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Mojca Marc

The relationship between market concentrations in banking and product markets

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INTRODUCTION

The repercussions of banking markets' for the real economy (i.e. non-financial industries) has been painfully clear in the aftermath of the 2008-2009 financial and banking crises. The circumstances in the banking markets not only affect the birth, life, and death of individual firms, but the growth and development of industries and economies as well (see, for example, King & Levine, 1993a; Demirgüç-Kunt & Maksimovic, 1998; Rajan & Zingales, 1998; Levine, Loayza & Beck, 2000). An extensive strand of academic literature that considers the question of the relationship between banking and real markets is concerned with the role of financial markets in explaining economic growth. There are two opposing views here. The prevailing argument is that the services provided by the financial sector (reallocation of capital to the greatest value use without substantial risk of loss through moral hazard, adverse selection, or transactions costs) have a positive impact on economic growth. In support of this explanation, empirical studies from Demirgüç-Kunt and Maksimovic (1998), Rajan and Zingales (1998), Levine, Loayza and Beck (2000) indeed find that more developed financial markets promote economic growth (also see the survey by Levine, 1997). Conversely, higher returns from better resource allocation may depress saving rates enough to cause overall growth rates to actually slow down along with enhanced financial development (King & Levine, 1993b). In this view, financial development is primarily a consequence and not a cause of economic growth.

A branch of this literature explores how the characteristics of banking markets (particularly market structure), apart from the general development of financial markets, affect economic growth and firm entry. Pagano (1993), for example, analytically shows that banking market power has a negative effect on economic growth. In contrast, Hellman and DaRin (2002) present theoretical and empirical evidence showing that, to act as catalysts for industrialisation and to promote new industries, banks must be large and hold sufficient market power. Petersen and Rajan (1995) also empirically confirm their theoretical model where banks with market power are more willing to finance young firms and hence increase firm entry. For a review of this literature see e.g. Berger, Demirüç-Kunt, Levine and Haubrich (2004).

Banks and firms chiefly come into contact with each other through the financing of business operations. After Brander and Lewis (1986) showed the limited liability effect, whereby using debt as financial source deters entry by promoting tougher behaviour in product markets, many contributions have studied this relationship and the literature has been extended in various directions. Papers by Maksimovic (1998) and Spagnolo (2000) analyse the effects of firms' capital structure on incentives for collusive behaviour. Poitevin (1989) and Bolton and Scharfstein (1990) focus on financial incentives for incumbents' predatory practices. Aghion, Dewatripont and Rey (1999) show how a firm's need for external finance interacts with their product market behaviour. Bhattacharya and Chiesa (1995) explore lenders' potential 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) confirmed there are indeed financial reasons (especially increased debt) that can influence real markets' behaviour.

On the real markets side, empirical evidence can also be found for the large contribution of market structure characteristics – such as 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 & Ericson, 1998; Bartelsman & Doms, 2000; Davis & Haltiwanger, 1999; Bartelsman, Haltiwanger & Scarpetta, 2004; Aghion & Howitt, 2005). Further, since product market structure also affects innovation (see, for instance, Aghion et al., 2005; Geroski, 1990), banking markets can also be viewed as instruments for promoting or abating innovation via their effects on market structures in the real economy.

However, there is not much specific literature on the relationship between the two market structures. This monograph focuses on the impacts of banking concentration – as an important market characteristic both influencing and reflecting the behaviour and performance of banks – on firms in product markets. For the purpose of this book, I thus define market structure in terms of market concentration (i.e. the number of firms or banks in the market and the market share of the biggest). Empirical studies by Cetorelli and co-authors (Cetorelli, 2001, 2004; Cetorelli & Strahan, 2006) were the first to reveal a very robust positive relationship between the two market structures, implying that more concentrated banking markets 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. Coricelli and Marc (2010) replicated Cetorrelli's studies for the 25 EU member countries in the period 1995-2004, when the consequences of the Second Banking Coordination Directive of 1993 had fully developed and banks from the European Union had branched freely into other EU countries. The processes of liberalisation and disintermediation have affected market structures and competitive conditions in banking markets across Europe, including transitional countries, which have experienced periods of rapid entry and subsequent consolidation following the breakdown of the command and social economic systems in the early 1990s. Contrary to Cetorelli (2004), this study is unable to confirm a positive relationship between banking and product market structure but, quite the opposite, it finds evidence of a negative relationship in non-transitional EU countries. This suggests the positive relationship identified by Cetorelli has turned negative since 1995 in more developed EU countries, implying that in these countries more concentrated banking markets lead to more fragmented industries. The study by Coricelli and Marc (2010) also shows that this relationship is indeed different in transitional countries, but it is unclear whether banking concentration affects product market structure at all since the estimates are mostly statistically non-significant and not very robust.

The lack of in-depth theoretical analysis of the relationship between banking and product market structures in existing empirical studies motivated the main topic of this monograph. Specifically, I argue the existing theoretical models linking banking and product market structures do not adequately consider the determinants of the product market structure that are crucial for understanding, explaining and modelling the relationship between both markets and consequently market structures. The core objective of this book is thus to develop a theoretical model of the relationship between banking and product market structures that is able to explain why the two market structures are linked and what their relationship is. I attempt to answer four specific research questions in this book:

- Which product market structure determinants are affected by conditions in the banking market? (RQ1)
- What is the mechanism that links the market structures of banking and product markets? (RQ2)
- How does greater banking market concentration affect the product market structure? (RQ3)
- What is the empirical evidence for the proposed model? (RQ4)

In what follows, in Chapter 1 I first present a review of related literature and explain the existing arguments pointing to links between banking and product market structure. In the industrial organisation literature, market structure – typically measured by market share – is traditionally explained as either the cause of firm conduct and performance (the SCP theory) or as a result of firm efficiency (efficient structure theory). A synthesis of both approaches was proposed by Sutton (1991, 1998) under the name of the "bounds approach". In his view, market structure is determined endogenously by the toughness of price competition as well as the effects of both externalities' and escalation.

In Chapter 2, I present a theoretical model of the relationship between product and banking market concentration developed as part of my PhD thesis (Marc, 2009). First, I model the product market based on Sutton's (1991) Cournot model with perceived quality with free entry, then I model the banking market as a Salop circle city with no free entry and possible information asymmetry. The banking market is considered as an upstream market for the product market, providing firms with funds for entry and enlargement operations. I analyse 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. I use comparative static analysis to study the interaction between both markets, focusing on the effects that a change in the banking market has on the product market structure. The main finding of this theoretical analysis is that the relationship between the two market structures is not monotonic but moderated by the industry-specific relationship between exogenous and endogenous fixed and sunk costs.

In Chapter 3, I investigate empirical evidence in support of the proposed theoretical model by estimating a model of the relationship between banking and product market concentration on a sample of EU countries in the period 1995–2004. Indeed, I find evidence of a non-monotonic relationship that is moderated by industry-specific external financial dependency acting as a proxy for the relationship between exogenous and endogenous fixed and sunk costs. Specifically, I find that a change in banking concentration from low concentration (e.g. 25th percentile in the sample distribution) to high concentration (e.g. 75th percentile in the sample distribution) has different impacts on industries with 'medium' dependency on external financial sources compared to 'low' or 'high'. Industries with low or high external financial dependency become more concentrated if banking concentration increases, while the medium external dependency industries become less concentrated if banking concentration increases.

Finally, in the Conclusion I discuss the findings in relation to the research questions and address the limitations and implications for further research.

1 LITERATURE REVIEW

In this chapter, I initially present the literature focused on the determinants of market structure and then present the literature looking at the relationship between banking and product market structure.

1.1 Determinants of market structure

I draw from relevant industrial organisation 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 and, in the next subsection, I analyse the literature on banking market structure.

1.1.1 Product Market

Traditional industrial organisation theory offers more than one explanation for market structure; these 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 most recognised is the SCP paradigm developed by Bain (1951). It argues that firm behaviour 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 the entry of new potential competitors and preserve their market power (Bain, 1956). In this view, market structure is explained 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 thus 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). Higher concentration thus monotonically translates 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 behaviour. The contestable markets and efficient market shares theories are more dynamic in this sense. The CM theory argues that firms also consider the effects of potential entry of new competitors when selecting their strategic behaviour (Baumol, Panzar & Willig, 1982). It is therefore possible to have highly competitive behaviour in highly concentrated markets if the threat of entry is credible and large enough. While the CM theory suffers from a lack of generality and can be attacked for only being relevant to relatively few specific cases, the EMS theory is much more general. Produced by Demsetz (1973, 1974), its main proposition is based on the reverse logic of the SCP: observed market shares are a result of firm cost efficiency and their past strategic actions and do not the cause its profit efficiency. Firms that are more cost efficient outperform – or even outlive – their competitors, grow faster and thus gain larger market shares (Jovanovic, 1982). Intensive competition forces inefficient firms out of the market, thereby increasing concentration ex-post. Market structure is hence established endogenously when efficient firms obtain larger market shares. Concentration and competition in the CM and EMS settings are not monotonically related and approximations of competition via concentration become questionable.

Sutton (1991) has successfully combined these partial explanations and proposed a "bounds" approach whereby 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), three mechanisms affect market structure: 1) the toughness of price competition; 2) the effects of externalities; 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. However, if price competition becomes tougher (not necessarily related to a drop in concentration), the profits of the firms are reduced and entry to the industry becomes less profitable. A firm entering this industry must achieve a greater market share in equilibrium in order to recoup its initial investment in set-up costs, with the outcome being a more concentrated market. Moreover, because of the intensive competition there are more exits and more consolidation (mergers and acquisitions) leading to a more concentrated market structure, which is similar to what EMS claims. In this sense, the term "toughness of competition" is not limited to the level of prices and price-cost margins but 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 is best seen when the entry process permits some firms 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 only produces outcomes of highly fragmented markets with identical firms of minimum size.

The idea of the escalation mechanism lies in firms' responses to growing markets by increasing fixed and sunk costs such as R&D and advertising spending. Increases in R&D and advertising spending induce greater market concentration in some industries but may have the opposite effect in others. 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 an entrant can obtain in equilibrium by outspending the incumbents by K. Alpha depends on the pattern of technology and tastes, along with the nature of price competition. A high-alpha industry is one where greater R&D and advertising spending increases consumers' willingness to pay for the firm's products (which can also be regarded as increases in product quality), 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 assign 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 at greater product variety not escalating effects stemming from consumers' increased willingness to pay for the firm's products.

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

1.1.2 Banking market

Turning to the banking market structure, we first find that similar factors determining product market structure also operate in the case of banking markets. For example, Dick (2007) believes that banking markets are characterised by endogenous sunk costs. Gianetti (2008) finds evidence that Italian retail banking belongs to the "exogenous sunk and fixed costs" type of industry, but believes the banking industry as a whole should be regarded as being of the "endogenous sunk and fixed costs" type. However, since Sutton's model of market concentration only includes the size of the market, the number of firms, and costs and returns to advertising or R&D matter, I use it only to model the product market.

Banking markets are specific and differ from product markets in two important respects. The first is the existence of extensive regulation and licensing policy which affects entry, mergers and acquisitions, capital requirements, and foreign operations and thus also affects market structure and market concentration. Because of this, I assume no free entry to the banking market in my theoretical model and I ignore the potential effect of product market concentration on banking market concentration. The second aspect is the importance of asymmetric information in the bank-firm relationship which affects how banks behave towards their clients and therefore affects entry, growth and exit in the 'downstream' product markets. Dell Ariccia (2001) shows that asymmetric information about clients in incumbent and entrant banks increases market concentration and leads to lower interest rates. Banking markets can thus have only a few banks, but they are then more aggressively competitive.

In spite of the 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 also holds for the literature on banking markets. Concentration ratios (CR) calculated as the market shares of the n largest firms in the market and the Herfindahl-Hirschman index have long been probably the most dominant measures of 'competition'. Angelini and Cetorelli (2003) provide an empirical example where consolidation in a banking market did not reduce competition, which can be explained by banks passing on the benefits arising from cost efficiency – brought by consolidation – to consumers (Berger, Demsetz & Strahan, 1999). 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 & Laeven, 2004) and the institutional framework (Bikker, Spierdijk & Finnie, 2007) affect competition in banking markets more than market structure does. 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. Jeon, Olivero, and Wu (2011) analyse the impact of foreign bank penetration on the competitive structure of domestic banking sectors in host emerging economies and find empirical evidence showing that an increase in foreign bank penetration enhances competition in these host countries banking sectors. However, Bonitsis and Rivera-Solis (2011) only find a short-run effect of external liberalisation on banking concentration and competition in Spain, while there seems to be no such effect in the long run.

There is already 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. In fact, there are two main alternative hypotheses concerning this question. The first accepts the traditional SCP paradigm and therefore claims that market concentration is bad for firms. Banks in concentrated markets hold greater market power, which is exercised to the detriment of firms by lowering the supply of credit and raising prices. The studies that support this argument are Black and Strahan (2002), Beck, Demirgüç-Kunt and Maksimovic (2004), Cetorelli (2004), Cetorelli and Strahan (2006), and Bertrand, Schoar and Thesmar (2007).

The alternative hypothesis is information-based and claims that banks with greater market power have incentives to obtain more information about potential creditors and are thus 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 therefore have an informational advantage that increases the incumbent's market power and may lead to 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 triggers more industry entry because banks can sustain the cost of initiating a long-term relationship with an entrant only if their market power allows them to re-coup the short-term losses at later stages if the entrant becomes successful. Banks with market power are able to smooth interest rates intertemporally and are hence 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 follows an inverted-U shape 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 again decreases. But contrary to Petersen and Rajan (1995), this effect comes from the informational advantage of incumbent banks and not from banking market concentration *per se*. Other empirical studies that also find evidence of a positive effect of banking market concentration on entry are Cettorelli and Gambera (2001), Bonaccorsi di Patti and Dell'Ariccia (2004), Claessens and Laeven (2004), Demirgüç-Kunt, Laeven, and Levine (2004), Dick (2007), Ratti, Lee, and Seol (2008), and Mitchener and Wheelock (2013).

Recently, another feature of banking markets has emerged in the literature: relationship banking. Relationship banking refers to the offering of more valuable services to firms (like ex-post management advice) by using 'soft' information about firms that can only be obtained through sequential or multiple transactions. Boot and Thakor (2000), Degryse and Ongena (2007) and Dell'Ariccia and Marquez (2004) show that stronger 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 lead to higher interest rates being paid by the 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 with entrants because there is a greater possibility the firm will go to a rival bank when it becomes better known or profitable. Theory does not clearly predict 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 availability of credit to new firms. Ogura (2007) studies the banking market in Japan and finds that banks are less likely to engage in relationship banking the higher the number of banks in the local market which, in turn, lowers the availability of credit to new firms and thus entry. On the other hand, Kysucky and Norden (2013) find that competition has a positive effect on relationship banking. In the proposed theoretical model, I consider the traditional banking market concentration effect and also introduce the effect of information asymmetry in the bank-firm relationship, but leave out the potential influences of relationship banking.

1.2 The relationship between market structures in banking and product markets

When we come to the question of how banking competition exactly affects product market structure, there is no single answer. There are two major alternative hypotheses about the role of banks and banking concentration in the real economy, each taking different characteristics of the bank-firm relationship into perspective. The existing explanations can be divided into two groups: one group consists of explanations for the positive relationship between market structures, while the other explains the negative link between market structures.

