1.13
1999	-2.54***	-5.95**	-11.90**	-8.10***	-5.84***	-5.58***	-5.63***	-5.76**	-4.99***	-2.45
2000	-3.33***	-2.24	-6.32***	-8.95***	-7.21***	-5.08***	-5.44***	-5.24***	-6.08***	-2.25
2001	-4.08***	-7.56***	-6.61***	-6.79***	-7.73***	-4.62***	-6.81***	-6.74***	-5.44***	-4.35***
2002	-3.23***	-4.17***	-5.54***	-5.61***	-7.04***	-3.22**	-5.26***	-15.18**	-4.86***	-5.16***
2003	-2.44***	-3.51***	-7.73***	-5.40***	-6.80***	-3.00***	-5.61***	-5.00***	-4.69***	-4.08**
2004	-3.05***	-5.17***	-5.32***	-5.27***	-4.87***	-2.68***	-4.82***	-3.50**	-4.11***	-5.61***
2005	-1.31**	-3.45***	-2.75	-4.80***	-3.01	-3.54***	-4.68***	-5.03***	-3.49***	-3.62***

Note: Gray area denotes the period used in the second stage.

Generally, transitional countries had the most intensive competitive banking markets during the period 2000-2002, which is right after eight of them became members of the EU (Table 4.5). The average PE in the 2000-2002 period was around 6 implying that a 1 percent increase in normalized costs caused a 6 percent drop in normalized profits. The least competitive behavior was typical for 1998 and 2005 when PE was around 3 % and 3.5 %, respectively. The magnitude of yearly PE's is mostly in the range 2 to 9 and it is broadly in line with the findings of Boone et al. (2007) whose estimated average PE for Dutch manufacturing firms was around 7. My results show that overall the competition in transitional banking markets has been intensifying till 2001 and then started to weaken. Hungary had the highest average PE in the whole period (indicating the most competitive banking market), while Bulgaria had the lowest one. These results are consistent with Bikker and Spierdijk (2008) who –using Panzar-Ross H statistics– find that Eastern European countries experienced a modest decrease in competition during the period 1994-2004 and that after 2001-2002 there was less competition in these banking markets. Also Yildirim and Philippatos (2007b) find an

increasing competition in transitional banking markets in the period 1993-2000. By contrast, Gelos and Roldós (2004) find a relatively stable competition during 1994-1999 for Czech Republic, Hungary and Poland.

The estimates offered by the non-linear model support my conclusions from the linear model. The dynamics of the competition revealed by the non-linear model is similar to the linear one. The estimated PE's are on average higher than in the linear model, but mostly in the range 3 to 15 (Table 4.6). There are a few extreme values that are likely a result of outliers and also some more cases with a positive PE compared to the linear model, but they are mostly not significant. The results confirm that most countries experienced a decreasing intensity of competition after 2000. The most and least competitive banking markets on average were again Hungary and Bulgaria, respectively, not counting Romania and Estonia where estimates are less reliable.

TABLE 4.6: Non-linear PE

Country Year	BG	CZ	EE	HU	LT	LV	PL	RO	SI	SK
1991		3.13***								
1992				-11.97**			0.53			
1993		-11.40***		-2.32			-1.90**		-8.15	
1994		-8.88***	24.34	-9.50	-7.09		-4.23***		-15.22***	
1995		-9.46***	241.43	-4.82***		808.07**	-4.32***	3.10	-14.01***	-6.59***
1996		-13.54***	-34.18	0.05		-26.63***	-3.61**	-5.16	-9.61***	-24.68***
1997	0.00	-9.34*	-39.31	-30.34***	-6.60***	-33.17***	-5.36***	4.05	-5.30**	-8.53***
1998	-18.78***	-4.81	5.98*	-10.45***	-9.90***	17.31**	-5.20***	-9.48***	-5.27***	-5.20***
1999	-4.44***	-13.01***	-13.37**	-17.69***	-7.02***	-5.72	-8.26***	-1.53	-5.07***	-13.84***
2000	-4.26***	-10.48*	-5.98	-13.32***	-7.91***	-6.37**	-8.79***	-9.71	-5.67***	-5.40**
2001	-6.51***	-12.43***	-14.87	-10.13***	-15.24***	-5.21***	-11.26***	-13.54***	-4.31***	-9.97
2002	-6.16***	-6.22***	-8.20*	-9.24***	-13.04***	-3.48	-9.70***	-66.90**	-7.05***	-9.45***
2003	-3.55***	-6.27***	-6.85**	-7.10***	-10.13***	-3.80***	-8.04***	-11.12**	-5.35***	-8.39**
2004	-4.75***	-8.15***	-7.08	-7.41***	-5.55***	-2.99**	-6.40***	-3.77	-4.67***	-9.82***
2005	-3.31***	-4.62***	40.35	-5.80***	-3.88***	-4.49***	-3.80***	-0.03	-4.02***	-6.85***

Note: $PE = \beta_1 + 2\beta_2 * ln\bar{c}$; $H_0 : PE = 0$; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Grey area denotes the period in the second stage.

Figure (4.3) and Table (4.10) in the Appendix show the yearly development of the PCM, which is a more traditional competition measure. Overall, we can see a similar development of competitive behavior as with PE measure: an increase of PCM in the period after 2000 or 2001 in most countries indicates a weakening of competitive conditions in that period. PCM's also show that the period 2000-2001 was among the most competitive years, while 2005 was among the least competitive years for transitional banking markets. Consistent with PE are also Bulgaria and Estonia with the least competitive banking markets, while Poland and Slovakia are the most competitive markets according to PCM. Pairwise correlations show that PE and PCM are statistically significantly negatively correlated, but the correlation is not high (Table (4.15)).

Figures (4.4) and (4.5) in the Appendix show the development of concentration measures CR3 and HHI. In comparison to the competition measures, the trend of an overall decreasing concentration is much more obvious in most countries, especially in the 1990's. In Poland, Slovenia and Slovakia the concentration measures are roughly consistent with

the competition measures according to SCP: they indicate a decrease of concentration (an increase of competition) in the first part of the studied period (until 1997-1999) and an increase of concentration (decrease of competition) in the last five to seven years. For the rest of the countries, a decrease of concentration is much more pronounced throughout the whole period.

These results show that until 2000-2001 consolidation in banking industry was accompanied by greater competition; after 2000-2001 the competitive conditions started to deteriorate, while consolidation proceeded. The relationship between concentration and competition in transitional countries was not monotonic. Moreover, it seems that competitive conditions might not be dependent of concentration at all. The pairwise correlation between CR3 and PCM is not significant and although correlation between CR3 and PE for the whole period is positive and significant, it is rather low (Table (4.15)). This is in line with the findings of Angellini and Cetorelli (2003), Claessens and Laeven (2004), and Bikker et al. (2007).

4.5.2 Estimation of effects on product market structure

Now, I can estimate the effects of banking concentration and competition on product market structure. The benchmark model in this section is the following:

$$\begin{aligned} ln(SIZE_{ict}) = \delta_1 CR3_{ct} * EDI_i + \delta_2 PE_{ct} * EDI_i + \delta_3 PCM_{ct} * EDI_i + \\ + \gamma ShareVA_{ict} + \alpha_i + \alpha_{ct} * DCY_{ct} + \varepsilon_{it}, \end{aligned} \tag{4.12}$$

where $SIZE_{ict}$ is average firm size measured in terms of value added for sector i, country c and year t (as explained in the Data description section), $CR3_{ct}$ is the concentration ratio for country c in year t based on income shares, PE_{ct} is minus profit elasticity[2] estimated in the previous subsection for country c in year t, and PCM_{ct} is the price-cost margin for country c in year t calculated as explained in Data description section.

All three measures of concentration and competition are identified by interacting them with external financial dependency indicator (EDI_i). The indicator variable EDI_i is equal to 1 for sectors with above-median external financial dependency and equal to 0 for sectors with a below-median external financial dependency. Significant coefficients δ_1, δ_2, and δ_3 indicate that sectors that are highly dependent on external financing have indeed different average firm size and number of firms than less dependent sectors

[2]The estimated PE's from previous subsection are negative numbers where a greater absolute number indicates more intensive competition. To simplify interpretation of coefficients, I multiply estimated PE's by minus 1 to get positive numbers where a greater number indicates more intensive competition.

because of banking concentration and/or competition. To put it differently, if banking concentration or competition does not affect the market structure in product markets, there should be no difference in their effects between more and less dependent sectors and δ coefficients should not be significant. I include two measures of competition (PE and PCM) because they measure different aspects of competition as explained above and to check the robustness of PE as a measure of competition. Low pairwise correlation between $CR3$, PE, and PCM suggests collinearity should not be problematic, but I check that by estimating specifications with only one of the measures included.

The variable $ShareVA_{ict}$ measures the share of sector i in value added of total manufacturing and serves as a control variable that guarantees my estimates are not biased by the growth of individual sector importance.

I also estimate the effects of concentration and competition on the number of firms:

$$\begin{aligned} ln(NUM_{ict}) = \delta_1 CR3_{ct} * EDI_i + \delta_2 PE_{ct} * EDI_i + \delta_3 PCM_{ct} * EDI_i + \\ + \gamma ShareVA_{ict} + \alpha_i + \alpha_{ct} * DCY_{ct} + \varepsilon_{it}. \end{aligned} \tag{4.13}$$

The signs of coefficients on $CR3$, PE, and PCM are a priori ambiguous. I expect $ShareVA$ to have a positive effect on average firm size and the number of firms. I do not report the coefficients on fixed effects.