Increases in banks' market power can either restrict firms' access to credit by lowering supply and charging higher prices, or due to incentives to produce information on potential borrowers, increase lending to firms that are informationally opaque. The difference in these two lines of reasoning can be boiled down to two questions: 1) in a situation where an entrant firm competes for bank credit with an incumbent firm, which 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 a positive relationship argue that banks with market power will decide to finance incumbents instead of entrants, while explanations of a negative relationship argue the entrants would be given credit. In the following sections, I present the arguments in support of both explanations.

On one hand, Cetorelli (2001) argues that banks with market power are inclined to finance 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 suboptimal lending decisions by bank managers favouring incumbents despite their inferior investment projects. Both types of behaviour are punished in more competitive banking markets but are viable if banks hold sufficient market power. This explanation suggests that a less concentrated banking market will stimulate firm entry and lead to smaller firms (i.e. a less concentrated product market) – a change in banking market structures induces a change in the same direction in the product market structure.

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 for instance 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 will change its bank at a later stage; 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 a later period firms will grow faster in more competitive banking markets. This explanation suggests that a less concentrated banking market will produce less entry and larger firms (i.e. a more concentrated product market) – a change in banking market structures induces a change in the opposite direction in the product market structure.

1.2.1 Explanations of a Positive Relationship

A positive relationship between market structures implies that product markets in countries with more concentrated banking markets will also be more concentrated. There are three causal explanations for this relationship proposed in the literature: the first is based on profit maximisation by banks, the second is a behavioral explanation, while the third explanation involves financing obstacles.

The main argument behind the 'profit maximisation' explanation is that banks shield their old clients by not giving credit to new entrants because this guarantees higher profits for the bank. Cestone and White (2003) and Spagnolo (2000) show theoretical frameworks where banks with market power tend to favour their established borrowers over new borrowers. Rosen (2004) calls this explanation "cannibalization" since banks effectively renounce some of their potential revenue in favour of what they assume will in the long run be a more profitable relationship with the incumbent firm.

Cestone and White's (2003) 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. Their reasoning is as follows: 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 the profits of their client (and thus also their own profits). 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 the industry and possible returns, and their return does not depend 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 due to its lack of commitment. Because the form of the financial contract between the investor and the firm (equity- or debt-claim) will affect the sensitivity of the 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. The authors' main proposition is that when investors hold equity claims in financed firms this is more entry-deterring than in 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 widescale entry. As the competition toughens, the incumbent must allow enough entry that the lender's competitors will be discouraged from financing the rejected entrants due to low quality. Therefore, the incumbent must provide its lender with a safer claim to induce a more accommodating attitude to entering firms. When the competition in credit markets is very strong, there is no way the incumbent can prevent entry, making debt the optimal claim.

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) that 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 into consideration in this latter respect, as well as the origin of law (civil law vs. common law).

One weak point in this framework is that its result depends on the assumption that banks can hold equity stakes in firms. Financial regulation in some countries does not allow banks to have equity claims and even in countries where this practice is allowed (for instance, Germany) the extent of equity financing by banks is negligible. A study of the German banking market by Dittmann, Maug and Schneider (2010) showed that the average equity stake held by German banks in 1994 was about 4 percent and had dropped to 0.4 percent by 2005. The same study showed that banks which had a representative on the board of a company increased their financing in the same industry, but not by financing the same firm – in Cestone and White's model, this is consistent with banks behaving as debtholders. If banks practically hold only debt claims, the incumbent firms cannot prevent entry and, ceteris paribus, product market concentration is not affected substantively via this channel.

Another flaw of Cestone and White's model relates to the validity of the traditional structure-conduct-performance (SCP) paradigm, which is inherent in their reasoning. I explain this paradigm in more detail in the following section. Consistent with this paradigm, they treat the relationship between competition and concentration as monotonic: 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 behaviour on product market entry, but the implications for concentration are valid if SCP is valid. However, the traditional SCP is being attacked as theoretically too simplistic and not convincingly empirically supported (e.g. for banking markets Hannan, 1997; Radecki, 1998; Berger, Demsetz & Strahan, 1999; Canoy et al., 2001; Gelos & Roldós, 2004; Mamatzakis, Staikouras & Koutsomanoli-Fillipaki, 2005; and Yildirim & Philippatos, 2007 do not find support for SCP).

Spagnolo's (2000) model explains how collusive credit markets transmit collusion in otherwise competitive product markets. The reason for this lies foremost in the lender's interest in cautious, conservative strategies that are supposed to reduce the shareholder – debtholder problem and is 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 a similar result by exploiting the "information network composed of indirectly interlocking directors, where each monitors a borrower of a competing bank." (Spagnolo, 2000, p. 3). When there is little credit market competition, the lender has greater bargaining power and can extract a larger share of the collusive rent. Therefore, its incentive for establishing these "conservative governance structures" (Spagnolo, 2000, p. 14) 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 faced with a perfect banking monopoly. Besides, what Spagnolo actually analyses is the effect of banking market collusion on product market collusion. Here again, it is not warranted to generalise this result as the effect of banking market concentration on product market concentration since this relationship is not necessarily monotonic.

The second type of explanation relates to the behaviour 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 the bank's profitability. Banks prefer to make less profitable loans to related companies than to lend more profitably to non-related companies. This explanation can be backed by some historical evidence from Mexico (Haber, 1991) and England (Lamoreaux, 1986). Rosen (2004) simply calls this "crony capitalism". Although Cetorelli (2001) offers no explicit explanation of how this behavior is different when a bank holds more market power, I assume banks with more market power do not face such competitive pressure for profit maximisation and can (sometimes) afford to finance firms on other grounds, for instance due to good long-term relationships or bank managers' personal motives.

The third type of explanation concerns financing obstacles. 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 (2006) include financing obstacles as a possible explanation and also explicitly establish a link with banking market structure which is missing in the first explanation: banks with greater 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 into the industry.

Some historical evidence supports the explanations of a positive relationship between both market structures: Cohen (1967) for the Italian industrialisation era in the late 19th century, Capie and Rodrik-Bali

(1982) for Britain in the early 1890s, and Haber (1991) for Mexican banking and textile industry in the late 19th century. Besides, Cetorelli (2001 and 2004) finds empirical evidence that bank concentration leads to a higher average firm size in manufacturing sectors, and evidence that the bank deregulation process has led to a lower average firm size. Cetorelli and Strahan (2006) empirically confirmed that lower concentration in banking markets is associated with a greater number of firms and lower average firm size in product markets, where the effect of banking concentration is particularly strong for the smallest firms and practically non-existent for large companies.

1.2.2 Explanations of a Negative Relationship

The explanation of the negative effect of banking market structure on industrial market structure 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 their market power allows them to recoup the cost at later stages if the entrant becomes successful. Banks with market power are able to smooth their 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 on in the firm's life, and later compensate that by charging an above-competitive interest rate.

Petersen and Rajan empirically confirmed that stronger 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 a decline in the interest rate paid as a firm ages is 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 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 obtain 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. Further, this implies banks continuously favour new entrants because by 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 a larger prevalence of smaller firms (Cetorelli & Strahan, 2006). Ratti, Lee, and Seol (2008) studied non-financial firms in 14 European countries between 1992 and 2005 and found that with a highly concentrated banking sector firms are less financially constrained.

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. In addition, Mitchener and Wheelock (2013) find that greater U.S. banking market concentration during 1899–1922 contributed considerably to the growth of manufacturing sectors. These findings are consistent with Cetorelli and Gambera (2001) who empirically confirm that stronger 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.

1.2.3 Limitations of the existing approaches

One of the main objections to the approaches that have so far emerged 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 account of 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 respond to 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 their analysis the determinants of banking or product market structure with the required attention and only empirical studies control for some industry-specific effects, albeit in a very ad hoc manner. This is why my analysis is based on the product market and the determinants of its market structure. The link between banking and product market is via the cost of financing and the 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, market power, and market structure. Often concentration is interpreted as the inverse of competition, which is not necessarily 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 can be conceptually defined as the distribution of market power in the market: the less symmetric the distribution of market power, the more concentrated the market. However, market power is difficult to define and measure if it is not operationalised. The industrial organisation literature relates concentration mainly to firm size, the configuration of market shares and the degree of vertical integration. We have to acknowledge that each of these is an imperfect measure of concentration. For example, activity restrictions imposed by the national banking regulation authority may diminish the market power of banks compared to other countries, but they do not affect the distribution of market shares *per se*. In spite of this, market concentration is typically measured by concentration ratios that indicate the combined market shares of the n largest firms in the market. A market structure is described as concentrated when there are 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 possibly other characteristics of the economy.

I do not study the difference in competition and concentration effect in this book. Instead, I study the effect of market structure which I define in terms of the number of firms in the market and the share held by the largest firm. Market structure in this monograph is measured by market concentration which is proxied by the market share of the largest (n) firm(s). I also do not study the effects of competition explicitly but, since concentration and competition are related to some extent, the results are also relevant for inferences about competition effects. Since the current body of research lacks a model that clearly shows a link between banking and product market concentration, this book attempts to contribute to the knowledge about this relationship by building a theoretical model that is: i) based on the determinants of product market structure; and ii) focused on the effect of concentration.

2 THEORETICAL MODEL

To the best of my knowledge, only two contributions study the relations between upstream and downstream markets and allow for free entry and endogenous market structure (Hendricks & McAfee, 2010; Reisinger & 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 modelled 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 regulator. The banking market is considered as an upstream market providing services to the downstream product market. Entry to the product market is free and simultaneous, but firms must pay a fixed set-up cost $\sigma > 0$ to enter the market and then pay additional fixed outlays $R > 0$ to enlarge their operations in the market. The fixed cost can be modelled as exogenous or endogenous sunk costs. Exogenous costs (σ) relate to the characteristics of technology, endogenous costs (R) relate to advertising and R&D, which are the outcomes of a 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 held by 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 upon which their rivals obtained 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 on 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 of recouping their investment at later stages by exercising their market power. Therefore, the competition in the first stage is fierce price competition for the new client-entrant. The cost of financing the entry cost σ (i_0) is considered to form part of firms' fixed and sunk costs.

In the second stage, successful entrants decide how much to invest in product quality enhancement. Above-average product quality u can help the firm 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 of acquiring a larger market share, market size and on the cost of financing i. Banks compete on prices and set interest rate i, which can be the same as in the first stage or different. In the third stage, firms compete à la Cournot.

In the following sections, I first look at the product market, then at the banking market and finally I analyse the interaction between them.

2.1 Product market

Firms differentiate their products by product quality attribute u, which can typically be enhanced by advertising, product-oriented R&D outlays or a combination of both. Consumers perceive products with a 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 maximise their utility function with respect to x and subject to their budget constraints. They choose the product that maximises the quality-price index u_i/p_i and their total demand for good x is S, which equals ϕ fraction of their budget.

2.1.1 The third stage

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

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

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 (Sutton, 1991):

$$\Pi\left(\frac{u}{\bar{u}}\right) = S\left\{1 - \frac{1}{\frac{1}{n-1} + \frac{u}{\bar{u}}}\right\}^2. \tag{2.1}$$

2.1.2 The second stage

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

$$R(u) = \frac{a}{\gamma}(u^\gamma - 1), \tag{2.2}$$

where a is per unit cost of advertising (in the original model) although 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. Interest charge is normally excluded from cost computations because it is a finance item, not a cost item. However, interest is included in capital budgeting computations, which are typically part of enlargement operations. In order to study the effects of banking markets, I incorporate the interest rate i that firms pay for funds $R(u)$ as follows:

$$R(u) = \frac{a}{\gamma}(u^{\gamma} - 1)(1 + i). \tag{2.3}$$

The total fixed sunk costs (TC) for a firm are therefore (including the cost of financing):

$$TC(u) = \sigma(1 + i_0) + R(u) = \sigma(1 + i_0) + \frac{a}{\gamma}(u^{\gamma} - 1)(1 + i). \tag{2.4}$$

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

$$\frac{u}{TC}\frac{dTC}{du} = \varepsilon_{TC(u)} = \gamma\left(1 - \frac{\sigma(1 + i_0) - \frac{a}{\gamma}(1 + i)}{TC}\right). \tag{2.5}$$

This expression is always positive and shows the following:
i) when $u \to \infty$, $TC(u) \to \infty$ so the elasticity of fixed costs tends to γ (the rate of diminishing returns to enlargement activities) 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, while 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 the banking market that induces banks to charge different interest rates (e.g. 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 maximise their profits. The marginal gain from enlargement is exactly offset by the marginal cost of enlargement. The first-order condition for this is:

$$\left.\frac{d\Pi}{du}\right|_{u=\bar{u}} = \left.\frac{dTC}{du}\right|_{u=\bar{u}}. \qquad (2.6)$$

The equilibrium solution for enlargement outlay $R^*(u)$ is obtained from solving (2.6) and is given implicitly by

$$2S\frac{(n-1)^2}{n^3} = \gamma[TC^* - (\sigma(1+i_0) - \frac{a}{\gamma}(1+i))], \qquad (2.7)$$

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

2.1.3 The first stage

In the first stage, N firms decide whether to enter the market or not taking into account the level of enlargement outlay R^* needed in the 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 (2.1) 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:

$$\frac{S}{n^2} \geq TC^*(n,S), \tag{2.8}$$

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 (2.8) to equality (zero-profit condition) and inserting it into (2.7) instead of S, giving the implicit solution for the equilibrium number of firms n^* in (N,TC) space:

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

$$n + \frac{1}{n} - 2 = \frac{\gamma}{2}[1 - \frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC}] = \frac{1}{2}\varepsilon_{TC(u)} \qquad (2.9)$$

Product market concentration thus depends on the elasticity of total sunk costs, which in turn depends on the market size. The locus (2.9) 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, parametrised 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 (2.9) approaches $\frac{\gamma}{2}$ for any n. Following Sutton (1991), I denote the solution for the 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 large S.

For a sufficiently small market, enlargement operations via R&D or advertising are not justified and firms only invest 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 (a positive relationship).

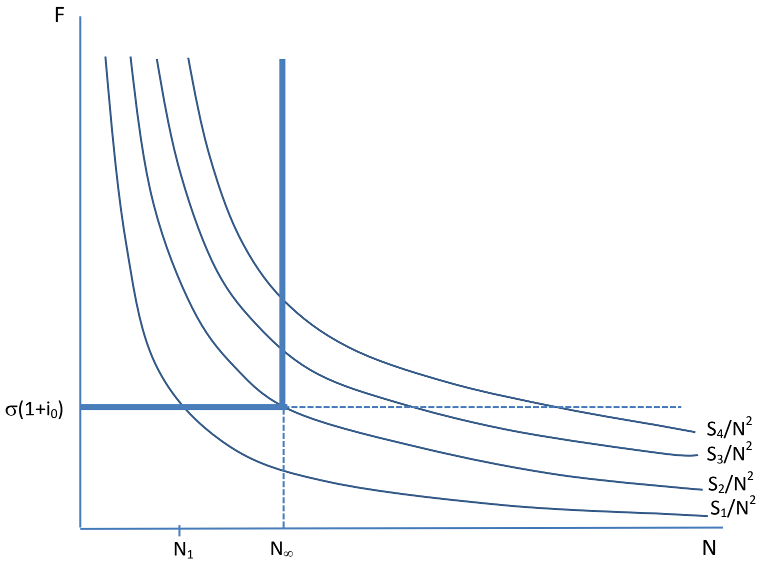
By increasing market size S to some 'medium' size, we eventually reach a number of firms n when it becomes profitable to engage in enlargement operations. This switch point between the non-enlargement and enlargement regime is determined by the condition (2.6) evaluated at $u = \bar{u} = 1$ as in equilibrium all firms offer the same quality u which is also equal to 1 when in a non-enlargement regime. This gives the critical value n^c:

$$n + \frac{1}{n} - 2 = \frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)} \tag{2.10}$$

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 non-enlargement regime; if the market size then increases, firms start to engage in enlargement operations in order to secure a greater market share.