Both models are estimated using the within (fixed effects) method that allows me to isolate the effects of concentration and competition from the time-cum-country specific and sector specific characteristics that are constant in time and influence the average firm size or the number of firms in a sector. The sectoral characteristics are typically related to entry barriers, product differentiation, technological characteristics or demand dynamics. Time-cum-country characteristics are mostly economic and institutional factors that affect similarly all sectors in an economy. Governmental antitrust or competition policy and general economic trends are typical examples of such characteristics. One of the sectoral characteristics is the dependency on the external financial funds which is used to identify the effects of banking concentration and competition, which are both time and country specific characteristics.

Since endogeneity bias arising from simultaneous dependence of dependent variables (product markets) and explanatory variables (banking markets) is not a likely problem in this setting, I do not use more sophisticated approaches to estimation. However, I do control for a possible omitted variable bias in the robustness check section by including other time-variable measures of banking markets' characteristics: the ratio of domestic credit to GDP, the ratio of private credit to GDP, the ratio of market capitalization to

GDP, and the ratio of foreign loans to GDP. I control also for the economy size effect by estimating the benchmark models for small, medium and large countries separately. To account for a possible heteroskedasticity, I use heteroskedasticity-robust standard error for hypothesis testing.

4.5.2.1 Benchmark models

The results of the benchmark estimations are presented in Table (4.7). Columns 4 and 8 contain estimates of models with all three measures of concentration and competition, other columns have only one of the measures as explanatory variable. The results show that concentration does not have a significant effect neither on average firm size nor on the number of firms in manufacturing sectors in transitional countries (columns 1, 4, 5, and 8). This is in sharp contrast with the findings in Cetorelli (2001), Cetorelli (2004) and Cetorelli and Strahan (2006), but consistent with my results for transitional countries in Chapter 2. Competition, on the other hand, does have a statistically significant effect on both proxies of product market structure. This confirms my main hypothesis that it is actually the intensity of competition in banking market that influences product market structure and traditional concentration measures should not be used as a proxy for competition in this respect.

Table 4.7: Estimation results for benchmark models

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.144***	17.164***	17.201***	17.240***	8.187***	8.192***	8.050***	8.034***
	(0.929)	(0.929)	(0.940)	(0.946)	(0.537)	(0.537)	(0.522)	(0.522)
CR3*EDI	0.193			0.009	0.028			0.099
	(0.191)			(0.196)	(0.140)			(0.153)
PE*EDI		0.030**		0.039**		0.012		-0.009
		(0.014)		(0.015)		(0.011)		(0.013)
PCM*EDI			0.663	1.070**			-2.003***	-2.108***
			(0.479)	(0.505)			(0.390)	(0.422)
R-squared	0.573	0.573	0.573	0.574	0.866	0.866	0.868	0.868
F	42.187	42.306	42.772	41.745	188.859	186.831	184.381	182.761
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

When comparing the two competition measures, I can see that PE seems to have a positive significant effect on the average firm size (columns 2 and 4), but not on the number of firms (columns 6 and 8). This indicates that a more competitive banking market has a greater positive effect on the average firm size in manufacturing sectors that are highly dependent on external finance than on the average firm size in less dependent sectors. Thus, based on PE, I conclude that firms are larger when banking markets are more competitive. This is consistent with the "negative" explanation of the relationship between banking competition and product market structure (Petersen and Rajan, 1995).

As far as average firm size serves as a proxy of product market concentration, I can say that banking competition increases product market concentration.

Looking at PCM, I see that it does not appear to have a statistically significant effect on average firm size when it is the only measure of banking market structure (column 3), but becomes significant when other two measures are added in the model (column 4).[3] Since the coefficient and significance of PE practically do not change when PCM is added, but the coefficient of CR3 falls close to zero, I conclude that PCM indeed measures a different aspect of "competition" than PE does and this aspect is likely related to the concentration in banking market. My result supports the argument of Boone et al. (2007) that PCM actually measures market structure and not competition. Since an increase in PCM is typically interpreted as a weakening of competition, the positive effect of PCM could indicate that this aspect of competition acts in the opposite direction than the one measured by PE. A conclusion would be that firms are larger in less competitive banking markets with higher price-cost margins. But as shown in Boone et al. (2007), it is perfectly possible to observe more competition and greater price-cost margins when aggressive competitive behavior shifts market shares to the more efficient firms (banks in my case) that have higher PCM's. This reallocation effect is inherent in the PCM, but not in PE. PCM as a measure of competition is tainted with an effect of concentration, while PE is a pure competition measure.

Since Fries and Taci (2005) and Yildirim and Philippatos (2007a) find that greater cost efficiency is associated with greater banking competition and even more studies (including our stage one estimations) have shown that banking competition increased in the period from 1994 to 1999/2000, I can argue that higher PCM's in transitional countries were indeed a result of greater cost efficiency. Therefore I can interpret my results also as evidence of the Boone reallocation effect and conclude that the larger market shares are gained by efficient banks (with large PCM's) or equivalently the more cost efficient banking markets on average are, the larger firms are. Since it is not clear to what extent PCM measures competition and to what extent concentration[4], I rely more on PE as a competition measure when interpreting results.

PCM has a significant negative effect on the number of firms meaning that there are less firms in manufacturing sectors when banking markets have high price cost-margins. Traditionally, this would be evidence of a negative effect of weak competition on firm entry ("positive explanation"). But since the high PCM were likely a result of the reallocation effect, I can conclude that consolidation and greater cost-efficiency in the

[3]The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

[4]Boone et al., 2007 provide a decomposition of PCM, but a balanced panel is necessary to distinguish the reallocation effect from other effects.

transition banking markets did prevent firm entry in product markets while competitive conditions appear to have been unimportant for entry. This seems to be more in line with the "negative explanation" of the relationship between banking competition and product market structure.

I check the robustness of coefficients on concentration and competition measures firstly by including four control variables (Tables (4.11), (4.12), and (4.13)). The results show that the coefficients are to a large extent robust to these alternative specifications. The effect of the concentration ratio CR3 is more or less of the same magnitude, positive, but never significant. The coefficient on PE also remains at a similar magnitude and it is significantly positive when average firm size is the dependent variable, except when private credit in GDP is used as control variable (Tables (4.11) and (4.12)). In the latter case, it is still positive, but insignificant. The effect on the number of firms is mostly not significant, although in two cases it is significantly positive (Table (4.12), columns 5 and 6). PCM, on the other hand, appears to have a more robust effect on the number of firms than on the average firm size (Tables (4.11) and (4.13)). As a standalone measure, it has no significant effect on the average firm size and in combination with other two measures it has a consistently positive effect, but not always significant. The effect on the number of firms is always significantly negative and of similar magnitude.

Comparing columns 8 in tables (4.11), (4.12), and (4.13), I note that PCM seems to capture the effect that foreign loans in the financial system have on the number of firms: the higher share of GDP they represent (the lower PCM's are), the greater firm entry in manufacturing sectors. This could be evidence of the market contestability effect. If more foreign loans are present in the national economy, domestic banks will behave more competitively ceteris paribus, since they have to persuade firms to borrow at home. This is particularly relevant for transitional countries, where some foreign banks set up branches mainly to attract clients, but the loans are then granted by the central offices in the foreign country. PCM could thus be picking up the effect of contestability conditions.

The next robustness check is the size effect of economy (Table (4.14)). I arbitrarily divide the sample into three groups: countries in the first quartile of the GDP distribution ("small"), countries in the second and third quartile ("medium"), and countries in the fourth quartile ("large"). The model is estimated for each group separately. Concentration does not have a significant effect in any of the groups, although the sign becomes negative for medium and large countries when average firm size is the dependent variable.

In small countries, none of the concentration/competition measures is significant for average firm size, but interestingly, concentration has a larger (positive) effect than PE (practically non-existant) and PCM. This could indicate that in small countries banking concentration has more important effects on average firm size than competition or that

concentration and competition are collinear (SCP holds) and concentration picks up most of the effects of both (the "positive" explanation for the relationship between banking and product markets holds). Firm entry in small countries is mostly negatively (significantly) related to PCM.

In medium countries PE and PCM have a positive significant effect on average firm size and a negative effect (significant for PCM) on firm entry. CR3 has a negative, non-significant sign. This is all consistent with the "negative" explanation for the relationship between banking and product markets.

In large countries, the effects of PE and PCM are positive, but not significant, for average firm size and for firm entry (except for PCM). This is not consistent with either of the explanations: greater banking competition seems to increase entry and average firm size. Most likely, this is evidence of country size effect indicating that banking concentration and competition do not have important effects on product market structure in large countries. The findings of this robustness check seem to confirm the predictions of the theoretical model developed in Chapter 3.

4.5.2.2 Non-linear PE estimations

To check the robustness of the results to the PE measure, I use also PE estimates from the non-linear model. Overall, the results are consistent with the benchmark model and are even more significant (Table (4.16)). They are robust to the inclusion of control variables (Tables (4.17), (4.18), and (4.19)). The main difference with the benchmark model is a significant negative effect of PE on the number of firms, which was not present in the benchmark model. This offers additional confirmation about the conclusions from the benchmark model.

Concentration ratio CR3 has no significant effect in all but one of the model specifications (Table (4.17), column 6). The coefficient is positive in most cases, but note that it is negative for medium and large countries.

PENL has smaller coefficients than PE, it is always significantly positive when average firm size is the dependent variable and always negative when the number of firms is the dependent variable. This confirms that more aggressive competition in banking markets increases the average size of manufacturing firms, as showed by the benchmark model, and it additionally suggests that more aggressive competition in banking markets reduces the number of firms. However, the effect on the number of firms is robustly significant only in the presence of PCM (Tables (4.17) and (4.18)).