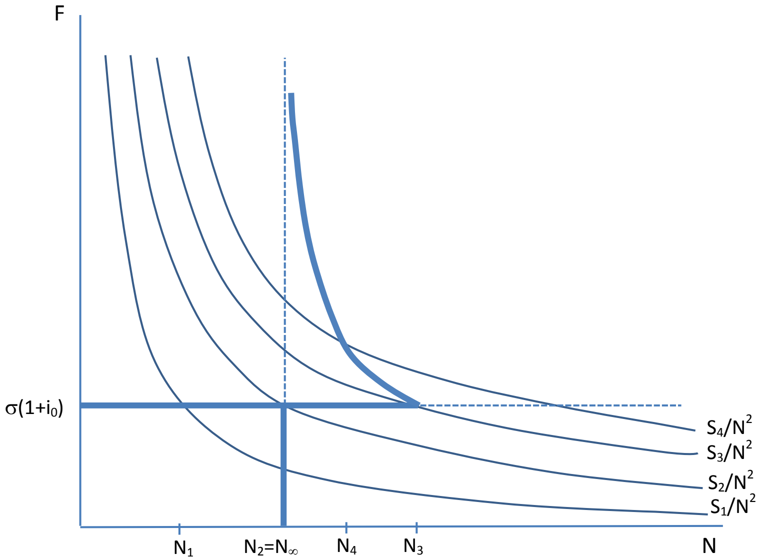
Let us first examine the case where $\sigma(1+i_0) = \frac{a}{\gamma}(1+i)$. This is equivalent to saying elasticity ε_{TC} equals the rate of diminishing returns to enlargement γ. The locus (2.9) is vertical and the solution $\tilde{n}(\frac{\gamma}{2})$ coincides with the asymptotic limit when $S \to \infty$ and also to the switch point $\tilde{n}(\frac{1}{2}\frac{a(1+i)}{\sigma(1+i_0)})$ (Figure 2.1). This means that once the market size is large enough to accommodate this number of firms in the non-enlargement 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 the product market structure (and we could denote this type of market as a 'zero-alpha' industry).

Figure 2.1: *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 the non-enlargement and the 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 2.2). Because 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. This is consistent with what Sutton (1998) describes as a 'positive-alpha' or 'high-alpha' industry.

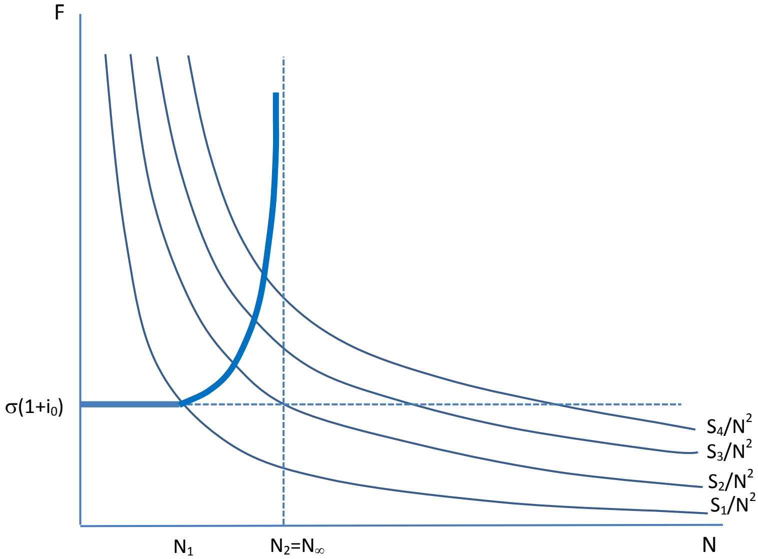
Figure 2.2: *Equilibrium configuration when* $\varepsilon_{TC} > \gamma$



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 (Figure 2.3). The relationship between market size and market concentration is monotonic: when market size increases, market concentration decreases. Enlargement operations will decrease product market concentration. This is consistent with what Sutton (1998) describes as a 'low-alpha' industry.

We saw that the effect of enlargement operations on a product mar-

Figure 2.3: *Equilibrium configuration when* $\varepsilon_{TC} < \gamma$



ket concentration depends on the relationship between $\sigma(1+i_0)$ and $\frac{a}{\gamma}(1+i)$. Now, I will inspect this relationship from the banking market point of view: what is the relationship between i_0 and i? The first possibility is that banks do not differentiate the interest rate between periods (or firms) and i_0 thus equals to i. In this case, the product market concentration is determined by the market size depending on σ and $\frac{a}{\gamma}$. A change in interest rates does not affect this relationship. The second possibility is that banks charge the lower interest rate i_0 in the first period and the higher interest rate i in the second period ($i_0 < i$). This means that entry is relatively cheaper than subsequent enlargement. There will be more firms in the market, but they will not grow as much as they could have had the interest rate remained the same. Enlargement operations will result in less concentrated product markets than in the baseline case with one interest rate for both periods. The third possibility is the reverse: banks charge the higher interest rate i_0 in the first period and the lower interest rate i in the second period ($i_0 > i$). Now, the entry is relatively more expensive than subsequent enlargement. There will be fewer firms in the market, but they will grow more than they could if the interest rate remained the same. Enlargement operations will result in more concentrated product markets than in the baseline case with one interest rate for both periods. This analysis demonstrates that if banking market concentration affects the relationship between i_0 and i, it also affects the product market structure of markets characterised with endogenous fixed and sunk costs.

2.2 Banking Market

Now I turn to the banking market analysis. We have seen 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 a unit-circumference and offer a 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 regulator such as a central bank and 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 due to a finite number of firms n, I assume banks do not know the exact location of firms but expect each point on the circle to be equally likely a location for a firm, such that the expected location is uniformly distributed over the circle (Reisinger & 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 received 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 the 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 the interest rate at bank j.

The cost $t(x_i - x_j)^2$ reflects the idea that banking market power can originate from the spatial distribution of banks in a local or regional market (e.g. Petersen & 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 the distances between them and the smaller the market power of banks. 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 of 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 therefore 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 the second period. Without loss of generality in the analysis, I normalise 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 a backward induction.

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

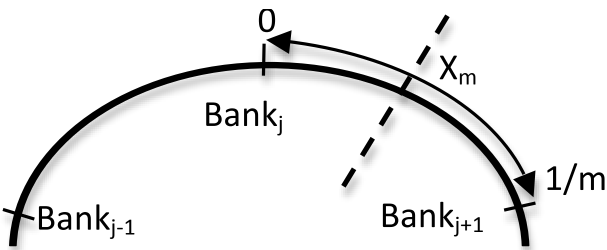
2.2.1 Stage Two

In stage two, $n^*(S, TC)$ firms decide on optimal enlargement outlay $R^*(u)$ and the latter is implicitly given by (2.7). 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 maximise their profit.

A marginal firm that is located at the distance $x \in (0, 1/m)$ from bank j is indifferent to obtaining credit in bank j and obtaining credit from j's closest neighbour bank $j+1$ if (see Figure 2.4):

$$i_j + tx^2 = i_{j+1} + t(\frac{1}{m} - x)^2, \tag{2.11}$$

Figure 2.4: *Banking market - Salop circle*



giving me the location of the marginal firm x_m:

$$x_m = \frac{m(i_{j+1} - i_j)}{2t} + \frac{1}{2m} \tag{2.12}$$

and the demand for bank j:

$$D_j = 2x_m = \frac{m(i_{j+1} - i_j)}{t} + \frac{1}{m}. \tag{2.13}$$

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 the private information they possess 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 it reflects the switch costs for firm i. Since the competition is on prices and there are no capacity constraints, a bank that sets the lowest price obtains the total demand in the market, which is $n^* R^*$. However, due to the market power gained by financing the firm in stage one, the incumbent bank can charge existing client i a higher interest rate i_j than its closest rival would (i_{j+1}):

$$i_{ij} = i_{ij+1} + t\frac{1}{m^2}, \tag{2.14}$$

The difference between the interest rates a firm is given 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 would obtain n/m clients. Hence, 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 (2.12) and (2.13) and the profit from potential new clients for each bank j is then given by

$$\Pi^n_{bankj} = \rho i^n_j D + (1-\rho)(-D) \tag{2.15}$$

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 (2.13) as D in the above expression and maximising Π^n_{bankj} with respect to i^n_j I obtain

$$i^n_j = \frac{t}{m^2} + \frac{1-\rho}{\rho} \tag{2.16}$$

and therefore

$$i_j = \frac{2t}{m^2} + \frac{1-\rho}{\rho} = i. \tag{2.17}$$

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 (a greater number of banks) would therefore decrease interest rates in the second period.

2.2.2 Stage One

The competition for clients in the first period is fierce price competition since banks can exercise market power in the second period and charge a higher interest rate to their existing clients. A bank that sets the lowest price would capture 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 in both periods have its marginal firm at location x_m as in (2.12) and demand (2.13); by maximising its profit with respect to interest rate, I obtain

$$i' = i^n = \frac{t}{m^2} + \frac{1-\rho}{\rho}. \tag{2.18}$$

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

$$\mathit{\Pi}^{i'}_{bank} = \frac{n}{m}[\sigma(\rho * i' - (1-\rho)) + R^*(\rho * i' - (1-\rho))] \tag{2.19}$$

$$\mathit{\Pi}^{i_0,i}_{bank} = \frac{n}{m}[\sigma(\rho * i_0 - (1-\rho)) + R^*(\rho * (i' + \frac{t}{m^2}) - (1-\rho))]. \tag{2.20}$$

By equating (2.20) with (2.19), I obtain the equilibrium interest rate in the first period i_0:

$$i_0 = \frac{t}{m^2}(1 - \frac{R^*}{\sigma}) + \frac{1-\rho}{\rho} \tag{2.21}$$

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).

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

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, Kristiansen and Vale (2005). 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 a banking market is less concentrated. Kim, Kristiansen and Vale (2005) find that the interest rate mark-up follows a life-cycle pattern: young firms pay a small or even negative mark-up, later the mark-up is increased and when firms become older the mark-up again falls. The proposed model is consistent with this result when $R^* > \sigma$. We can imagine there is a third stage or period when information about firms is also known by rival banks and is not exclusive to incumbent banks. As long as there is still information asymmetry in favour of the incumbent banks, the marginal firm in the 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 above analysis it is clear that the interest rate in the third stage will be above i', but closer to i' than interest rates in the second stage.

2.3 Analysis of Interaction

The 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 only affected by the 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 to charge a higher interest rate in the later period ($i_0 = i'$). Lower 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-existent for large product markets.

Now I study in greater detail how a change in banking market concentration affects the concentration of “medium”[5] product markets. I first assume 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 in which banks charge different interest rates (i_0 and i) due to information asymmetry.

2.3.1 No Information Asymmetry

The switch point between non-enlargement and enlargement regimes is given by (2.10) and we can see that a change in interest rate i' will not change the critical number of firms 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.

[5]Medium markets are product markets in an enlargement regime, but too small for asymptotic behaviour.

However, banking market concentration will affect the equilibrium number of firms in the medium product market (n^*) in certain conditions. For that, I need to inspect two relationships: the effect of interest rate i' on TC^* and on n^*. Since the 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 2.5.1.)

$$\frac{\partial TC^*}{\partial i'} = \sigma - \frac{a}{\gamma} \tag{2.22}$$

$$\frac{\partial n^*}{\partial i'} = \frac{1}{2}\frac{\gamma(-\frac{\sigma - \frac{a}{\gamma}}{TC^*} + \frac{(1+i')(\sigma - \frac{a}{\gamma})\frac{\partial TC^*}{\partial i'}}{TC^{*2}})}{1 - \frac{1}{n^2}}. \tag{2.23}$$

The combined effect of a change in banking market concentration is thus:

$$\frac{\partial n^*}{\partial m} = \frac{\partial n*}{\partial i'}\frac{\partial i'}{\partial m} = \frac{\varepsilon_{TC}}{(1 - \frac{1}{n^2})}\frac{2t}{m^3}\frac{1}{TC}(\sigma - \frac{a}{\gamma}) \tag{2.24}$$

First, let us look at the case where $\sigma = \frac{a}{\gamma}$ (i.e. the elasticity ε_{TC} is equal to the rate of diminishing returns γ). Since both derivatives, (2.22) and (2.23), 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 the banking market concentration will not have an effect on the product market concentration.

When $\sigma < \frac{a}{\gamma}$, the elasticity ε_{TC} is larger than γ. This means that the total costs of entry and enlargement are increasing faster than the 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 (2.22) is negative and the second one (2.23) is positive (Appendix 2.5.2). Since greater banking concentration increases the interest rate ($\frac{\partial i'}{\partial m}$ is negative, see (2.18)), the combined effect $\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i'}\frac{\partial i'}{\partial m}$ is negative. More banks in the banking market translate into less firms in the product market. Greater concentration in the banking market will raise 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 rise even faster when the 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 there is a larger number of firms in equilibrium. Greater banking concentration will thus result in lower product market concentration (i.e. a negative relationship).

Finally, when $\sigma > \frac{a}{\gamma}$, the elasticity ε_{TC} is smaller than γ. The entry cost, which is inelastic to the interest rate, is large relative to the enlargement cost and its effect dominates. The total costs are growing at a slower rate than the returns to enlargement, implying that enlargement becomes cheaper relative to the cost of entry. Thus, the first derivative (2.22) is positive and the second one (2.23) is negative (Appendix 2.5.2). The combined effect $\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i'}\frac{\partial i'}{\partial m}$ is now positive. More banks in the banking market translate into more firms in the product market. Greater concentration in the banking market will raise 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 the interest rate rises because the costs of enlargement will not increase as fast as the returns, but fewer firms will be able to stay in the market and support this level of enlargement in equilibrium. Greater banking concentration will thus result in greater product market concentration (i.e. a positive relationship).

2.3.2 Information Asymmetry

If banks charge different interest rates in the two periods, 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 2.5.3) shows that the maximum number of firms in a non-enlargement 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 the enlargement regime to become profitable. When $R < \sigma$, the change in n^c depends on the magnitude of the effects of i and i_0 and also on the magnitude of the effects banking concentration has on i and i_0. The analysis of these effects shows the combined effect of banking concentration on the critical number of firms is also negative for this case (Appendix 2.5.4). This implies that increased banking concentration may hinder the growth of small product markets. Fewer markets will reach the critical firm number for the enlargement regime and will therefore stay small.

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

$$\frac{\partial n^*}{\partial i} = \frac{\gamma}{2}\frac{\frac{a}{\gamma * TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i}}{1-\frac{1}{n^2}} \tag{2.25}$$

$$\frac{\partial n^*}{\partial i_0} = \frac{\gamma}{2}\frac{-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i_0}}{1-\frac{1}{n^2}} \tag{2.26}$$

The analysis in Appendix 2.5.5 shows that the first derivative (2.25) is positive and the second one (2.26) is negative. An increase in i will increase the equilibrium number of firms, while an increase in i_0 will lower the equilibrium number of firms. I now check how banking market concentration affects product market concentration by analysing 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):

$$\frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} = \frac{\gamma}{2}\frac{\frac{a}{\gamma * TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i}}{1-\frac{1}{n^2}}(-\frac{4t}{m^3}) \tag{2.27}$$

$$\frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = \frac{\gamma}{2}\frac{-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i_0}}{1-\frac{1}{n^2}}(-\frac{2t(1-\frac{R}{\sigma})}{m^3}) \tag{2.28}$$

We can see that (2.27) is always negative and (2.28) is positive for $R < \sigma$ and negative for $R > \sigma$. The combined effect is thus:

$$\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} + \frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{\varepsilon_{TC}}{(1-\frac{1}{n^2})}\frac{t}{m^3}\frac{1}{TC}[(R-\sigma)+2\frac{a}{\gamma}]. \quad (2.29)$$

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

The effect is less clear in markets where enlargement outlays are smaller than the entry cost ($R < \sigma$) and depends on the magnitudes of (2.27) and (2.28). Only if the difference between σ and R is greater than $2\frac{a}{\gamma}$ is the effect of m positive; otherwise, the effect is negative. This implies that in product markets where the entry cost exceeds the enlargement cost by 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. However, if the difference is not big enough, the relationship is negative. The difference will be big enough (to establish a positive relationship) 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 fewer banks and firms (lower m and n), the elasticity of total fixed and sunk costs is higher, transport costs in the banking market are higher, and the level of total fixed and sunk costs is lower.

2.4 Discussion

The focus of this chapter is the building of a theoretical model that allows us to study the link between product and banking market concentration and thereby enhance our understanding of this specific relationship. The existing body of literature on this topic has hitherto mainly been empirically oriented and lacking in adequate theoretical analysis. One of the main problems of the existing theory is the lack of consideration of the determinants of product market structure. The approach in this monograph departs from other contributions precisely in this respect; I build the model by first considering 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 (as is typical in theoretical contributions from banking literature).

By using Sutton's theory of endogenous product market structure and linking it with a simple model of the 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 (in my analysis) are those industries mainly characterised 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 (i.e. zero-alpha industries). In such industries, greater banking concentration increases product market concentration (a positive link).

Medium markets are those industries that are characterised by endogenous fixed and sunk costs of enlargement that follow the initial entry cost. Firms are encouraged to invest in enlargement since in some industries it allows them to increase their market share above their rivals' (i.e. low- or high-alpha industries). 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 and vice versa (i.e. a negative link).

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 the entry cost is above a critical level.

The results 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 exogenous and endogenous fixed and sunk set-up costs (e.g. zero-, low-, and high-alpha industries), and for banking market characteristics related to information asymmetry and bank-switching 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 the transition process in both product and banking markets. This might call for a dynamically specified econometric model in such cases, explicitly taking the development of the analysed relationship into account.

The main limitations of the proposed model are the assumptions of non-free entry and no capacity constraints in the banking market. Possible future extensions of the theoretical model thus include allowing for free entry and capacity constraints in the banking market, distinguishing the effect of concentration from competition, and the introduction of relationship banking.

In summarising the specific results of the model, I make the following remarks regarding the tentative policy implications. Particularly small and medium countries' banking authorities consider the effects of banking concentration in product markets. The results support the hypothesis that banking concentration is not necessarily bad, especially not in markets characterised by endogenous fixed and sunk costs, and therefore policy regarding mergers and acquisitions in banking need not be *a priori* restrictive or licensing policies permissive. The supervision of banks should involve the careful monitoring of potentially detrimental competitive pressures that could result from an excessively fragmented banking market.

2.5 Appendix to Chapter 2

2.5.1 The effect of i' on TC^* n^*

The solution for TC^* is given as

$$TC^* = \frac{2S(n^*-1)^2}{\gamma n^{*3}} + \sigma(1+i_0) - \frac{a}{\gamma}(1+i) = \frac{2S(n^*-1)^2}{\gamma n^{*3}} + (\sigma - \frac{a}{\gamma})(1+i'), \tag{2.30}$$

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

$$\frac{\partial TC^*}{\partial i'} = \sigma - \frac{a}{\gamma}. \tag{2.31}$$

The solution for n^* is given as

$$n + \frac{1}{n} - 2 = \frac{\gamma}{2}[1 - \frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC}] = \frac{1}{2}\varepsilon_{TC(u)}. \tag{2.32}$$

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

$$\frac{\partial n^*}{\partial i'} = \frac{1}{2}\frac{\gamma(-\frac{\sigma - \frac{a}{\gamma}}{TC^*} + \frac{(1+i')(\sigma - \frac{a}{\gamma})\frac{\partial TC^*}{\partial i'}}{TC^{*2}})}{1 - \frac{1}{n^2}}. \tag{2.33}$$

2.5.2 The effect of i' on n^*

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

$$sign\frac{\partial n^*}{\partial i'} = sign[-\frac{\sigma - \frac{a}{\gamma}}{TC^*} + \frac{(1+i')(\sigma - \frac{a}{\gamma})\frac{\partial TC^*}{\partial i'}}{TC^{*2}}] \tag{2.34}$$

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:

$$(1+i')(\sigma - \frac{a}{\gamma}) \lesseqgtr TC^* \tag{2.35}$$

Since $TC^* = (\sigma + R^*)(1+i')$, we obtain the condition $-\frac{a}{\gamma} \lesseqgtr R^*$ 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.

2.5.3 The effects of i and i_0 on n^c

$$\frac{\partial n^c}{\partial i} = \frac{1}{2}\frac{a}{\sigma(1+i_0)(1-\frac{1}{n^2})} \tag{2.36}$$

$$\frac{\partial n^c}{\partial i_0} = -\frac{1}{2}\frac{a(1+i)}{\sigma(i+i_0)^2(1-\frac{1}{n^2})} \tag{2.37}$$

(2.36) is positive and (2.37) is negative.

2.5.4 The 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:

$$\frac{\partial n^c}{\partial i}\frac{\partial i}{\partial m} = \frac{1}{2}\frac{a}{\sigma(1+i_0)(1-\frac{1}{n^2})}\frac{-4t}{m^3} = -\frac{2at}{\sigma(1+i_0)(1-\frac{1}{n^2})m^3} \quad (2.38)$$

$$\frac{\partial n^c}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{1}{2}\frac{a(1+i)}{\sigma(i+i_0)^2(1-\frac{1}{n^2})}\frac{-2t(1-\frac{R}{\sigma})}{m^3} = \frac{at(1+i)(1-\frac{R}{\sigma})}{\sigma(1+i_0)^2(1-\frac{1}{n^2})m^3} \quad (2.39)$$

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

$$\frac{\partial n^c}{\partial m} = \frac{\partial n^c}{\partial i}\frac{\partial i}{\partial m} + \frac{\partial n^c}{\partial i_0}\frac{\partial i_0}{\partial m} = \frac{at}{\sigma(1+i_0)(1-\frac{1}{n^2})m^3}[\frac{1+i}{1+i_0}(1-\frac{R}{\sigma})-2] \quad (2.40)$$

The sign of this effect depends on the 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.

2.5.5 The effect of i and i_0 on n^*

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

$$sign\frac{\partial n^*}{\partial i} = sign[\frac{a}{\gamma TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i}] \quad (2.41)$$

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

$$sign\frac{\partial n^*}{\partial i} = sign[1 - \frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC}] \tag{2.42}$$

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 $\frac{\partial n^*}{\partial i_0}$:

$$sign\frac{\partial n^*}{\partial i_0} = sign[-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0) - \frac{a}{\gamma}(1+i)]}{TC^2}\frac{\partial TC^*}{\partial i_0}]. \tag{2.43}$$

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

$$sign\frac{\partial n^*}{\partial i} = sign[\frac{\sigma(1+i_0) - \frac{a}{\gamma}(1+i)}{TC} - 1] \tag{2.44}$$

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

2.5.6 The effect of m on n^*

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

$$\frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} = -\frac{2t\gamma}{m^3}[\frac{\frac{a}{\gamma * TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\frac{-a}{\gamma}}{1-\frac{1}{n^2}}] = -\frac{2t}{m^3}\frac{a}{\gamma TC}\frac{\varepsilon_{TC}}{(1-\frac{1}{n^2})} \tag{2.45}$$

$$\frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{t(1-\frac{R}{\sigma})\gamma}{m^3}[\frac{-\frac{\sigma}{TC} + \frac{[\sigma(1+i_0)-\frac{a}{\gamma}(1+i)]}{TC^2}\sigma}{1-\frac{1}{n^2}}] = \frac{t(\sigma - R)}{m^3}\frac{1}{TC}\frac{\varepsilon_{TC}}{(1-\frac{1}{n^2})} \tag{2.46}$$

Since the elasticity ε_{TC} is positive, the first derivative is always negative, while the 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:

$$\frac{\partial n^*}{\partial m} = \frac{\partial n^*}{\partial i}\frac{\partial i}{\partial m} + \frac{\partial n^*}{\partial i_0}\frac{\partial i_0}{\partial m} = -\frac{\varepsilon_{TC}}{(1-\frac{1}{n^2})}\frac{t}{m^3}\frac{1}{TC}[(R-\sigma)+2\frac{a}{\gamma}] \tag{2.47}$$

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 n^* in the product market and reduce the concentration. The relationship between banking and product market concentration is negative.

3 EMPIRICAL ESTIMATION

3.1 Introduction

A series of previous empirical studies of the relationship between product market and banking market concentration was carried out by Cetorelli and co-authors (Cetorelli, 2001 and 2004; Cetorelli & Gambera, 2001; Cetorelli & Strahan, 2006). They all found a positive relationship between both market concentrations, implying that a more concentrated banking market increases product market concentration. Taking into consideration the mechanisms offered in the previous chapter as explanations for the identified relationship, I believe this relationship is not the same in all industries but is moderated by what Sutton (1998) calls the industry's alpha. In this chapter, I present some empirical evidence for this claim.

In the following paragraphs, I first briefly summarise the literature related to the main research question. The section focuses on the empirical literature investigating the relationship between banks and firms. The literature review section is followed by a description of the research method and the econometric model used. I mainly draw on the approach developed by Cetorelli (2001 and 2004). Next, I present the data used in the estimation and the results obtained. The discussion section concludes the chapter with a commentary on the results and points out further research needed to overcome some of the weaknesses of the presented approach.

3.2 Related literature

As explained in Chapter 1, the literature studying the link between banking and product markets can be divided into explanations of the positive or negative relationship between concentrations in both markets. A positive relationship can be explained by the profit maximisation of banks, by managerial behaviour favouring existing clients over new entrants, or by financial obstacles (e.g. reduced credit availability). A negative relationship is explained by interest-rate smoothing over time (Petersen & Rajan, 1995). The majority of this literature is empirical. Cetorelli (2001 and 2004) analyses a sample of OECD countries and finds that countries with more concentrated banking markets have those industries that are more dependent on external financial sources more concentrated. Cetorelli and Strahan (2006) analyse the effects of banking concentration, not just on the average firm size, but on the size distribution. They find the relationship between both market concentrations is moderated by firm size: smaller firms are more affected by increased banking concentration than large firms are.

On the other hand, Cetorelli and Gambera (2001) find that the relationship is moderated by firm age: younger firms benefit from more concentrated banking markets with higher growth rates, while mature firms experience lower growth rates in this circumstance. In addition, Kim, Kristian and Vale (2005) find an inverted U-shaped effect of firm age: young and mature firms pay a lower interest rate than 'middle-aged' firms. Tabak, Guerra and DeSouza Penaloza (2009) find no evidence that greater banking concentration in the Brazilian banking market leads to uncompetitive practices. Also consistent with these findings is the study by Ratti, Lee and Seol (2008) who find that with a highly concentrated banking sector firms are less financially constrained. Hoxha (2013) provides empirical evidence showing that industries that rely more on external financing perform better in countries where the banking competition is lower and the banking concentration is greater.

Apart from Cetorelli, other authors have studied the effects of concepts close to market concentration, such as competition or market power, on firms. For example, Bertrand, Schoar and Thesmar (2007) find that after deregulation of the French banking market banks are less willing to bail out poorly performing firms and firms in the more bank-dependent sectors are more likely to undertake restructuring activities. At the industry level, they observe a decline in concentration. Black and Strahan (2002) find that the rate of new incorporations in the USA increases following the deregulation of branching restrictions, and that deregulation in the banking market reduces the negative effect of concentration on new incorporations. Beck, Demirgüç-Kunt and Maksimovic (2004) find that greater bank concentration increases obstacles to obtaining finance, but only in countries with low levels of economic and institutional development. The effect is smaller in countries with a larger share of foreign-owned banks and an efficient credit registry, but larger where there are more restrictions on banks activities, more government interference in the banking sector, and a larger share of government-owned banks. Dell'Arricia and Marquez (2004) show analytically that a banks informational advantage provides it with some degree of market power and when faced with greater competition; therefore, banks reallocate credit toward more captured borrowers. Bonacorsi di Patti and Dell'Arricia (2004) find for Italian data that bank competition results are less favourable to the emergence of new firms in industrial sectors where informational asymmetries are more important. On the other hand, Cipollini and Fiordalisi (2012) find that greater banking market power does not necessarily increase the overall risks taken by banks, even though it might result in riskier loan portfolios.

I contribute to this literature by investigating the role of one important determinant of product market concentration – an industry's alpha – in the relationship between banking and product market structure. Sutton's (1998) alpha is an 'escalation' parameter explaining the effect of outspending the rival firms on R&D by a factor K on the *ex-ante* level of industry sales revenue. A positive alpha indicates that a firm can increase its market share by outspending the rival companies by offering a higher quality product. In the theoretical model developed in Chapter 2, I assume firms develop higher quality products through enlargement operations involving R&D and advertising. I find that the relationship between both market structures is non-monotonic with respect to alpha: increased banking concentration differently affects markets with zero, low or high alpha. The theoretical analysis also shows the following.

First, very large markets are not affected by changes in banking concentrations. Second, markets where the escalation effect is not present (i.e. zero-alpha industries) are affected by conditions in the banking market only through the cost of financing the set-up (or entry) cost. This means there is no 'second' period investment undertaken by firms and banks behave accordingly as if the interaction with a firm is a one-period game. Because interest-rate smoothing across time period is impossible, the banks maximise profits by charging the maximum possible interest rate. In this case, higher banking concentration increases interest rates, the cost of entry is higher, there is less entry, and product market concentration also increases.

Third, markets where the escalation effect is present (i.e. low- or high-alpha industries) are affected by banking markets via the costs of financing entry, as well as subsequent enlargement. The effect therefore depends on the relationship between the cost of entry and the cost of enlargement, as well as the relationship between total fixed cost elasticity and the rate of diminishing returns to enlargement, and whether banks find interest-rate smoothing profitable. Industries where enlargement cost is higher than entry cost, because companies expect this will increase their market share (i.e. high-alpha industries), can become less concentrated when banking concentration increases. This happens because banks smooth their interest rates and charge a lower rate in the first period and a higher one in the second. The rate of entry into the industry is thus higher, but enlargement operations in the second period are lower – the result is a higher number of smaller firms. On the other hand, industries where enlargement cost is lower than entry cost (and the difference is big enough), since companies anticipate that enlargement operations will not yield a higher market share (i.e. low-alpha industries), can become more concentrated when banking concentration increases. In this case, banks charge a higher interest rate for financing the cost of entry, which reduces the number of firms in the industry.