PCM effects on average firm size are smaller than in the benchmark model, while they are larger on the number of firms. Their signs are the same as in the benchmark model: positive for average firm size and negative for the number of firms. The effect on the average firm size is mostly insignificant, after I include control variables or when I use PCM as the only measure of banking market competition. The effect on the number of firms is always significantly negative and robust to control variables. Again, it seems that PCM picks up the effect of foreign loans in the domestic financial system (column 8 in Tables (4.17), (4.18), and (4.19)).

I check the effect of economy size in the same way as for the benchmark model - by estimating the models for three groups of countries (small, medium and large). The results are generally similar as for the benchmark model (Table (4.20)). A positive significant effect of PENL and PCM on average firm size is typical for medium countries (as it was in the benchmark model), but they are both negative, although not significant, in large countries (positive, not significant in the benchmark model).

4.5.2.3 The effect of outliers

Extreme values of individual observations can influence the estimations and lead to wrong conclusions. Influential outliers in dependent and explanatory variables are usually difficult to identify. On one hand they give more information about the relations in the population under examination, but on the other hand their extreme values can also distort the estimate of real relations in the population. Figures (4.1), (4.2), (4.3), and (4.4) show that there are observations with extreme values in my dependent and explanatory variables and they could be influential outliers. I check the robustness of our results by excluding the top and bottom 5 percent of observations in the distributions of the dependent and explanatory variables. Tables (4.21) and (4.22) present the results of these estimations where average firm size and the number of firms are the dependent variables, respectively. The first four columns in both tables show the sensitivity of benchmark estimates to the exclusion of potentially influential outliers; the last four columns show the estimates when non-linear PE (PENL) is used as a measure of competition. Overall, my results seem to be unrelated to influential outliers.

PE has still a significant positive effect on the average firm size regardless of whether it is estimated in the linear or non-linear model. When non-linear PE is used, it has also a significant negative effect on the number of firms. It seems that the effects are actually larger when extreme values of PE and PCM are excluded (columns 2, 3 and 6 in both tables). PCM has a significant positive effect on the average firm size, except when observations with extreme concentration ratios are excluded (the sign is still positive).

Also its significant negative effect on the number of firms appears to be independent of influential outliers and the magnitude is higher when extreme values of PCM are excluded.

4.6 Conclusion

I have used a new approach in measuring competition – Boone's indicator or profit elasticity (PE) – to assess the level and evolution of competitive conditions in ten transitional banking markets that are part of the enlarged EU in the period 1991-2005. Based on this measure, my results show that overall the competition in transitional banking markets has been intensifying till 2001 and then it has started to weaken. Transitional countries had the most intensively competitive banking markets during the period 2000-2002. In Hungary and Slovenia, the competition was becoming generally less intensive after 1996 and 1997, respectively. In Poland and Slovakia, the competition was becoming generally more intensive after 1996 and 1998, respectively. Other banking markets in the sample were characterized by more fluctuations. Hungary had the most competitive banking market on average in the whole period, while Bulgaria had the least competitive one.

The evolution of competition depicted by PE is consistent with the widely used Panzar-Rosse H statistics in other studies, which gives valuable confidence in the performance of PE since its applications are scarce so far. When compared to the traditional (directly measured) price-cost margin (PCM), a similar pattern of competition evolution can be seen and the correlation between the two measures is significantly negative. However, the correlation is low, which indicates that PE and PCM do not measure the same aspect of competition.

In the same period, the traditional concentration measure CR3 shows a pronounced tendency to consolidation throughout the whole period in most countries. Until around 2001, greater consolidation in banking industry has been compatible with greater competition, thereby rejecting the validity of structure-conduct-performance theory. Greater competition was most likely a result of improved cost efficiency (Fries and Taci, 2005; Yildirim and Philippatos, 2007a) brought by consolidation (decreasing CR3), foreign entry (Bonin et al, 2005), greater contestability (relationship of foreign loans and PCM), and above all better institutional framework, such as regulation, antitrust policies, and foreign investment policies (Bikker et al, 2007).

After 2001, competitive conditions deteriorated in most transitional countries, but also in the Euro area markets, as found by Bikker and Spierdijk (2008). They list a number

of reasons for this to happen: i) it is possible that banks were expecting more competition because of the introduction of euro and behaved more competitively, ii) the euro reduced the traditional direct bank lending in favor of corporate capital markets, iii) further consolidation in the industry, and iv) the shift to more complex and opaque banking products. Only banking expectations of greater competitive pressures and further consolidation seem plausible explanations for transitional countries. Assuming the latter holds, there seems to be a critical level of consolidation in banking industry where greater concentration starts to reduce competitive pressures.

Turning to the effects of banking concentration and competition on product market structure, I have analyzed the same ten transitional countries in the period 1997-2004. The first thing I point out is that there seems to be no important effect of banking concentration on product market structure in transitional countries which contrasts the findings of Cetorelli (2001, 2004) and Cetorelli and Strahan (2006) but confirms my results in Chapter 2.

Confirming my expectations, I find that banking competition indeed has a robust positive effect on firm size and a possible negative one on firm entry. This means that greater competition in banking industry actually discourages firm entry, but stimulates the growth of incumbent firms which is consistent to the arguments of Petersen and Rajan (1995). PCM has no effect or a possible positive one on firm size and a robust negative effect on firm number, which can be interpreted in line with Petersen and Rajan, but since it is not clear to what extent PCM measures concentration and to what extent competition, it is hard to base strong conclusions on this measure. Significant results for both competition measures when they are in the same model specification again confirm that PCM measures a different aspect of competition than PE does. There are two candidates for this aspect. One is the reallocation effect which is inherent in PCM, but not in PE and it is related to market shares and concentration, not really to competition. The other seems to be related to contestability conditions and foreign loans in the market. I leave to future research the task of identifying the right one.

Since the identified effects could be related to country size effects, I have estimated the benchmark model also for groups of small, medium and large countries. The results indicate that small countries could be characterized by the "positive" explanation where banking concentration has a greater influence on product market structure than banking competition, prevents entry of new firms and stimulates the growth of incumbents thereby increasing the concentration in product markets. Product markets in medium countries are affected by banking competition and PCM's, concentration has no important effect. More competitive banking markets are a greater financial barrier to entry, but they are favorable for the growth of incumbents thus leading to more concentrated

product markets. Finally, it seems that product market structure in large countries is not affected by banking concentration or competition, but more by the sheer size of the economy. These conclusions regarding the effect of country size are consistent with the theoretical model developed in Chapter 3.

The results of this study confirm that competition should not be measured by concentration proxies as this can lead to wrong conclusions. Also, the study has confirmed PE as a reliable measure of competition and revealed that more research is needed to identify better which aspect of competition is measured by PCM. Another contribution is the confirmation that it is in fact banking competition that affects product market structure and not banking concentration as it was reported in the literature. Moreover, the study confirmed that the relationship between banking and product market is different when we control for economy size: the "positive" explanation seems to fit small countries, the "negative" one to medium size countries, while there seems to be no such effects in large countries.