3.3 Method

As Sutton (1998) notes, alpha does not depend on the number of firms in the industry but on the nature of the industry's technology. Alpha cannot be measured directly, but we have to infer the value of this parameter from observable industry characteristics. For the purpose of empirical testing in this study, I will use the concept of external financial dependency as developed by Rajan and Zingales (1989) as a proxy for an industry's alpha. The concept of external financial dependence is defined as a technological characteristic of an industry: it is assumed that there are technological reasons why some industries need more external finance than others. Rajan and Zingales (1989) identified the following determinants of external financial dependency:

1. the extent of the initial project scale;
2. the gestation period;
3. the cash-harvest period; and
4. the requirement for continuing investment.

The first two determinants (the extent of the initial project scale and the gestation period) are associated with the initial set-up (or entry) cost σ in the theoretical model: the higher the extent of the initial project scale and the longer the gestation period, the higher the entry cost σ. The second two determinants (the cash-harvest period and the requirement for continuing investment) are associated with enlargement outlay R in the theoretical model: the longer the cash-harvest period and the higher requirement for continuing investment, the higher the desired R. Therefore, the higher are an industry's σ and R, the higher is its external dependency. Assuming that firms are rational, we should observe higher external dependency in high-alpha industries (i.e. where enlargement operations can result in greater market shares) and lower external dependency in low-alpha industries (i.e. where enlargement operations do not result in greater market shares). Taken together, I believe external financial dependency can serve as a reasonable proxy for an industry's alpha. External financial dependency is operationalised as the difference between investments and cash flow from operations (Rajan & Zingales, 1989). Positive external dependency thus means that the industry's investment needs, due to technological reasons, are higher than its operational cash flows. Negative external dependency means that the industry's investment needs, due to technological reasons, are lower than its operational cash flows.

I use panel data analysis and the fixed-effects (within) approach to empirically estimate the sign and magnitude of the relationship between the banking and product market structures. My panel data structure has three dimensions: industry i (i=1...N), country j (j=1...M) and year t (j=1...T). The unit of observation is industry i, which is observed across different countries and years. The fixed-effects (within) estimator controls for industry-specific heterogeneity by eliminating (demeaning) all the information that does not vary across all three dimensions of data. The parameters are estimated based on the variation around the industry-specific means. The main advantage of using this estimator is that it greatly reduces the problems of omitted variable bias, but the drawback is that it is impossible to estimate the effects of variables that vary only across the country-cum-time dimension of panel data. Because banking concentration is this kind of variable, I cannot estimate its standalone effect on the average firm size. However, I can control for this effect (together with the effects of all other variables that vary across country-cum-time, but not across industries) through its absorption in the total country-cum-time effect. The econometric model is therefore identified by focusing on the differential effect of banking concentration across industries.

This approach was developed by Rajan and Zingales (1998) and also used by e.g. Cetorelli and Gambera (2001), Cetorelli (2004), Bonacorsi di Patti and Dell'Arricia (2004). My approach is most similar to Cetorelli (2004) where the main 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. Based on the theoretical model presented in the previous chapter, I hypothesise that this relationship is not monotonic but is conditional on the industry's alpha (proxied by external financial dependence):

> H1: The effect of banking concentration on product market concentration is moderated by an industry's alpha (as proxied by external financial dependence).

The basic econometric model has a measure of product market concentration as the dependent variable and an interaction term between banking concentration and external financial dependency as the main variable of interest. The common effect of banking concentration, as well as any other factor that varies across country and time, on all industries is absorbed by δ_{1jt}, which is the country-cum-time specific component of the average firm size. The industry-specific component of the average firm size is δ_{2i}. A general reduced-form econometric model may be:

$$Average\ firm\ size_{ijt} = \alpha_{ijt} Bank\ Conc_{jt} \times ED_i + \\ + \beta_{ijt} Control\ variable_{ijt} + \delta_{1jt} + \delta_{2i} + \varepsilon_{ijt} \tag{3.1}$$

where δ_{1jt} controls for the country-cum-time fixed effect, δ_{2i} controls for the industry-specific fixed effect, while ε_{ijt} captures the idiosyncratic error across all three dimensions. The idiosyncratic error is assumed to be normally distributed, with constant variance, uncorrelated between any two country-cum-time observations of each industry, independent of the variables in the model, as well as independent of industry-specific and country-cum-time-specific unobserved heterogeneity.

As in Cetorelli (2001, 2004), concentration in product markets is proxied by average firm size ($Averagefirmsize_{ijt}$), mainly because there is not much other data available at the sector level, but also because this has been a frequently used approach in industrial organisation empirical work. A larger average firm size indicates more concentrated industries and a smaller average firm size indicates less concentrated industries.

Banking market concentration is measured yearly for each country and an interaction term with external financial dependency (ED) of industrial sectors is used to identify its effect ($BankConc_{jt} \times ED_i$). Since banking concentration cannot be zero, the interaction term identifies the change between non-zero and zero ED. If the term is significantly different from zero, this indicates that the effect of banking concentration is different for industries with non-zero ED and I interpret this as evidence that ED (alpha) moderates the effect of banking concentration on product market concentration. A statistically significant interaction term thus supports H1. Given that non-zero ED can be positive or negative, I continue first by estimating the model on subsamples with positive and negative ED, and then also by estimating the model where ED is represented in percentiles of its distribution to avoid the effect of the cut-off at zero ED.

Industry-specific characteristics, beside external financial dependency, that might affect the average firm size are the technical nature of the production process and economies of scale. Country fixed effects are 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 are related to general economic conditions, which are the same for all industries. Following Cetorelli (2004), in the benchmark model I control for country-cum-time effects and the share of an industry's value added. The benchmark model is thus the following:

$$Average\ firm\ size_{ijt} = \alpha_{ijt} BankConc_{jt} \times ED_i + \beta_{ijt} ShareVA_{ijt} + \\ + \delta_{1jt} Dummy_{1jt} + \delta_{2i} Dummy_{2i} + \varepsilon_{ijt} \tag{3.2}$$

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 I also tested other specifications by using total revenues and employment.

$BankConc_{jt} \times ED_i$ is the interaction term between banking concentration for country j in year t and external financial dependency for sector i (ED_i). Banking concentration is alternatively measured by concentration ratios of the three and five largest banks, and Herfindahl-Hirschman'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 is taken from Cetorelli (2001) who, in turn, takes it from Rajan and Zingales (1998). If the coefficient on this term is statistically significant, this supports H1. Because my data are clustered, I use cluster-robust (and heteroscedasticity-robust) standard errors for inference.

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

$Dummy_{1jt}$ is the country-cum-time indicator variable, $Dummy_{2i}$ is the industrial sector indicator variable, and ε_{ijt} is the error term.

3.4 Data and sample

3.4.1 Sample description

I estimate the model on a sample of 25 European countries in the 10-year period between 1995 and 2004. This period well captures the turbulent processes in European banking markets following the Second Banking Coordination Directive in 1993, which initiated changes in the banking market structures of many countries. In this period, there were transitional countries aspiring to become EU members, which typically saw a relatively rapid succession of entry and consolidation periods during the EU accession process that for the majority of them ended in 2004. There were also existing EU members that had to adapt themselves to the rapidly changing conditions of extensive deregulation and liberalisation of banking regulation. On the other hand, this period avoids the overheating years of banking markets before the global financial crisis which erupted in 2007. I use Eurostat's data for industry sectors for 15 old EU member countries[6] and 10 new member countries[7].

I use the industrial data for manufacturing sectors at the 4-digit NACE Rev 1.1 level from Eurostat's New Cronos database. Eurostat's data are classified by NACE code and I therefore first matched it with the ISIC 2 code to allow the use of data on the external financial dependency of industrial sectors. Typically, the three-digit NACE code corresponds quite accurately with the ISIC 3 code and this corresponds relatively closely to ISIC 2. However, there are some cases where it is impossible to accurately translate from the NACE code to the ISIC 2 code. In general, this problem occurred with less important subcategories which do not alter the magnitude of a sector's value added significantly. This matching procedure produced

[6] Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and United Kingdom. Greece was excluded due to the poor quality of data.

[7] Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Slovakia, Slovenia, Poland, and Romania.

data for 33 manufacturing sectors[8].

3.4.2 Data description

3.4.2.1 Dependent variable

The dependent variable in the model is the average firm size of (33) sectors i, in (25) countries j, and (10) years t. I use three variables to measure firm size: value added, turnover, and the number of employees, which I divide by the number of firms in individual sectors (in each country and year) to calculate the average firm size. I deflate the nominal data from Eurostats database with wholesale/producer prices indices (PPI) taken from the IMF's International Financial Statistics (IFS) database and I convert data into USD millions based on the EUR(ECU)/USD exchange rate from IFS and the Federal Reserve Bank of New York. Finally, I take the logarithms of the variables to mitigate the effects of skewness in the distribution. Table 3.1 summarises the main statistics for the variables used in the regression models.

The dependent variable in the benchmark model is the logarithm of value added per enterprise ($LNVA$), measured in constant prices, in USD million. There are 6,274 observations for this variable for 25 countries and 10 years (1995–2004). Most missing observations are associated with Romania, Lithuania and Hungary, with sectors 354, 314 and 361 (Petroleum, Tobacco, and Pottery, respectively), and with the years 1995, 1996 and 1997. Missing observations are foremost

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

Table 3.1: *Summary statistics of main variables*

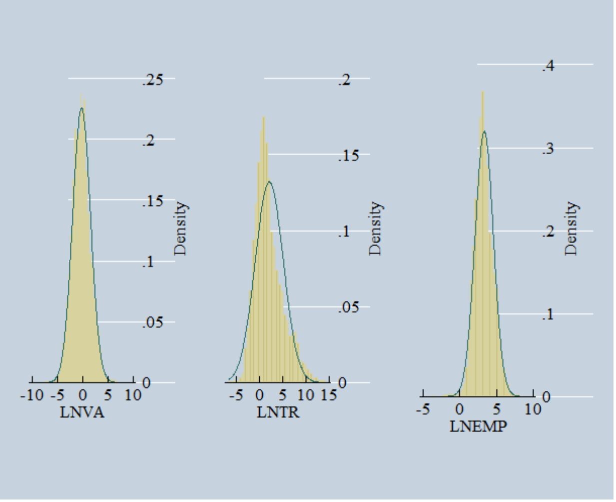
Variable	Obs	Mean	Std. Dev.	Min	Max
Average firm size					
LNVA	6274	−0.256	1.768	−7.396	6.730
LNTR	6304	2.180	3.022	−6.511	14.322
LNEMP	6293	3.324	1.248	−3.656	8.126
Banking concentration					
CR3	6487	0.599	0.189	0.205	0.989
CR5	4950	0.711	0.178	0.327	1.000
HHI	4950	0.178	0.124	0.036	0.610
External dependency					
ED	7994	0.010	0.309	−1.330	0.394
EDpercent	7994	49.906	29.007	1.000	98.000
Control variables					
Share_VA	6898	0.028	0.032	0.000	0.345
Dom_cre	7837	81.068	43.298	10.880	170.620
Priv_cre	7804	68.523	40.970	6.599	158.650
Mar_cap	7944	52.659	50.118	0.019	271.120
Gdp_pc	7994	16300.300	11609.070	1351.733	50536.740
Floans	7994	0.119	0.250	0.009	2.088

Notes: LNVA is the natural logarithm of value added per firm for each industry i, country j and year t. LNTR is the natural logarithm of turnover per firm for each industry i, country j and year t. LNEMP is the natural logarithm of number of employees per firm for each industry i, country j and year t. CR3 (CR5) is the share of the three (five) largest banks' total assets for each country j and year t. HHI is Herfindahl-Hirschman's index for each country j and year t. ED is the external financial dependency of each industry i. EDpercent is the percentile of each industry j in the ED distribution. Share_VA is the share of industry i in total manufacturing value added for each country j and year t. Dom_cre is domestic credit as a percentage of GDP. Priv_cre is domestic credit to the private sector as a percentage of GDP. Mar_cap is the market capitalisation of listed companies as a percentage of GDP. Gdp_pc is GDP per capita in USD. Floans is the ratio of foreign loans to non-banking organisations to GDP.

Sources: Eurostat, Bankscope, Rajan & Zingales (1998), BIS-IMF-OECD-WB External Debt Hub, World Development Indicators database.

due to the missing data for the value added of industries, rather than a missing number of firms. The histogram of the variable shows that it is distributed approximately normally, without prominent outliers (Figure 3.1).

Figure 3.1: *Histograms of variables measuring average firm size*



3.4.2.2 Banking concentration

My main variable of interest is concentration in banking markets. This variable varies by country and year, but not for individual sectors within each country-year. I use Bankscopes data to calculate three banking markets' concentration ratios for the period 1995–2004: concentration ratios *CR3* and *CR5* are calculated as the share of the three and five largest banks' total assets, respectively, while Herfindahl-

Hirschman's Index (HHI) is calculated as:

$$HHI = \sum_{i=1}^{n} \left(\frac{TA_i}{TA} \right)^2 \tag{3.3}$$

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.

I include savings and cooperative banks in the concentration measures because in several countries some of the top three (five) largest banks are categorised in Bankscope as savings and cooperative banks. Since they are effectively also present 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 also 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 (the results are available upon request). On average, Estonia had the most concentrated banking market of all countries included in the analysis (Table 3.2). The average *CR3* and *CR5* were 98% and 99%, respectively. The least concentrated country was Luxembourg with an average *CR3* around 29% of the market.

3.4.2.3 External financial dependency

Consistent with other studies (e.g. Cetorelli, 2004), I use the measure of external financial dependence (ED) developed by Rajan and Zingales (1998). They observe that technological differences between

Table 3.2: *Banking concentration across countries*

Country	**mean(N_Banks)**	**mean(CR3)**	**mean(CR5)**	**mean(HHI)**
Austria	178	0.564	0.615	0.110
Belgium	57	0.743	0.910	0.248
Bulgaria	25	0.490	0.618	0.109
Czech Republic	25	0.659	0.753	0.153
Denmark	93	0.774	0.870	0.335
Estonia	5	0.983	0.999	0.559
Finland	8	0.894	0.980	0.431
France	319	0.379	0.452	0.058
Germany	510	0.381	0.528	0.066
Hungary	25	0.526	0.640	0.121
Ireland	32	0.612	0.752	0.155
Italy	394	0.313	0.401	0.044
Latvia	21	0.540	0.671	0.118
Lithuania	9	0.826	0.929	0.280
Luxembourg	108	0.278	0.365	0.042
Netherland	42	0.775	0.906	0.232
Norway	51	0.707	0.723	0.174
Poland	101	0.426	0.569	0.092
Portugal	42	0.604	0.797	0.178
Romania	27	0.600	0.719	0.172
Slovakia	16	0.632	0.739	0.156
Slovenia	17	0.598	0.728	0.195
Spain	148	0.497	0.603	0.101
Sweden	69	0.808	0.957	0.232
United Kingdom	144	0.431	0.558	0.083

Notes: Mean (N_Banks) is the average number of banks in the period 1995-2004. CR3 (CR5) is the concentration ratio of the three (five) largest banks in the banking market, the mean (CR3 or CR5) refers to the average CR3 (CR5) in the period 1995-2004. HHI is Herfindahl-Hirschman's index, the mean (HHI) refers to the average HHI in the period 1999-2004.