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4.8 Appendix

TABLE 4.8: Linear PE

	Bulgaria	Czech republic	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovenia	Slovakia
Equity-TA	-0.342**	-0.310***	0.117	0.316	-0.426	-0.349**	-0.383***	-0.549	-0.201	0.067
	(0.167)	(0.110)	(0.200)	(0.312)	(0.276)	(0.155)	(0.098)	(0.644)	(0.217)	(0.214)
Securities-TA	-0.123	0.062	0.146	0.118	0.056	0.054	0.115	0.183	0.050	0.184
	(0.087)	(0.082)	(0.118)	(0.174)	(0.099)	(0.193)	(0.073)	(0.123)	(0.093)	(0.112)
Loans-TA	-0.348*	0.225	0.193	-2.011**	0.087	-0.195	0.419**	0.688**	0.573**	-0.028
	(0.181)	(0.188)	(0.645)	(0.767)	(0.390)	(0.407)	(0.162)	(0.329)	(0.266)	(0.212)
Deposits-TA	-1.763***	0.318	-0.631	6.089***	0.310	-0.482	-0.872	1.965	0.710	0.478
	(0.400)	(0.604)	(1.456)	(1.960)	(1.001)	(1.291)	(0.651)	(2.666)	(0.479)	(1.144)
lnc91	(dropped)	4.451***	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
		(1.411)								
lnc92	(dropped)	(dropped)	(dropped)	-25.004***	(dropped)	(dropped)	2.567	(dropped)	(dropped)	(dropped)
				(9.122)			(3.512)			
lnc93	(dropped)	-7.843***	(dropped)	-2.826	(dropped)	(dropped)	-2.445***	(dropped)	-2.262***	(dropped)
		(2.276)		(4.483)			(0.690)		(0.676)	
lnc94	(dropped)	-5.402***	-2.351	-6.969***	-7.014**	(dropped)	-2.687***	(dropped)	-6.563***	(dropped)
		(1.044)	(2.033)	(2.089)	(3.029)		(0.636)		(1.731)	
lnc95	(dropped)	-7.271***	-5.062**	-7.244***	(dropped)	-4.416**	-2.607**	1.076	-7.868***	-2.930
		(1.625)	(2.028)	(1.617)		(1.758)	(1.094)	(5.103)	(1.244)	(5.248)
lnc96	(dropped)	-7.761***	-2.949*	-8.497***	(dropped)	-5.357	-2.184***	-6.412*	-9.064***	-1.422
		(1.969)	(1.533)	(2.789)		(7.622)	(0.770)	(3.417)	(1.263)	(2.055)
lnc97	(dropped)	-4.065**	-3.326***	-14.524***	-6.760***	-4.210	-3.630***	0.317	-5.736***	-2.520
		(1.833)	(1.024)	(4.630)	(1.425)	(2.593)	(0.638)	(1.994)	(1.099)	(1.669)
lnc98	-3.896***	-2.229**	7.188	-6.852***	-5.473***	6.428*	-3.881***	-4.050*	-5.274***	-1.126
	(0.629)	(0.947)	(4.636)	(1.537)	(1.279)	(3.401)	(0.844)	(2.253)	(0.740)	(0.949)
lnc99	-2.539***	-5.955**	-11.901**	-8.103***	-5.839***	-5.583***	-5.635***	-5.756**	-4.994***	-2.447
	(0.625)	(2.323)	(4.726)	(1.364)	(0.818)	(1.488)	(0.924)	(2.281)	(0.614)	(1.989)
lnc00	-3.326***	-2.237	-6.316***	-8.945***	-7.210***	-5.081***	-5.436***	-5.235***	-6.083***	-2.246
	(0.739)	(2.137)	(1.720)	(1.517)	(1.286)	(1.303)	(0.992)	(1.417)	(0.843)	(1.439)
lnc01	-4.084***	-7.561***	-6.615***	-6.786***	-7.731***	-4.616***	-6.810***	-6.737***	-5.444***	-4.352***
	(0.752)	(1.548)	(1.977)	(2.032)	(1.439)	(1.090)	(1.133)	(1.541)	(0.553)	(1.459)
lnc02	-3.225***	-4.171***	-5.541***	-5.613***	-7.042***	-3.220**	-5.255***	-15.181**	-4.859***	-5.165***
	(0.639)	(1.391)	(1.236)	(1.428)	(1.603)	(1.321)	(1.288)	(6.439)	(0.525)	(1.466)
lnc03	-2.438***	-3.515***	-7.732***	-5.404***	-6.795***	-3.000***	-5.607***	-5.000***	-4.688***	-4.076**
	(0.372)	(0.754)	(2.476)	(0.976)	(1.473)	(0.845)	(0.583)	(1.345)	(0.468)	(1.578)
lnc04	-3.055***	-5.171***	-5.317***	-5.268***	-4.870***	-2.685***	-4.824***	-3.496**	-4.112***	-5.612***
	(0.546)	(1.136)	(1.761)	(1.391)	(0.655)	(0.939)	(0.732)	(1.495)	(0.573)	(1.221)
lnc05	-1.310**	-3.452***	-2.755	-4.805***	-3.005	-3.543***	-4.679***	-5.029***	-3.487***	-3.621***
	(0.582)	(0.963)	(5.241)	(1.809)	(1.983)	(0.732)	(1.025)	(1.641)	(0.369)	(0.970)
cons	2.651***	0.299	0.431	-4.109**	0.704	0.911	1.197	-1.373	-1.751**	-1.009
	(0.534)	(0.725)	(1.680)	(1.863)	(1.432)	(1.684)	(0.729)	(3.051)	(0.691)	(1.325)
R-squared	0.754	0.648	0.823	0.770	0.848	0.918	0.624	0.429	0.887	0.580
F	24.786	37.257	122.836	14.360	190.888	70.923	20.425	172.035	41.491	10.099
N	146	160	51	159	66	163	298	127	136	107

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE 4.9: Non-linear model for estimating PE

	Bulgaria	Czech republic	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovenia	Slovakia
ETA	-0.530***	-0.304***	0.137	0.209	-0.225	-0.100	-0.314***	-0.923	-0.209	-0.272**
	(0.142)	(0.109)	(1.405)	(0.279)	(0.211)	(0.136)	(0.088)	(0.640)	(0.266)	(0.117)
STA	-0.050	0.132**	0.047	-0.009	0.028	-0.257	0.091	0.104	-0.124	0.112
	(0.071)	(0.065)	(0.230)	(0.134)	(0.066)	(0.255)	(0.066)	(0.084)	(0.082)	(0.092)
LTA	-0.255*	0.393**	0.024	-1.371*	-0.394	-0.505	0.421***	0.319	-0.263	-0.070
	(0.148)	(0.180)	(0.861)	(0.734)	(0.387)	(0.503)	(0.146)	(0.304)	(0.277)	(0.129)
DTA	-1.696***	0.906*	-2.597	2.814*	1.334	-0.461	-0.905	0.650	0.906*	-0.458
	(0.311)	(0.524)	(2.281)	(1.526)	(0.786)	(1.211)	(0.647)	(2.533)	(0.482)	(0.702)
lnc91	(dropped)	3.132***	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
		(1.060)								
lnc92	(dropped)	(dropped)	(dropped)	-11.971**	(dropped)	(dropped)	1.374	(dropped)	(dropped)	(dropped)
				(4.958)			(1.674)			
lnc93	(dropped)	-12.086***	(dropped)	-4.968**	(dropped)	(dropped)	-1.732	(dropped)	-15.320	(dropped)
		(2.872)		(2.209)			(1.224)		(14.945)	
lnc94	(dropped)	-9.889***	13.176	-8.459	-7.085***	(dropped)	-4.712***	(dropped)	-17.245***	(dropped)
		(2.513)	(12.700)	(5.999)	(2.412)		(1.551)		(4.592)	
lnc95	(dropped)	-11.213***	17.052	-1.447	(dropped)	130.958**	-4.375**	3.096	-11.972***	-6.592***
		(2.580)	(17.705)	(2.372)		(64.653)	(1.685)	(4.759)	(1.590)	(1.572)
lnc96	(dropped)	-12.065***	-35.456	1.558	(dropped)	-64.001***	-3.572**	-5.156	-7.285***	-9.826***
		(2.914)	(35.708)	(4.189)		(22.782)	(1.511)	(3.119)	(0.594)	(2.161)
lnc97	(dropped)	-6.331**	-50.332	-8.773	-6.604***	-36.239***	-5.239***	6.209	-5.644***	-8.532***
		(3.000)	(43.670)	(6.023)	(1.198)	(12.693)	(0.942)	(7.775)	(0.916)	(2.602)
lnc98	-8.319***	-2.909**	7.406**	-10.263***	-8.175***	31.120**	-5.152***	-7.181***	-5.299***	-5.893***
	(1.990)	(1.386)	(1.557)	(2.199)	(1.379)	(14.168)	(1.025)	(1.730)	(0.670)	(1.385)
lnc99	-4.199***	-13.887***	-13.823**	-16.226***	-7.243***	-5.264**	-7.933***	-4.920*	-5.099***	-7.854***
	(1.476)	(3.042)	(2.035)	(4.005)	(1.773)	(2.043)	(1.039)	(2.776)	(0.513)	(1.733)

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	Bulgaria	Czech republic	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovenia	Slovakia
lnc00	-4.309***	-7.743*	-6.236	-11.811***	-8.030***	-4.260***	-8.639***	-6.335**	-5.511***	-4.394***
	(0.996)	(4.106)	(2.283)	(1.879)	(1.638)	(1.439)	(1.763)	(2.881)	(0.560)	(1.409)
lnc01	-5.385***	-10.015***	-29.431	-9.977***	-10.184***	-5.433***	-10.270***	-9.467***	-3.886***	-6.427***
	(0.758)	(1.571)	(14.893)	(1.566)	(1.402)	(1.696)	(0.934)	(2.156)	(0.788)	(1.706)
lnc02	-5.630***	-5.371***	-10.175	-9.407***	-9.410***	-3.336*	-9.662***	-27.925**	-6.648***	-7.839***
	(0.881)	(1.387)	(3.845)	(1.557)	(0.721)	(1.934)	(2.091)	(10.966)	(0.742)	(1.232)
lnc03	-3.488***	-7.569***	-3.210	-7.559***	-7.781***	-3.897***	-7.824***	-9.248**	-5.363***	-7.117***
	(0.606)	(1.235)	(3.440)	(1.144)	(0.765)	(1.071)	(1.353)	(3.733)	(0.696)	(2.400)
lnc04	-4.977***	-8.973***	-6.747	-7.495***	-6.811***	-2.883**	-6.558***	-3.808	-4.896***	-12.739***
	(0.673)	(2.171)	(25.319)	(1.920)	(1.051)	(1.245)	(1.846)	(4.104)	(0.874)	(1.685)
lnc05	-3.654***	-4.332***	2.705	-6.495***	-3.766***	-4.778***	-4.034***	-0.831	-4.626***	-8.783***
	(0.531)	(0.972)	(18.227)	(2.254)	(1.159)	(0.685)	(1.255)	(3.985)	(0.769)	(1.276)
$lnc91^2$	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
$lnc92^2$	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	-68.534***	(dropped)	(dropped)	(dropped)
							(25.598)			
$lnc93^2$	(dropped)	-24.656***	(dropped)	-46.007***	(dropped)	(dropped)	5.504	(dropped)	-30.440	(dropped)
		(8.206)		(13.690)			(8.320)		(35.586)	
$lnc94^2$	(dropped)	-17.173**	232.078	-51.787**	(dropped)	(dropped)	-4.295	(dropped)	-29.102	(dropped)
		(6.946)	(248.595)	(20.738)			(3.226)		(18.116)	
$lnc95^2$	(dropped)	-36.340**	1507.612	-33.545***	(dropped)	440.908**	-8.965	(dropped)	-34.458***	(dropped)
		(14.495)	(1581.894)	(8.266)		(204.100)	(6.520)		(9.124)	
$lnc96^2$	(dropped)	-36.095	12.085	-99.048***	(dropped)	-1068.079***	-2.376	(dropped)	-23.493***	-27.096***
		(22.231)	(20.109)	(22.876)		(383.153)	(4.333)		(3.533)	(5.755)
$lnc97^2$	(dropped)	-15.586	-77.613	-192.503***	(dropped)	-40.644***	-3.596	17.283	2.223	-19.629**
		(13.110)	(61.780)	(42.557)		(13.432)	(2.586)	(16.872)	(8.478)	(8.247)
$lnc98^2$	-5.112**	-2.498	-45.655**	-29.380***	-21.095**	-20.680**	-0.718	-25.256***	-9.539***	-8.114***
	(2.202)	(3.572)	(9.048)	(9.408)	(9.381)	(10.007)	(3.187)	(6.910)	(2.895)	(1.946)

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	Bulgaria	Czech republic	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovenia	Slovakia
lnc99^2	-2.444	-30.773***	23.047	-23.792***	-9.930***	-1.341	-7.845**	13.628	-8.457***	-28.692***
	(2.085)	(10.262)	(41.535)	(7.328)	(3.487)	(9.443)	(3.210)	(20.837)	(2.848)	(9.271)
lnc00^2	-3.580	-31.523**	11.624	-32.546***	-23.183***	-5.131	-11.627	-10.224	-10.359***	-11.687
	(3.162)	(14.799)	(18.458)	(9.373)	(6.814)	(5.150)	(7.042)	(14.756)	(2.822)	(11.034)
lnc01^2	-9.815***	-41.806**	-88.064	-26.415***	-29.147***	-8.935*	-15.250***	-17.995**	-3.890*	-7.994
	(3.349)	(17.657)	(58.085)	(6.301)	(7.682)	(4.881)	(4.072)	(7.403)	(2.206)	(15.512)
lnc02^2	-6.378***	-17.953	18.024	-14.976***	-27.601***	-4.469	-8.038***	-95.352**	-7.815***	-24.303*
	(1.946)	(14.099)	(22.473)	(3.406)	(5.130)	(6.007)	(2.368)	(43.680)	(1.642)	(13.311)
lnc03^2	-1.677	-11.720***	-18.420	-8.680***	-29.573***	-6.460	-4.911**	-10.265	-5.735***	-18.143
	(1.295)	(3.999)	(13.780)	(2.208)	(6.770)	(5.270)	(2.284)	(7.374)	(1.552)	(24.985)
lnc04^2	-6.311***	-12.888**	-10.229	-11.357**	-15.878***	-2.127	-4.252	0.389	-4.776**	-37.701***
	(1.786)	(5.190)	(116.949)	(4.483)	(4.670)	(4.432)	(3.029)	(6.744)	(2.067)	(7.972)
lnc05^2	-2.385***	-4.901*	106.441	-9.674*	-6.708	-5.076**	7.681**	7.935	-3.288**	-13.327***
	(0.412)	(2.766)	(220.983)	(5.052)	(13.407)	(2.426)	(3.546)	(7.495)	(1.265)	(2.792)
cons	2.680***	-0.389	4.052	-0.881	0.171	1.249	1.135	0.889	-0.858	0.368
	(0.418)	(0.665)	(3.017)	(1.301)	(1.133)	(1.619)	(0.705)	(2.867)	(0.763)	(0.833)
R-squared	0.847	0.775	0.994	0.892	0.952	0.945	0.704	0.680	0.937	0.877
F	36.941	52.819	13689.533	86.478	1248.094	4.76e+06	142.889	948.867	616.136	45.062
N	146	160	51	159	66	163	298	127	136	107

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4.10: PCM

Country Year	BG	CZ	EE	HU	LT	LV	PL	RO	SI	SK
1991		0.09								
1992		0.28	0.40	0.34			0.29	0.61		
1993		0.31	0.32	0.32	0.41	0.27	0.27	0.51	0.52	0.28
1994		0.27	0.18	0.33	0.32	0.05	0.22	0.14	0.18	0.20
1995	0.01	0.14	0.24	0.20	0.24	0.14	0.23	0.30	0.20	0.19
1996	0.30	0.17	0.34	0.27	0.40	0.13	0.23	0.18	0.24	0.20
1997		0.19	0.33	0.21	0.15	0.17	0.24	0.15	0.22	0.21
1998	0.40	0.19		0.14	0.17		0.19	0.22	0.25	0.15
1999	0.44	0.16	0.12	0.16	0.20	0.24	0.20	0.27	0.24	0.21
2000	0.31	0.19	0.23	0.19	0.17	0.26	0.16	0.21	0.24	0.18
2001	0.30	0.15	0.30	0.22	0.19	0.24	0.13	0.26	0.25	0.15
2002	0.34	0.23	0.25	0.21	0.23	0.28	0.18	0.20	0.23	0.17
2003	0.34	0.30	0.31	0.23	0.26	0.31	0.17	0.24	0.23	0.20
2004	0.35	0.24	0.34	0.23	0.27	0.34	0.24	0.28	0.25	0.22
2005	0.36	0.24	0.26	0.30	0.27	0.37	0.27	0.33	0.33	0.27

Table 4.11: Estimation results for models with control variables

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.310***	17.323***	17.258***	17.250***	7.903***	7.930***	7.920***	8.022***
	(0.944)	(0.944)	(0.946)	(0.947)	(0.527)	(0.526)	(0.521)	(0.523)
CR3*EDI	0.009	0.012	0.019	0.023	0.099	0.096	0.041	0.082
	(0.197)	(0.197)	(0.198)	(0.203)	(0.153)	(0.153)	(0.153)	(0.155)
PE*EDI	0.034**	0.028	0.041**	0.038**	0.001	0.005	-0.020	-0.007
	(0.016)	(0.017)	(0.016)	(0.016)	(0.013)	(0.014)	(0.013)	(0.013)
PCM*EDI	0.846	0.751	1.083**	1.003*	-1.686***	-1.703***	-2.193***	-2.023***
	(0.569)	(0.572)	(0.505)	(0.546)	(0.438)	(0.437)	(0.422)	(0.449)
domcre*EDI	-0.002				0.004***			
	(0.002)				(0.002)			
privcre*EDI		-0.004				0.005**		
		(0.003)				(0.002)		
marcap*EDI			-0.002				0.010***	
			(0.003)				(0.002)	
floanss*EDI				-0.471				0.598
				(1.427)				(1.072)
R-squared	0.574	0.574	0.574	0.574	0.869	0.869	0.869	0.868
F	41.216	41.094	41.178	41.119	179.908	179.534	183.734	181.127
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

Table 4.12: Estimation results for models with control variables

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.291***	17.304***	17.176***	17.206***	7.951***	7.981***	8.089***	8.115***
	(0.934)	(0.934)	(0.930)	(0.935)	(0.538)	(0.536)	(0.536)	(0.534)
PE*EDI	0.025*	0.019	0.032**	0.029**	0.022*	0.029**	0.001	0.013
	(0.014)	(0.015)	(0.015)	(0.014)	(0.011)	(0.012)	(0.011)	(0.011)
domcre*EDI	-0.004*				0.007***			
	(0.002)				(0.002)			
privcre*EDI		-0.005**				0.008***		
		(0.002)				(0.002)		
marcap*EDI			-0.001				0.009***	
			(0.003)				(0.002)	
floanss*EDI				-1.249				2.279**
				(1.297)				(0.999)
R-squared	0.574	0.574	0.573	0.573	0.868	0.868	0.867	0.867
F	42.011	41.851	41.740	41.674	181.559	181.397	187.194	184.256
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

Table 4.13: Estimation results for models with control variables

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.321***	17.341***	17.193***	17.227***	7.914***	7.944***	7.953***	8.030***
	(0.941)	(0.942)	(0.939)	(0.943)	(0.527)	(0.526)	(0.521)	(0.523)
PCM*EDI	0.397	0.363	0.664	0.550	-1.701***	-1.776***	-1.985***	-1.916***
	(0.521)	(0.510)	(0.479)	(0.506)	(0.398)	(0.392)	(0.389)	(0.409)
domcre*EDI	-0.004*				0.004***			
	(0.002)				(0.002)			
privcre*EDI		-0.006**				0.004**		
		(0.002)				(0.002)		
marcap*EDI			0.001				0.009***	
			(0.003)				(0.002)	
floanss*EDI				-1.001				0.778
				(1.366)				(1.050)
R-squared	0.573	0.574	0.573	0.573	0.869	0.869	0.869	0.868
F	42.288	42.137	42.227	42.123	181.566	181.276	184.953	183.419
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

Table 4.14: Estimation results by country size – linear

	Firm size			Number of firms		
	(Small)	(Medium)	(Large)	(Small)	(Medium)	(Large)
Share of VA	13.536***	19.374***	15.086***	5.980***	9.482***	8.581***
	(1.513)	(1.363)	(2.166)	(0.644)	(0.910)	(1.680)
CR3*EDI	0.490	-0.021	-0.103	0.024	0.105	0.380
	(0.470)	(0.344)	(0.356)	(0.233)	(0.253)	(0.329)
PE*EDI	0.009	0.040**	0.029	-0.009	-0.011	0.035
	(0.055)	(0.017)	(0.041)	(0.029)	(0.013)	(0.039)
PCM*EDI	-0.083	1.610*	0.389	-2.426***	-1.990***	2.031*
	(1.090)	(0.854)	(1.236)	(0.606)	(0.608)	(1.177)
R-squared	0.503	0.644	0.338	0.755	0.812	0.446
F	26.989	55.774	10.575	36.169	109.625	16.952
N	464	975	479	464	975	479