Source: Bankscope.

industrial sectors generate different needs for external funds. Their ED measures the average share of capital expenditure that is not financed by cash from operations, for mature listed companies[9] in the USA in the period 1980–1990. Rajan and Zingales measure the need for external funds for US manufacturing sectors because the demand, rather than the supply, of funds is of interest and it therefore had to be estimated in a country with a well-developed financial market and small financial constraints.

They present four reasons for the external dependence of US 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, a product's cash-harvest period); iii) there is a high correlation between external dependence measured for 1980s and 1970s in the USA, and a high correlation between external dependence measured using Canadian and US 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 despite a noisy measure for external dependency that would create bias against finding such interaction.

In the benchmark regression model, I use ED as calculated by Rajan and Zingales (1998). In variations of the model, I also use the percentile of the observed ED distribution for each sector. Both ED

[9]Mature companies are companies that are present more than 10 years after being first listed.

variables across sectors are shown in Table 3.3.

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 Communication equipment). The external dependency ratio of the 'Radio, TV and Communication' industry is 0.3935, meaning that approximately 40 percent of capital expenditures is typically financed by external sources. A scatter plot of *ED* against average firm size per sector shows there are three candidates for outliers: sectors 323 (Leather industry), 324 (Footwear) and 314 (Tobacco). All three sectors have extremely low ED with respect to their average firm size.

3.4.2.4 Control variables

The control variable *Share_VA* represents the fraction of value added in total manufacturing for individual sectors. There are 6,898 observations for this variable. The distribution of *Share_VA* is skewed to the right as the majority of sectors represent only a small fraction of total manufacturing value added (Figure 3.2). A pairwise correlation (Table 3.5) shows there is no statistically significant correlation between the fraction of value added in total manufacturing, or other control variables, and concentration ratios. There is a moderate correlation with *ED*. This implies that my explanatory variables can be considered as independent and problems due to multicollinearity are unlikely.

For the robustness check section, I use the following institutional variables controlling for general economic and financial markets' conditions: domestic credit provided by the banking sector (*Dom_cre*),

Table 3.3: *External Financial Dependence across Sectors*

ISIC 2		**ED**	**ED_percentile**
311	Food products	−0.0521	22
313	Beverages	−0.1464	15
314	Tobacco	−0.3755	7
321	Textile	0.1410	65
322	Apparel	−0.0201	31
323	Leather	−1.3302	1
324	Footwear	−0.5728	4
331	Wood products	0.2492	90
332	Furniture	0.3292	95
341	Paper and products	0.1044	54
342	Printing and publishing	0.1358	61
352	Other chemicals	−0.1836	12
354	Petroleum and coal products	0.1620	71
355	Rubber products	−0.1226	18
361	Pottery	0.1634	77
362	Glass	0.0310	36
369	Nonmetal products	0.1519	68
371	Iron and steel	0.0871	51
372	Nonferrous material	0.0731	45
381	Metal products	0.0437	42
382	Machinery	0.2166	83
383	Electric machinery	0.2300	86
384	Transportation equipment	0.1632	74
385	Professional goods	0.1937	80
390	Other industries	−0.0513	25
3411	Pulp, paper	0.1268	59
3511	Basic industrial chemicals, excluding fertilisers	0.0753	48
3513	Synthetic resins	−0.2267	10
3522	Drugs	0.0275	34
3825	Office and computing	0.2607	93
3832	Radio	0.3935	98
3841	Ship	0.0409	40
3843	Motor vehicle	0.1096	57

Notes: *ED* is the average external financial dependency for American mature firms in the 1980s. The measure is taken from Rajan and Zingales (1998). *ED_percentile* is the percentile in the distribution of ED.

Source: Rajan & Zingales (1998).

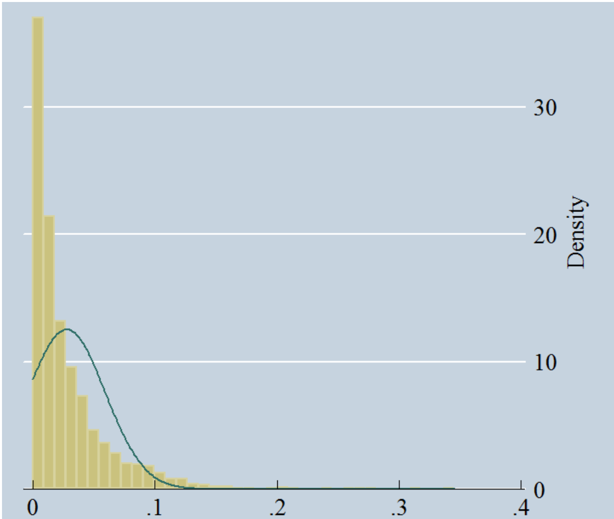
Table 3.4: *Institutional control variables across countries*

Country	**Dom_cre**	**Priv_cre**	**Mar_cap**	**GDP_pc**	**Floans**
Austria	123.725	100.822	17.044	23349	0.040
Belgium	127.416	75.452	77.623	21945	0.100
Bulgaria	33.744	23.994	5.032	1614	0.031
Czech Republic	53.868	49.445	21.965	5590	0.053
Denmark	106.197	89.686	52.738	29048	0.095
Estonia	38.131	26.213	32.681	4067	0.052
Finland	61.690	58.347	123.956	22308	0.080
France	103.251	85.509	71.519	21827	0.053
Germany	139.086	113.005	45.087	22502	0.053
Hungary	61.225	30.942	22.754	4503	0.065
Ireland	103.547	101.129	62.160	24118	0.356
Italia	95.401	69.745	41.870	18756	0.027
Latvia	27.338	20.515	6.825	3366	0.020
Lithuania	17.054	14.209	13.241	3367	0.036
Luxembourg	93.804	102.402	149.690	44315	1.207
Netherland	140.314	125.646	116.936	23237	0.152
Norway	75.829	72.495	39.315	36419	0.078
Poland	33.122	24.553	14.481	4318	0.034
Portugal	118.240	111.880	38.624	10486	0.091
Romania	18.425	10.543	5.020	1798	0.045
Slovakia	54.492	43.762	7.559	3775	0.073
Slovenia	42.651	34.904	14.629	9536	0.056
Spain	115.103	94.220	66.415	13889	0.036
Sweden	104.863	94.707	104.859	26282	0.100
United Kingdom	134.624	131.061	150.396	23844	0.124

Notes: *Dom_cre* is domestic credit as % of GDP; *Priv_cre* is domestic credit to the private sector as % of GDP; *Mar_cap* is the market capitalisation of listed companies as % of GDP; *GDP_pc* is GDP per capita measured in constant (year 2000) US dollars; *Floans* is the ratio of foreign loans to non-banking organisations-to-GDP.

Sources: BIS-IMF-OECD-WB External Debt Hub, World Development Indicators database.

Figure 3.2: *Histogram of Share_VA*



domestic credit to the private sector (*Priv_cre*), the market capitalisation of listed companies (*Mar_cap*), gross domestic product per capita (*Gdp_pc*), and loans to non-banks provided by foreign banks (*Floans*). The data source for the latter is the Joint BIS-IMF-OECD-WB External Debt Hub (at www.jedh.org), while data for other variables come from the World Development Indicators database. The average values across the countries in the sample are presented in Table 3.4.

Domestic credit (*Dom_cre*), domestic credit to the private sector (*Priv_cre*) and the market capitalisation 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 (Figure 3.4). The distribution of the latter is skewed to the right with outliers being 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 organisations to gross domestic product and its distribution is heavily skewed to the right. The outliers with extremely high ratios are observations for Luxembourg (Figure 3.5). GDP per capita is also measured in constant (year 2000) US dollars. The histogram of the variable in Figure 3.5 shows outliers with a very high GDP per capita (Luxembourg) and a bi-modal distribution roughly marking the division of countries into two groups: transitional countries that entered the EU in 2004, and other countries.

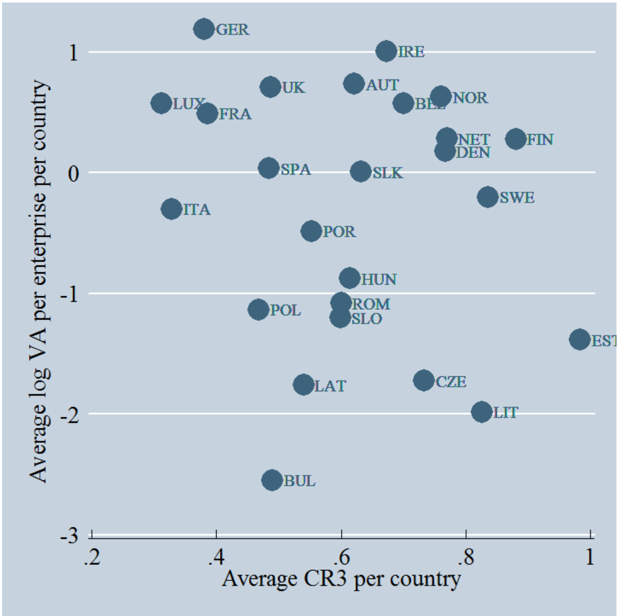
3.4.3 Bivariate analysis of data

The scatter plot of the average concentration ratio *CR3* against average firm size shows Bulgaria having an extremely low average firm size and Estonia having an extremely high average banking concentration, indicating these countries could be potential outliers (Figure 3.3).

Pairwise correlation coefficients show there is a small negative correlation between the average firm size and every one of the three concentration measures, which is statistically significant at 5% (Table 3.5). *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.

Scatter plots of institutional variables against concentration ratio *CR3* show Luxembourg and Ireland as outliers (Figures 3.6 and 3.7). 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 the private sector.

Figure 3.3: *Scatter plot of average firm size vs. concentration ratio, by country*



Pairwise correlation coefficients verify a moderate and statistically significant positive correlation between the average firm size and all these institutional variables, implying that more developed economies have on average larger firms. Pairwise correlations between the share of value added in total manufacturing and institutional variables show mostly a small and statistically significant negative correlation, implying that in economically more developed countries manufacturing sectors on average represent smaller fractions of total manufacturing value added.

Figure 3.4: *Histograms of the control variables Dom_cre, Priv_cre, and Mar_cap*

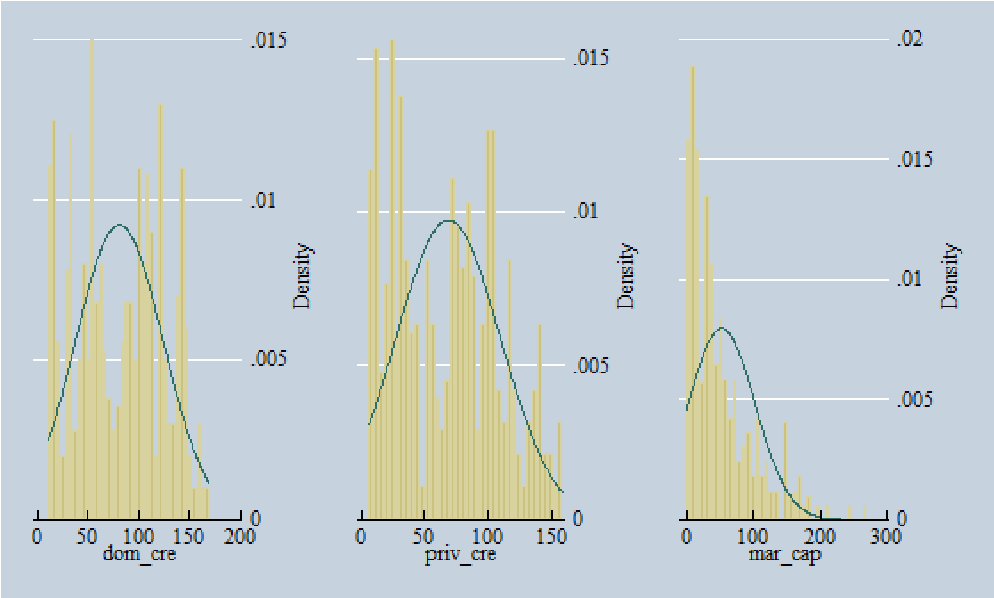


Figure 3.5: *Histograms of the control variables Gdp_pc and Floans*

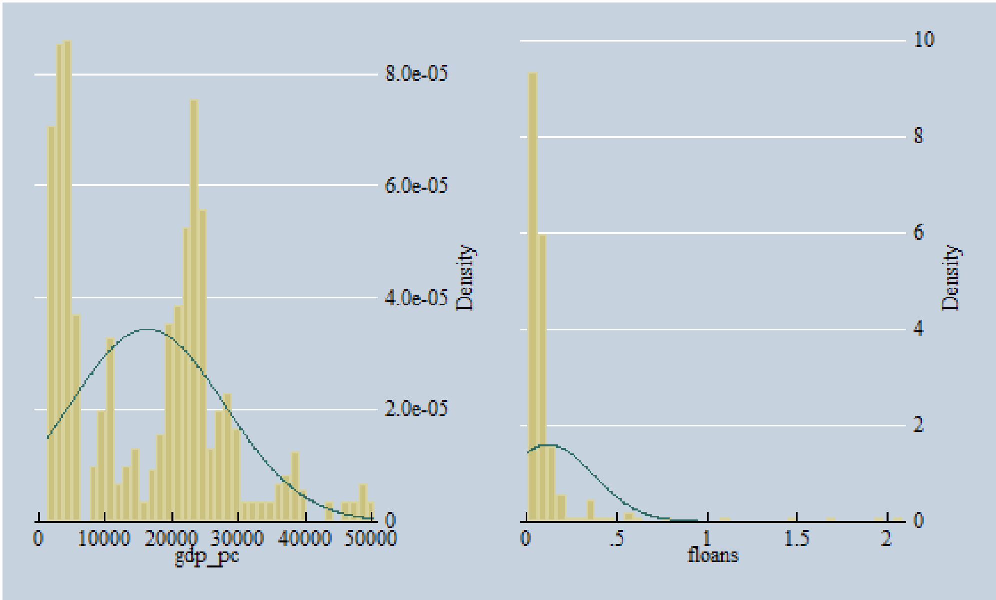


Figure 3.6: *Scatter plot of the institutional control variables vs. concentration ratio, by country*