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

TABLE 4.15: Correlations

	CR3	PE	PCM	Foreign loans
CR3	1.000			
PE	0.180***	1.000		
	0.000			
PCM	0.027	-0.316***	1.000	
	0.192	0.000		
Foreign loans	0.047**	-0.050**	-0.259***	1.000
	0.026	0.017	0.000	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE 4.16: Estimation results for non-linear benchmark models

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.144***	17.189***	17.201***	17.258***	8.187***	8.170***	8.050***	7.977***
	(0.929)	(0.919)	(0.940)	(0.930)	(0.537)	(0.541)	(0.522)	(0.526)
CR3*EDI	0.193			0.010	0.028			0.232
	(0.191)			(0.202)	(0.140)			(0.147)
PENL*EDI		0.008**		0.009**		-0.004*		-0.009***
		(0.003)		(0.004)		(0.002)		(0.003)
PCM*EDI			0.663	0.924*			-2.003***	-2.291***
			(0.479)	(0.488)			(0.390)	(0.402)
R-squared	0.573	0.573	0.573	0.574	0.866	0.867	0.868	0.869
F	42.187	42.364	42.772	41.718	188.859	184.837	184.381	179.615
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

TABLE 4.17: Estimation results for models with control variables

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.328***	17.354***	17.247***	17.279***	7.882***	7.904***	7.904***	7.967***
	(0.933)	(0.935)	(0.930)	(0.933)	(0.530)	(0.529)	(0.525)	(0.528)
CR3*EDI	0.009	-0.008	-0.007	0.029	0.234	0.246*	0.120	0.222
	(0.202)	(0.201)	(0.208)	(0.206)	(0.147)	(0.148)	(0.153)	(0.149)
PENL*EDI	0.008**	0.007*	0.009**	0.009**	-0.007***	-0.008***	-0.008***	-0.009***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
PCM*EDI	0.712	0.641	0.933*	0.813	-2.005***	-2.075***	-2.225***	-2.235***
	(0.547)	(0.531)	(0.490)	(0.520)	(0.416)	(0.407)	(0.401)	(0.424)
domcre*EDI	-0.002				0.003**			
	(0.002)				(0.002)			
privcre*EDI		-0.004*				0.003*		
		(0.003)				(0.002)		
marcap*EDI			0.001				0.008***	
			(0.003)				(0.002)	
floanss*EDI				-0.905				0.460
				(1.395)				(1.062)
R-squared	0.574	0.574	0.574	0.574	0.869	0.869	0.870	0.869
F	41.287	41.183	41.223	41.094	177.742	177.557	180.071	178.364
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

TABLE 4.18: Estimation results for models with control variables

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.308***	17.327***	17.178***	17.240***	7.966***	8.015***	8.073***	8.093***
	(0.927)	(0.929)	(0.919)	(0.926)	(0.542)	(0.541)	(0.539)	(0.539)
PENL*EDI	0.006*	0.006*	0.008**	0.008**	-0.002	-0.002	-0.004	-0.005*
	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
domcre*EDI	-0.003				0.006***			
	(0.002)				(0.002)			
privcre*EDI		-0.005**				0.006***		
		(0.002)				(0.002)		
marcap*EDI			0.001				0.009***	
			(0.003)				(0.002)	
floanss*EDI				-1.482				2.246**
				(1.296)				(1.008)
R-squared	0.574	0.574	0.573	0.574	0.868	0.867	0.868	0.867
F	42.155	41.995	41.818	41.790	181.230	181.362	185.360	182.212
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

TABLE 4.19: Estimation results for models with control variables

	Firm size				Number of firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	17.321***	17.341***	17.193***	17.227***	7.914***	7.944***	7.953***	8.030***
	(0.941)	(0.942)	(0.939)	(0.943)	(0.527)	(0.526)	(0.521)	(0.523)
PCM*EDI	0.397	0.363	0.664	0.550	-1.701***	-1.776***	-1.985***	-1.916***
	(0.521)	(0.510)	(0.479)	(0.506)	(0.398)	(0.392)	(0.389)	(0.409)
domcre*EDI	-0.004*				0.004***			
	(0.002)				(0.002)			
privcre*EDI		-0.006**				0.004**		
		(0.002)				(0.002)		
marcap*EDI			0.001				0.009***	
			(0.003)				(0.002)	
floanss*EDI				-1.001				0.778
				(1.366)				(1.050)
R-squared	0.573	0.574	0.573	0.573	0.869	0.869	0.869	0.868
F	42.288	42.137	42.227	42.123	181.566	181.276	184.953	183.419
N	1982	1982	1982	1982	1982	1982	1982	1982

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

TABLE 4.20: Estimation results by country size – non-linear

	Firm size			Number of firms		
	(Small)	(Medium)	(Large)	(Small)	(Medium)	(Large)
Share of VA	13.575***	19.406***	15.119***	5.882***	9.401***	8.577***
	(1.480)	(1.363)	(2.179)	(0.655)	(0.914)	(1.679)
CR3*EDI	0.518	-0.089	-0.145	0.048	0.361	0.153
	(0.333)	(0.356)	(0.347)	(0.178)	(0.257)	(0.332)
PENL*EDI	0.002	0.011***	-0.009	-0.005	-0.010***	0.030
	(0.008)	(0.004)	(0.027)	(0.005)	(0.003)	(0.026)
PCM*EDI	-0.173	1.651*	-0.406	-2.414***	-2.152***	2.653*
	(0.860)	(0.849)	(1.485)	(0.539)	(0.599)	(1.432)
R-squared	0.503	0.644	0.338	0.756	0.814	0.446
F	27.121	56.287	10.506	35.347	112.043	17.114
N	464	975	479	464	975	479

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.

TABLE 4.21: Outliers - average firm size

	Linear PE				Non-linear PE			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	13.895***	17.156***	17.302***	17.076***	13.925***	18.311***	17.312***	17.092***
	(0.860)	(0.980)	(1.018)	(0.958)	(0.845)	(0.939)	(1.000)	(0.943)
CR3*EDI	0.034	0.012	0.113	0.072	0.059	-0.164	0.131	0.071
	(0.191)	(0.201)	(0.213)	(0.220)	(0.194)	(0.212)	(0.219)	(0.228)
PE*EDI	0.038**	0.053**	0.045***	0.036**				
	(0.015)	(0.025)	(0.016)	(0.016)				
PCM*EDI	1.331***	1.342**	1.714**	0.792	1.159**	1.859***	1.654**	0.664
	(0.515)	(0.546)	(0.704)	(0.531)	(0.496)	(0.620)	(0.705)	(0.513)
PENL*EDI					0.008**	0.042***	0.010**	0.008**
					(0.003)	(0.013)	(0.004)	(0.004)
R-squared	0.544	0.564	0.551	0.581	0.543	0.582	0.551	0.581
F	33.864	41.200	36.571	44.569	33.846	43.164	36.643	44.547
N	1799	1871	1783	1857	1799	1832	1783	1857

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.
(1), (5) - outliers in average firm size (top and bottom 5%)
(2), (6) - outliers in PE or PENL (top and bottom 5%)
(3), (7) - outliers in PCM (top and bottom 5%)
(4), (8) - outliers in CR3 (top and bottom 5%)

TABLE 4.22: Outliers - number of firms

	Linear PE				Non-linear PE			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of VA	8.210***	7.960***	7.886***	8.211***	8.156***	8.151***	7.839***	8.156***
	(0.490)	(0.534)	(0.541)	(0.535)	(0.494)	(0.564)	(0.546)	(0.539)
CR3*EDI	-0.047	0.068	0.038	0.027	0.073	0.351**	0.138	0.188
	(0.154)	(0.161)	(0.159)	(0.170)	(0.147)	(0.161)	(0.155)	(0.166)
PE*EDI	-0.005	0.019	-0.016	-0.007				
	(0.012)	(0.020)	(0.013)	(0.013)				
PCM*EDI	-1.981***	-2.087***	-2.246***	-1.877***	-2.134***	-2.599***	-2.456***	-2.097***
	(0.413)	(0.462)	(0.551)	(0.443)	(0.399)	(0.498)	(0.548)	(0.421)
PENL*EDI					-0.007***	-0.026***	-0.009***	-0.009***
					(0.003)	(0.009)	(0.003)	(0.003)
R-squared	0.856	0.869	0.871	0.864	0.856	0.872	0.871	0.864
F	150.660	190.066	196.378	168.106	148.253	184.874	193.421	165.534
N	1794	1871	1783	1857	1794	1832	1783	1857

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
The magnitude of coefficient on PCM should be divided by 10 to be comparable to the coefficient on PE.
(1), (5) - outliers in the number of firms (top and bottom 5%)
(2), (6) - outliers in PE or PENL (top and bottom 5%)
(3), (7) - outliers in PCM (top and bottom 5%)
(4), (8) - outliers in CR3 (top and bottom 5%)

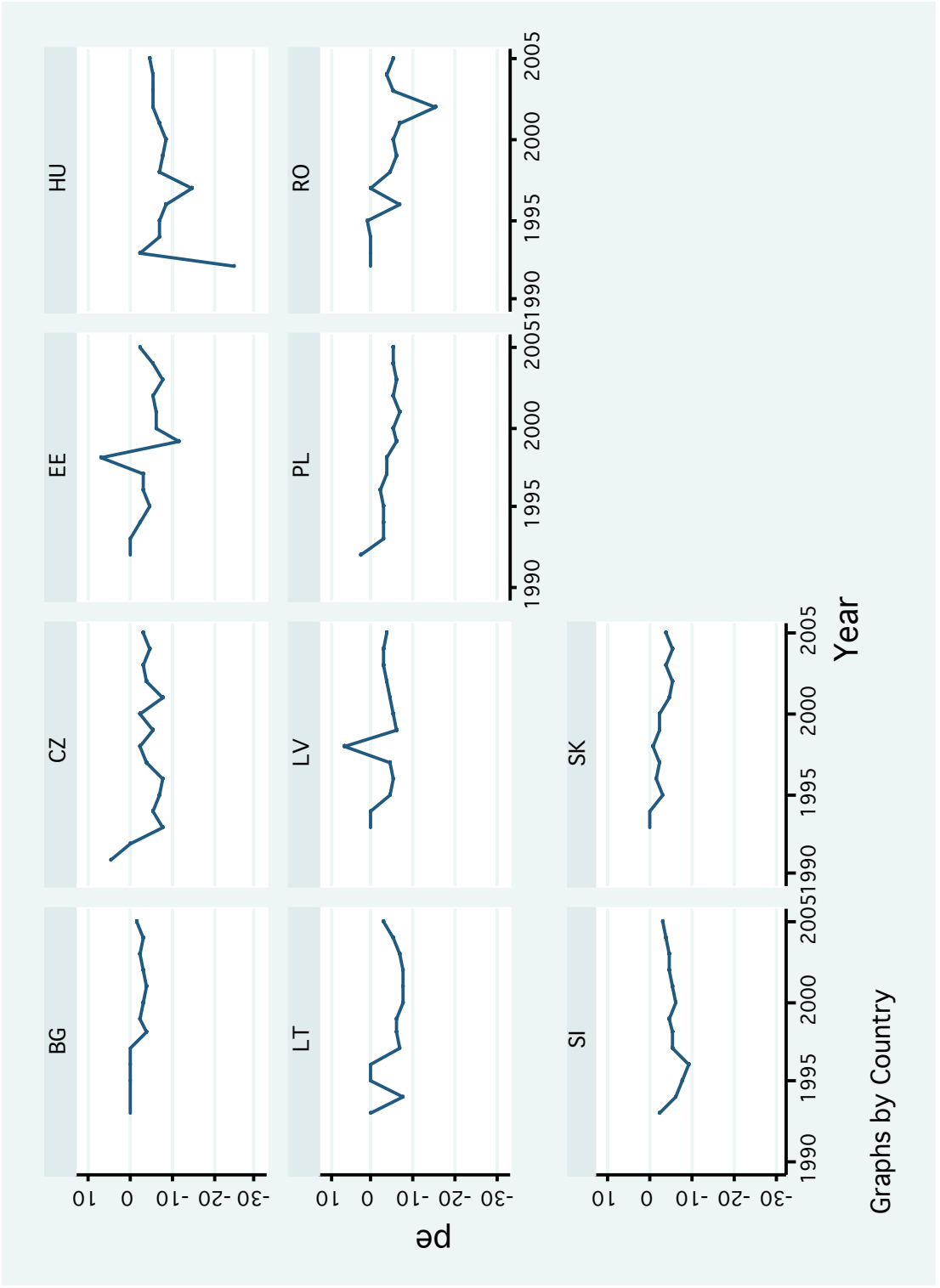

FIGURE 4.1: The development of PE in the period 1991-2005 by country – linear model

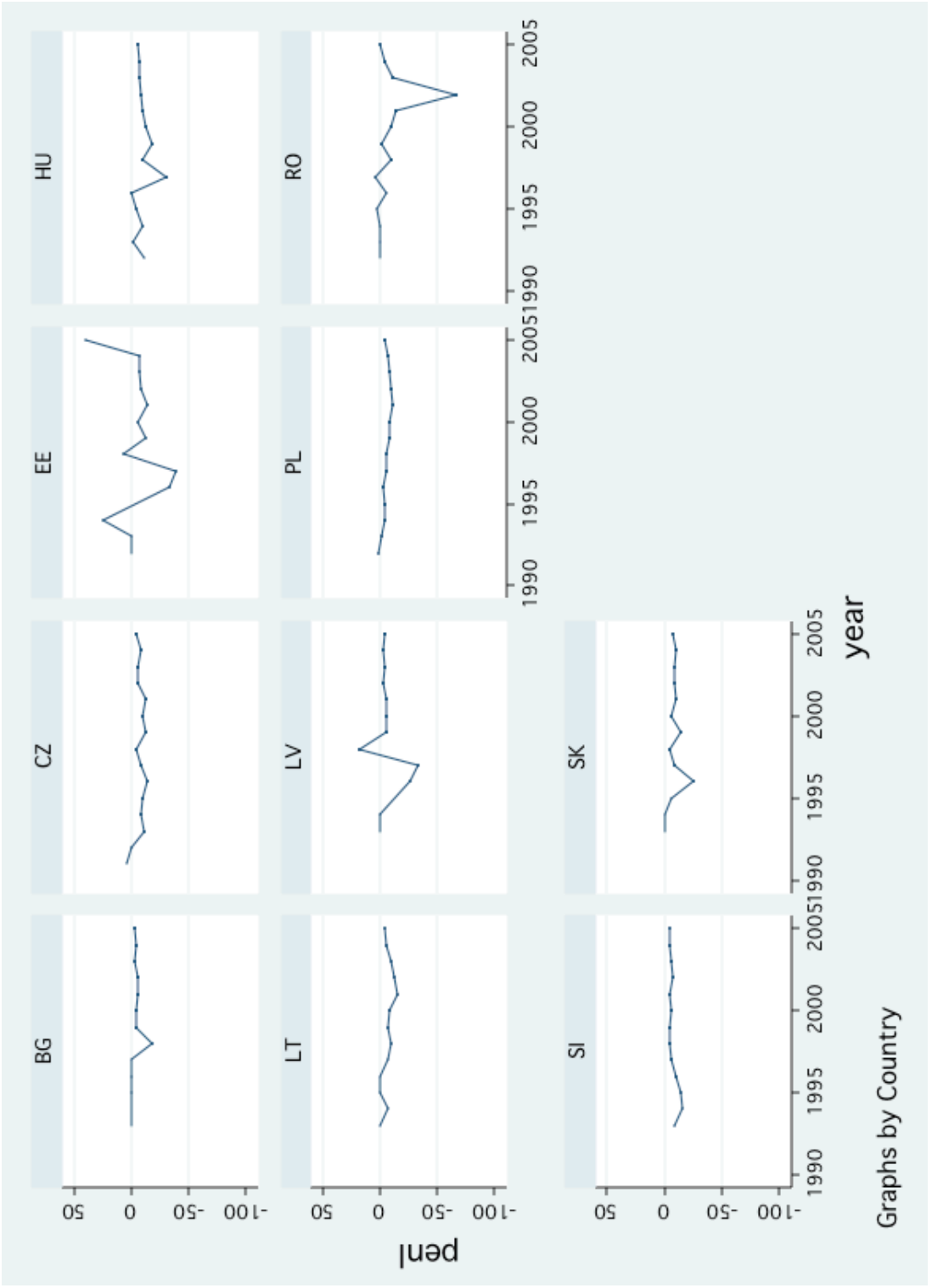

FIGURE 4.2: The development of PE in the period 1991-2005 by country – non-linear model