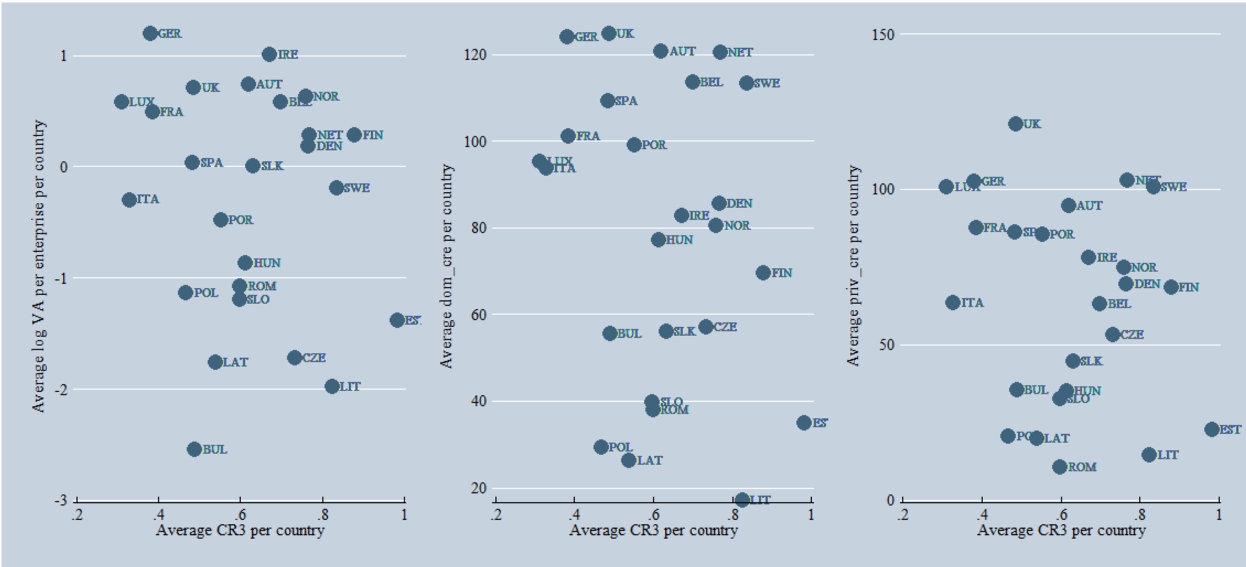


Figure 3.7: *Scatter plot of the institutional control variables vs. concentration ratio, by country*

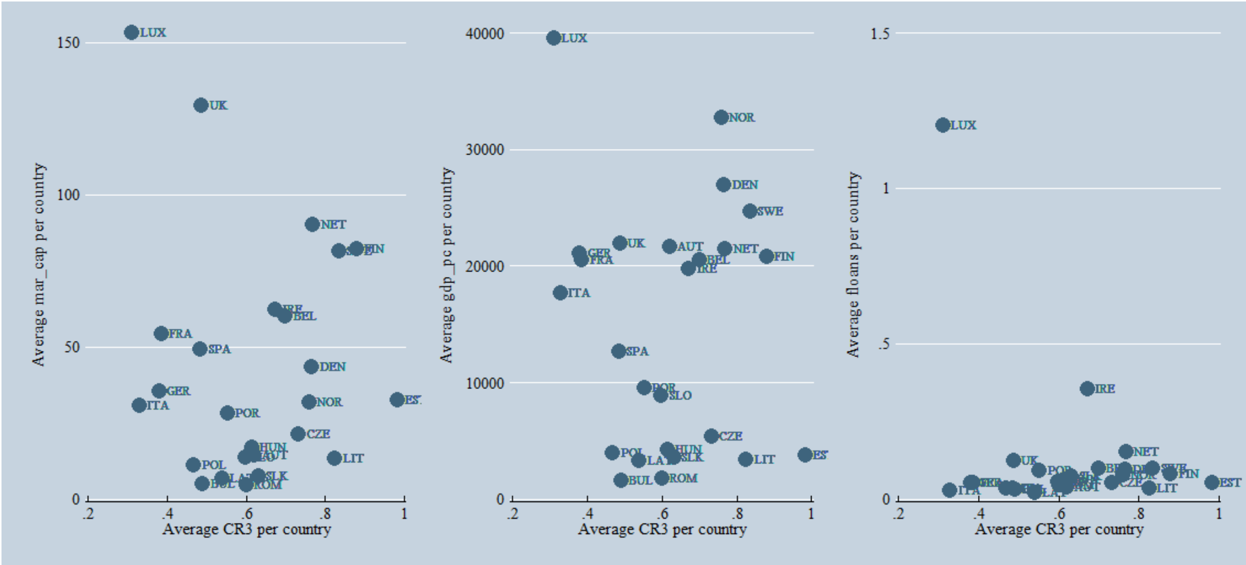


Table 3.5: *Pairwise Correlations*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) LNVA	1						
(2) LNTR	0.6048*	1					
(3) LNEMP	0.7509*	0.4352*	1				
(4) CR3	−0.0457*	−0.2024*	−0.0286*	1			
(5) CR5	−0.0811*	−0.2552*	−0.0385*	0.9838*	1		
(6) HHI	−0.0682*	−0.1969*	−0.0529*	0.8924*	0.8428*	1	
(7) Ext_dep	0.0816*	0.0420*	0.0652*	0.0020	0.0000	0.0000	1
(8) ED_percent	−0.0851*	−0.0562*	−0.0857*	0.0012	0.0000	0.0000	0.7854*
(9) Share_VA	0.1523*	0.0794*	0.1332*	0.0003	0.0084	0.0122	0.2143*
(10) Dom_cre	0.3883*	0.2986*	−0.0448*	−0.0848*	−0.0985*	−0.1378*	0.0070
(11) Priv_cre	0.3790*	0.2787*	−0.0425*	−0.0957*	−0.1156*	−0.1515*	0.0060
(12) Mar_cap	0.2765*	0.1677*	−0.0854*	−0.0022	0.0277	0.0631*	0.0027
(13) Gdp_pc	0.4275*	0.1980*	−0.0794*	−0.0840*	−0.1710*	−0.1057*	0.0048
(14) Floans	0.1437*	0.0960*	0.0110	−0.2839*	−0.3065*	−0.1874*	−0.0006

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(8) ED_percent	1						
(9) Share_VA	0.1480*	1					
(10) Dom_cre	0.0041	−0.0359*	1				
(11) Priv_cre	0.0035	−0.0416*	0.9498*	1			
(12) Mar_cap	0.0016	−0.0295*	0.4874*	0.5594*	1		
(13) Gdp_pc	0.0028	−0.0469*	0.6326*	0.6835*	0.6386*	1	
(14) Floans	−0.0003	−0.0468*	0.1610*	0.2674*	0.3897*	0.5370*	1

Notes: * At a 5 % significance level

3.5 Results

The results of the benchmark estimations are presented in Table 3.6. The coefficient of interest *CR3ED* is positive and statistically significant at a 10 percent level of confidence (column 1). When the institutional control variables are added, the magnitude and significance do not change, indicating there are no confounding effects between the institutional control variables and *CR3ED* (column 2). As explained before, this indicates a positive relationship between banking and real market structures.

Because the variable of interest is an interaction term, the magnitude of the coefficient is difficult to interpret and I rely on graphs to show its meaning. Figure 3.7 demonstrates the estimated relationship between *ED* and the average firm size for three different levels of *CR3* (25th percentile – red line, mean – blue line, 75th percentile – green line), where the other variables are held at their mean values. We can see that the slopes are positive, meaning that at every level of banking concentration sectors with higher *ED* have a larger average firm size. This implies that high-alpha sectors are more concentrated, which is consistent with Sutton's predictions. We can observe that a change in banking market concentration (*CR3*) from a low level (25th percentile – red line) to a high level (75th percentile – green line) results in a smaller average firm size if *ED* is negative, but in a higher average firm size if *ED* is positive (see the violet line showing the difference). This indicates that industries with different needs for external finance are affected differently by banking concentration. Increased banking concentration would translate into more concentrated industries in those industries that are dependent on external sources.

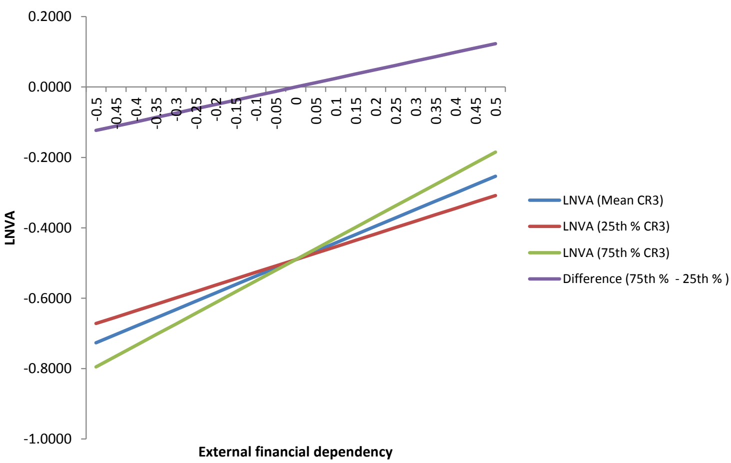
Table 3.6: *Benchmark estimations*

	(1)	(2)	(3) $ED < 0$	(4) $ED > 0$	(5) $ED > 0$
CR3ED	0.793*	0.793*	1.574***	0.594	−13.297**
	0.434	0.434	0.371	1.702	5.801
CR3ED2					36.219**
					13.807
Share_VA	16.986***	16.986***	20.036***	17.083***	16.902***
	1.942	1.942	6.106	2.179	2.116
Dom_cre		0.014***	0.008	0.018***	0.018***
		0.003	0.007	0.003	0.003
Priv_cre		−0.012***	−0.006	−0.017***	−0.016***
		0.003	0.008	0.004	0.004
Mar_cap		0.002***	0.001	0.003***	0.003***
		0.001	0.001	0.001	0.001
Gdp_pc		0.000***	0.000***	0.000***	0.000***
		0.000	0.000	0.000	0.000
Floans		−0.315*	−0.359	−0.216	−0.479*
		0.184	0.310	0.211	0.250
R-squared	0.657	0.657	0.654	0.660	0.663
N	5394	5394	1591	3803	3803

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. Columns 1-2 are a benchmark estimation without/with institutional control variables. Column 3 is estimated on a subsample with negative *ED*. Columns 4-5 are estimated on a subsample with positive *ED*. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (external financial dependency for each industry i); *CR3ED2* is *CR3ED* squared. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

However, increased banking concentration reduces the concentration in industries that are not dependant on external finance. As shown by the violet line, the differential effects are smaller when *ED* is close to 0 and greater when *ED* is more positive or more negative. This supports my hypothesis that the effect of banking concentration is non-monotonic across industries and that it depends on an industry's alpha, as proxied by *ED*.

Figure 3.8: *Predicted average firm size (LNVA) at mean values of the control variables and different levels of banking concentration (CR3) and external financial dependency (ED)*



I next estimate the benchmark model (with institutional control variables included) separately for sub-samples of industries with negative and positive external dependency ($ED > 0$ and $ED > 0$). The results of these estimations are presented in columns 3–5 of Table 3.6. For industries with negative *ED*, we can see a positive (statistically significant) coefficient on the interaction term, which is almost twice as large as in the benchmark estimation for the overall sample. For industries with positive *ED*, we can see that a U-shaped quadratic model fits the data better (column 5). Again, I refer to a graphical representation to interpret the results (Figure 3.8). As before, the figure represents the estimated relationship between *ED* and the average firm size for three different levels of *CR3*, where the other variables are held at their mean values. The left part of Figure 3.8 shows the estimated relationship when *ED* is negative. Similarly as for the overall sample, we can see that an increase in banking concentration (*CR3*) from a low (25th percentile) level to a high (75th percentile) level reduces the average firm size. This implies that higher banking concentration is associated with higher real market concentration and supports the view that both market structures move in the same way. The right part of the figure shows the results for industries with positive *ED*. Here, we can see that an increase in banking concentration reduces the average firm size if *ED* is lower than around 0.35, while it increases the average firm size if *ED* is higher than this. This again supports my hypothesis that the effect of banking concentration depends on an industry's alpha, as proxied by *ED*.

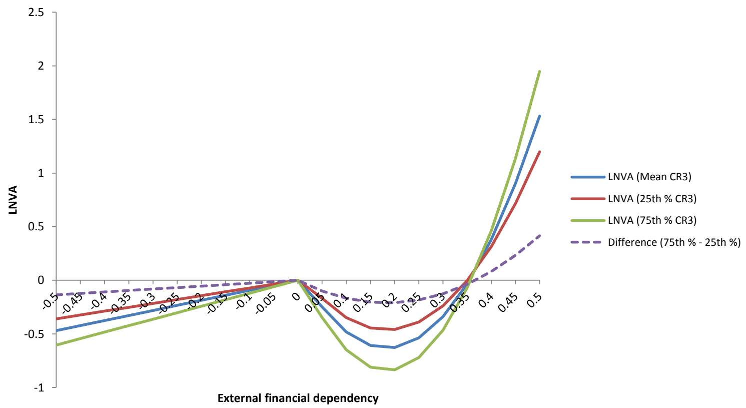
Since the 0 cut-off value for *ED* and the corresponding sample split are somewhat arbitrary, I also estimate models with a more relative measure of external financial dependency. For each industry's actual *ED*, I calculate the percentile in the *ED* distribution and use this in the interaction term *CR3ED*. Columns 1 – 3 in Table 3.7 demonstrate that a cubic model best fits the relationship between the ED percentile and the average firm size. The interpretation of the coefficients is again presented graphically in Figures 3.9 and 3.10.

Table 3.7: *Estimations with percentiles of external financial dependency (ED_percent)*

	(1)	(2)	(3)
CR3EDp	−0.000	0.010	0.155∗∗∗
	0.007	0.025	0.045
CR3EDp2		−0.000	−0.004∗∗∗
		0.000	0.001
CR3EDp3			0.000∗∗∗
			0.000
Share_VA	17.085∗∗∗	17.116∗∗∗	16.929∗∗∗
	1.952	1.958	1.941
Dom_cre	0.014∗∗∗	0.014∗∗∗	0.014∗∗∗
	0.003	0.003	0.003
Priv_cre	−0.012∗∗∗	−0.012∗∗∗	−0.013∗∗∗
	0.003	0.003	0.003
Mar_cap	0.002∗∗∗	0.002∗∗∗	0.002 ∗ ∗
	0.001	0.001	0.001
Gdp_pc	0.000∗∗∗	0.000∗∗∗	0.000∗∗∗
	0.000	0.000	0.000
Floans	−0.335	−0.289	0.067
	0.222	0.280	0.236
R-squared	0.656	0.656	0.661
N	5394	5394	5394

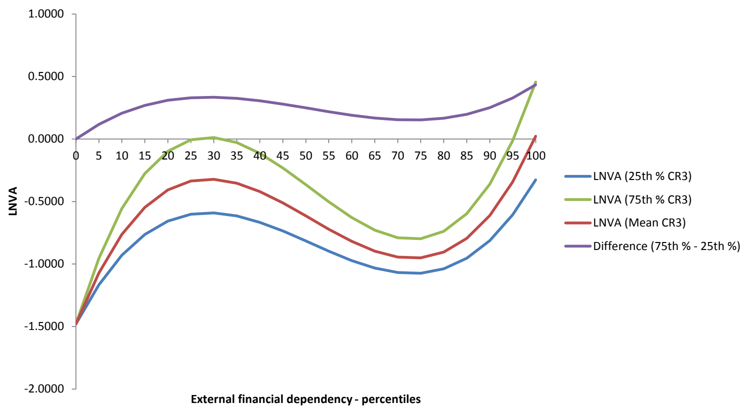
Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR3EDp* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED_percent* (percentile in the distribution of external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Figure 3.9: *Predicted values of average firm size (LNVA) at mean values of the control variables and different levels of banking concentration (CR3) and external financial dependency (ED) from the benchmark model estimated on two subsamples: industries with negative external financial dependency ($ED > 0$) and industries with positive external financial dependency ($ED > 0$) (columns 3 and 5 in Table 3.6)*



The x-axis in Figure 3.9 shows the percentiles of external dependency distribution (from 0 to 100). The green, red and blue lines show the predicted values of the average firm size (in logs) in relation to the percentiles of the observed distribution of *ED* based on the cubic model for three different levels of banking concentration (low level at the 25th percentile, mean, and high level at the 75th percentile). The shape of the curve is similar for all three: there is one peak and one bottom in the relationship, and this directly confirms the non-monotonicity hypothesis. At low and high levels of external dependency, higher *ED*