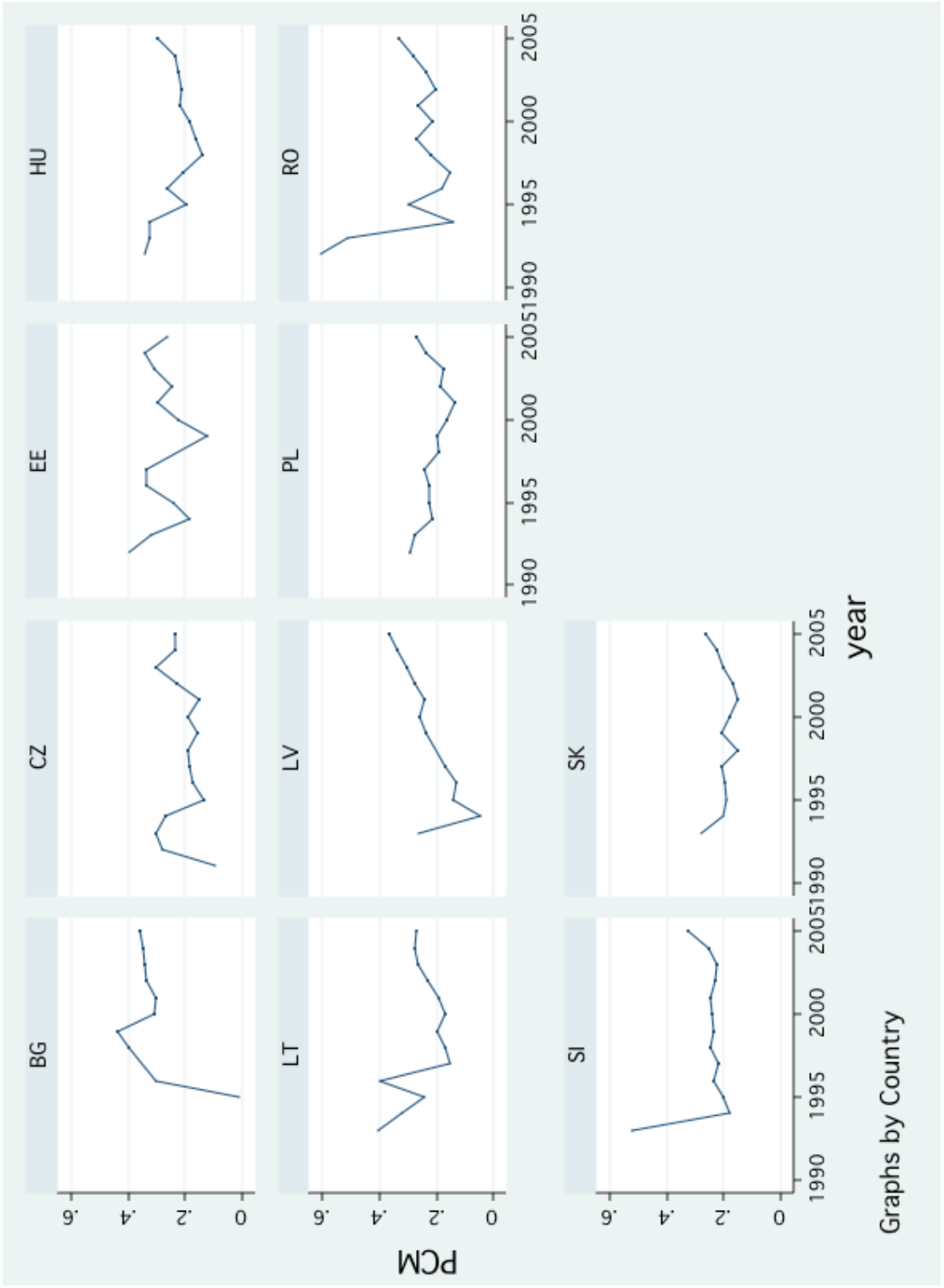

FIGURE 4.3: The development of PCM in the period 1991-2005 by country

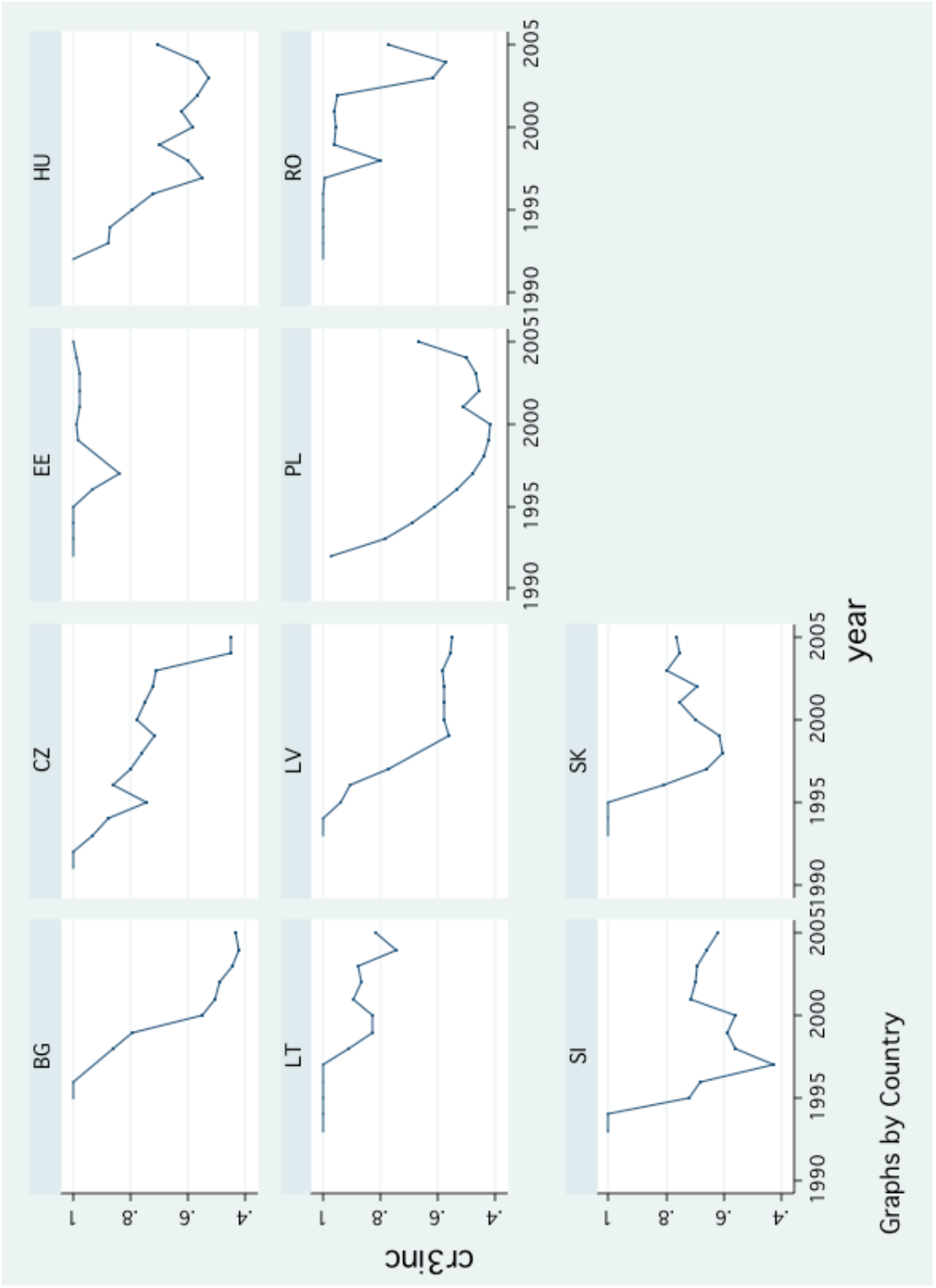

FIGURE 4.4: The development of CR3 in the period 1991-2005 by country

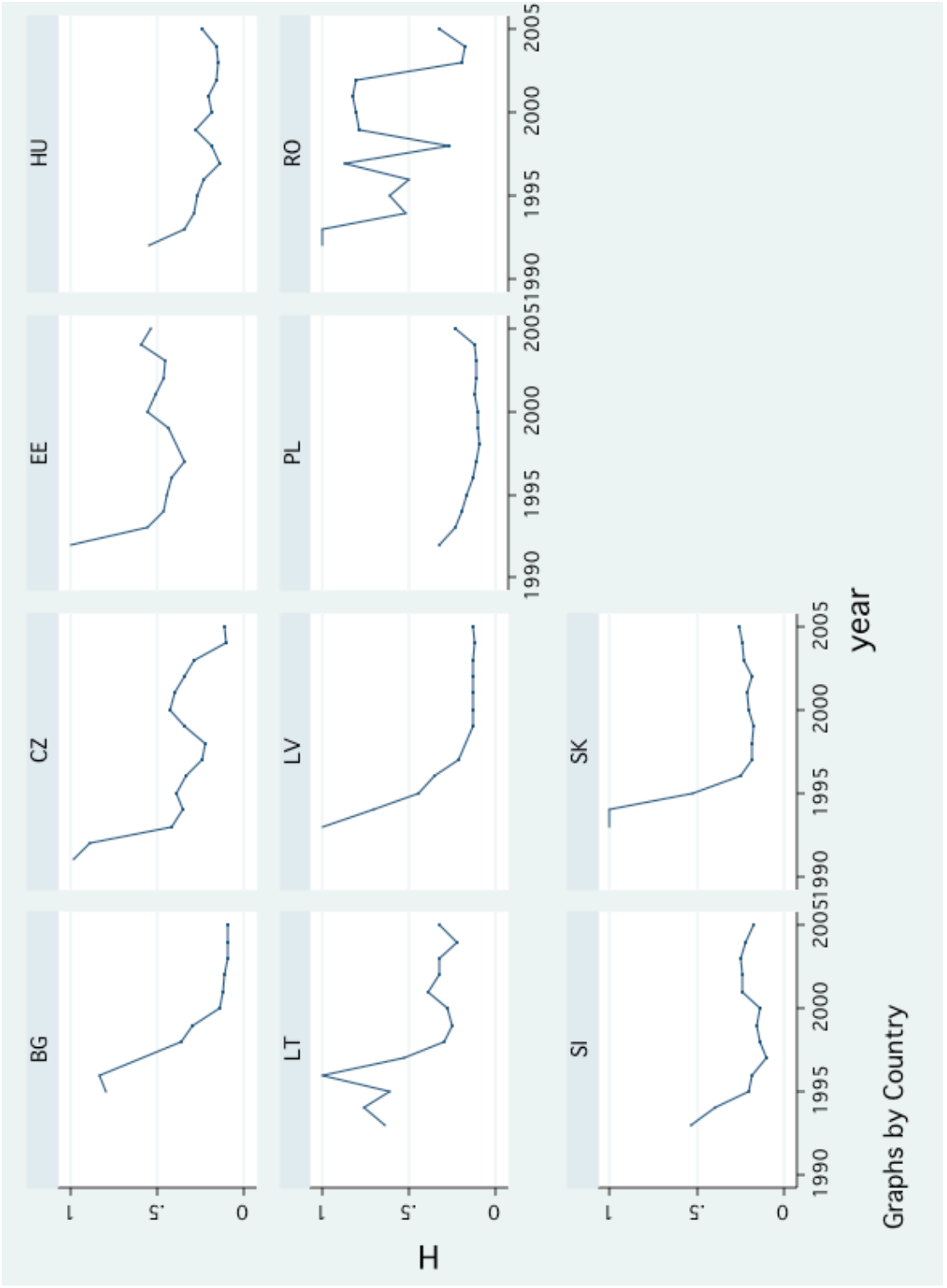

FIGURE 4.5: The development of HHI in the period 1991-2005 by country