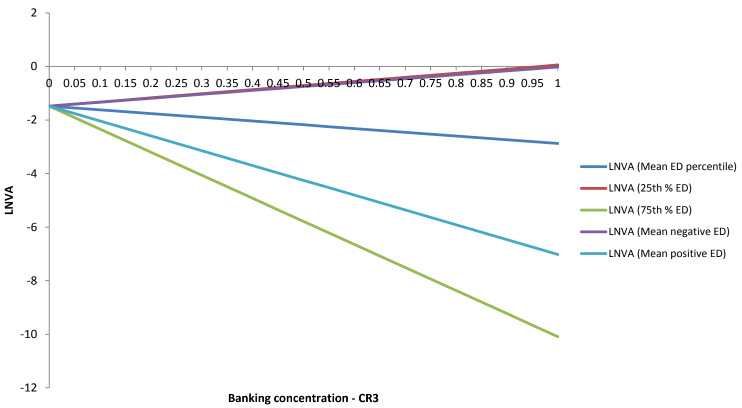
Figure 3.10: *Relationship between percentiles of external financial dependency (ED_percent) and predicted values of average firm size (LNVA) at mean values of the control variables and different levels of banking concentration (CR3) from the cubic model (column 3 in Table 3.7)*



leads to larger size firms, while in medium-range external dependency, higher *ED* leads to smaller firms. This implies that in very low- and very high-alpha industries an increase in alpha (due to a change in technology, for example) leads to more market concentration, while in medium-range alpha industries an increase in alpha leads to lower market concentration. Now we have to look at how a change in banking concentration affects the average firm's size. The violet line shows one such example: a change from a low banking concentration (25th percentile) to high banking concentration (75th percentile). Cetorelli (2004) based the indicator of ED on the median (50 percentile), so he was looking for the difference between industries to the left and to the right of the median and found a positive relationship between banking and product market concentration). In my graph this would show as an upward violet curve: a change in banking concentration from the 25th percentile to the 75th percentile increases the average firm size (concentration) more in sectors with higher ED. Indeed, the violet line increases for sectors with EDs roughly in the lower 30 percent and upper 25 percent of the distribution, but it decreases for sectors with EDs in the medium 30 to 75 percent. This means that sectors with low or very high ED (proxying for alpha) become more concentrated if banking concentration increases, while the medium ED sectors become less concentrated when banking concentration increases. This is roughly in line with the theoretical model in the previous section: zero- and low-alpha industries become more concentrated when banking concentration increases and there is a segment of the low- and high-alpha industries that becomes less concentrated when banking concentration increases.

The effects of changes in banking concentration are more directly shown in Figure 3.10, which presents the same model as before (cubic) but from a different perspective: it has *CR3* on the x-axis and the lines show the effects of *CR3* on average firm size (in logs) at different levels of ED. The red and violet lines show the effect for low-level ED (25 percentile) and mean, negative EDs (14 percentile), respectively. Both lines are upward-sloping and show that at low levels of ED greater banking concentration increases the average firms size and thus also product market concentration. The other three lines (blue, light blue, and green) show the effect of banking concentration at medium and high levels of ED: the overall mean, the mean for the positive ED, and the 75th percentile, respectively. These lines

Figure 3.11: *Relationship between banking concentration (CR3) and predicted values of average firm size (LNVA) at mean values of the control variables and different levels of external financial dependency (ED_percent) from the cubic model (column 3 in Table 3.7)*



have a downward slope, indicating that greater banking concentration decreases the average firm size (product market concentration) for medium and high levels of ED (alpha).

The theoretical model in Chapter 2 predicts that concentrations in very large-alpha sectors are not affected by changes in banking concentration. The empirical results did not show this; instead, we see a positive relationship between both market concentrations at very high levels of ED. This could be a result of one or more of the following empirical limitations: i) the measured *ED* does not capture the alpha completely (measurement error); ii) we do not observe the full distribution of *ED*, perhaps there are other sectors or subsectors that have even higher *ED* and, by including them in the analysis, we would confirm the theoretical result; iii) there could be additional factors affecting the relationship between banking and product concentration in high *ED* (alpha) sectors. Nevertheless, within these limitations, the results confirm the main hypothesis of non-monotonicity in the relationship between both market concentrations due to industries' external financial dependency (and/or industries' alpha).

I check the robustness of results first by changing the measure of the dependent variable: instead of value added, I use turnover and number of employees as measures of firm size. The results presented in Table 3.8 and Table 3.9 remain similar to the original models and do not change my conclusions. Then I change the measure of banking concentration to *CR5* and *HHI*. The results are substantively the same as in the models with *CR3* (Tables 3.10 and 3.11). Next, I check the sensitivity of the results to influential observation by excluding the top and bottom 1 percent of observations in the distributions of the average firm size, *ED*, and *CR3* (Tables 3.12, 3.13, and 3.14, respectively). In all models, the cubic model with *ED_percentile* shows a similar fit and coefficients with a similar magnitude and statistical significance. The coefficient in the benchmark model for the overall sample is not significant at a 10 percent level of confidence anymore, but the models for sub-samples of negative and positive *ED* have similar results as before. Then, I run three models where I eliminate observations from Luxembourg, Bulgaria and Slovakia, respectively (Table 3.15). Again, the results mainly remain similar, the only exception being the benchmark model when Luxembourg is excluded: in this case, the coefficient is significant at p=0.114.

Table 3.8: *Robustness check: the dependent variable is turnover per firm*

	(1)	(2) $ED<0$	(3) $ED>0$	(4)	(5)	(6)
CR3ED	0.921 **	1.544***	−13.712 **			
	0.386	0.422	6.406			
CR3ED2			38.925 **			
			15.516			
CR3EDp				0.002	0.007	0.174***
				0.007	0.025	0.047
CR3EDp2					−0.000	−0.004***
					0.000	0.001
CR3EDp3						0.000***
						0.000
Share_VA	15.790***	15.670 **	16.306***	15.865***	15.879***	15.663***
	1.969	5.126	2.143	1.973	1.970	1.940
Dom_cre	0.028***	0.030***	0.035***	0.028***	0.028***	0.027***
	0.002	0.007	0.003	0.002	0.002	0.002
Priv_cre	−0.039***	−0.041***	−0.052***	−0.039***	−0.040***	−0.041***
	0.003	0.009	0.004	0.003	0.003	0.003
Mar_cap	−0.005***	−0.005***	−0.003***	−0.005***	−0.005***	−0.006***
	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	0.000	0.000	0.000	0.000	0.000	0.000
Floans	3.818***	3.516***	3.981***	3.833***	3.854***	4.264***
	0.218	0.291	0.296	0.250	0.305	0.255
R-squared	0.924	0.930	0.923	0.924	0.924	0.925
N	5391	1590	3801	5391	5391	5391

Notes: *$p<0.1$, **$p<0.05$, ***$p<0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNTR* (the natural logarithm of turnover per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (external financial dependency for each industry i); *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.9: *Robustness check: the dependent variable is number of employees per firm*

	(1)	(2) ED< 0	(3) ED> 0	(4)	(5)	(6)
CR3ED	0.859 ∗ ∗	1.460∗∗∗	−11.460 ∗ ∗			
	0.374	0.422	5.028			
CR3ED2			34.349∗∗∗			
			12.179			
CR3EDp				0.002	0.001	0.137∗∗∗
				0.007	0.025	0.043
CR3EDp2					0.000	−0.003∗∗∗
					0.000	0.001
CR3EDp3						0.000∗∗∗
						0.000
Share_VA	10.934∗∗∗	14.234 ∗ ∗	10.601∗∗∗	11.010∗∗∗	11.007∗∗∗	10.827∗∗∗
	1.759	5.013	1.933	1.763	1.773	1.778
Dom_cre	−0.001	0.000	0.000	−0.001	−0.001	−0.001
	0.003	0.006	0.004	0.003	0.003	0.003
Priv_cre	−0.000	−0.000	−0.001	−0.000	−0.000	−0.001
	0.003	0.007	0.004	0.003	0.003	0.003
Mar_cap	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001∗
	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	−0.000∗∗∗	−0.000 ∗ ∗	−0.000∗∗∗	−0.000∗∗∗	−0.000∗∗∗	−0.000∗∗∗
	0.000	0.000	0.000	0.000	0.000	0.000
Floans	0.534∗∗∗	0.317	0.367	0.543 ∗ ∗	0.539∗	0.874∗∗∗
	0.194	0.307	0.240	0.221	0.282	0.230
R-squared	0.403	0.399	0.409	0.400	0.400	0.409
N	5366	1585	3781	5366	5366	5366

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNEMP* (the natural logarithm of number of employees per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (external financial dependency for each industry i); *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.10: *Robustness check: banking concentration CR5*

	(1)	(2) $ED<0$	(3) $ED>0$	(4) $ED>0$	(5)	(6)	(7)
CR5ED	1.024**	1.771***	1.248	−12.961**			
	0.416	0.413	1.807	6.198			
CR5ED2				36.929**			
				14.377			
CR5EDp					0.002	0.012	0.161***
					0.008	0.026	0.047
CR5EDp2						−0.000	−0.004***
						0.000	0.001
CR5EDp3							0.000***
							0.000
Share_VA	16.836***	19.881***	16.950***	16.761***	16.906***	16.936***	16.748***
	2.005	5.931	2.271	2.220	2.016	2.022	2.009
Dom_cre	0.014***	0.009	0.008***	0.010***	0.014***	0.014***	0.012***
	0.003	0.007	0.003	0.003	0.003	0.003	0.003
Priv_cre	−0.012***	−0.006	−0.000	−0.001	−0.012***	−0.012***	−0.011***
	0.003	0.008	0.004	0.004	0.003	0.003	0.003
Mar_cap	0.002***	0.001	0.001*	0.002***	0.002***	0.002**	0.001
	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Floans	−0.308*	−0.334	−0.553**	−0.767**	−0.300	−0.262	0.046
	0.182	0.308	0.243	0.285	0.214	0.264	0.224
R-squared	0.676	0.674	0.677	0.680	0.674	0.674	0.678
N	4316	1264	3052	3052	4316	4316	4316

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR5ED* is the interaction term between *CR5* (the share of the five largest banks' total assets for each country j and year t) and *ED* (external financial dependency for each industry i); *CR5ED2* is *CR5ED* squared. *CR5EDp* is the interaction term between *CR5* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR5EDp2* is *CR5EDp* squared; *CR5EDp3* is *CR5EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.11: *Robustness check: banking concentration HHI*

	(1)	(2) ED< 0	(3) ED> 0	(4) ED> 0	(5)	(6)	(7)
HHIED	0.972*	1.763***	−0.160	−15.451*			
	0.522	0.478	2.314	8.167			
HHIED2				39.688*			
				19.283			
HHIEDp					0.001	0.027	0.183***
					0.009	0.031	0.061
HHIEDp2						−0.000	−0.004**
						0.000	0.002
HHIEDp3							0.000**
							0.000
Share_VA	16.861***	19.919***	17.037***	16.880***	16.925***	16.986***	16.832***
	2.014	5.917	2.312	2.271	2.027	2.046	2.039
Dom_cre	0.014***	0.008	0.009***	0.009***	0.014***	0.015***	0.016***
	0.003	0.007	0.003	0.003	0.003	0.003	0.003
Priv_cre	−0.012***	−0.005	−0.000	−0.001	−0.012***	−0.013***	−0.015***
	0.003	0.008	0.004	0.004	0.003	0.004	0.003
Mar_cap	0.002***	0.001	0.002**	0.002***	0.002***	0.002***	0.002***
	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Floans	−0.319*	−0.333	−0.607**	−0.716**	−0.322	−0.250	−0.034
	0.182	0.308	0.251	0.270	0.212	0.245	0.223
R-squared	0.675	0.669	0.677	0.679	0.674	0.674	0.676
F	.	.	.	.	.	.	.
N	4316	1264	3052	3052	4316	4316	4316

Notes: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *HHIED* is the interaction term between *HHI* (Herfindahl-Hirschman's Index for each country j and year t) and *ED* (the external financial dependency for each industry i); *HHIED2* is *HHIED* squared. *HHIEDp* is the interaction term between *HHI* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *HHIEDp2* is *HHIEDp* squared; *HHIEDp3* is *HHIEDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.12: *Robustness check: outliers for LNVA*

	(1)	(2) $ED<0$	(3) $ED>0$	(4)	(5)	(6)
CR3ED	0.424	1.062 **	−12.231 **			
	0.391	0.335	5.463			
CR3ED2			33.098 **			
			13.033			
CR3EDp				−0.002	−0.001	0.119***
				0.006	0.021	0.039
CR3EDp2					−0.000	−0.003 **
					0.000	0.001
CR3EDp3						0.000 **
						0.000
Share_VA	17.402***	18.969***	17.534***	17.495***	17.500***	17.281***
	2.248	5.726	2.558	2.254	2.262	2.257
Dom_cre	0.014***	0.007	0.011***	0.014***	0.014***	0.014***
	0.003	0.007	0.002	0.003	0.003	0.003
Priv_cre	−0.012***	−0.005	−0.003	−0.012***	−0.012***	−0.012***
	0.003	0.008	0.002	0.003	0.003	0.003
Mar_cap	0.002***	0.001	0.002***	0.002***	0.002***	0.002***
	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	0.000	0.000	0.000	0.000	0.000	0.000
Floans	−0.310	−0.248	−0.744 **	−0.351	−0.346	−0.047
	0.185	0.313	0.280	0.217	0.265	0.224
R-squared	0.678	0.671	0.685	0.678	0.678	0.681
N	5301	1553	3748	5301	5301	5301

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). The top and bottom 1 percent of the *LNVA* distribution is excluded. *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (the external financial dependency for each industry i); *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.13: *Robustness check: outliers for CR3*

	(1)	(2) ED< 0	(3) ED> 0	(4)	(5)	(6)
CR3ED	0.747	1.568***	−11.374*			
	0.447	0.375	6.167			
CR3ED2			30.350*			
			14.979			
CR3EDp				−0.001	0.012	0.149***
				0.007	0.024	0.047
CR3EDp2					−0.000	−0.004***
					0.000	0.001
CR3EDp3						0.000 * *
						0.000
Share_VA	16.896***	19.640 * *	16.909***	16.995***	17.027***	16.862***
	1.925	6.122	2.098	1.937	1.946	1.929
Dom_cre	0.014***	0.008	0.018***	0.014***	0.014***	0.014***
	0.003	0.007	0.003	0.003	0.003	0.003
Priv_cre	−0.012***	−0.006	−0.016***	−0.012***	−0.012***	−0.013***
	0.003	0.008	0.004	0.003	0.003	0.003
Mar_cap	0.002***	0.001	0.003***	0.002***	0.002***	0.002 * *
	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	0.000	0.000	0.000	0.000	0.000	0.000
Floans	−0.317*	−0.351	−0.455*	−0.346	−0.289	0.044
	0.185	0.312	0.258	0.230	0.278	0.242
R-squared	0.658	0.652	0.664	0.657	0.657	0.661
N	5334	1575	3759	5334	5334	5334

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (the external financial dependency for each industry i). The top and bottom 1 percent of the *CR3* distribution is excluded. *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.14: *Robustness check: outliers for ED*

	(1)	(2) *ED* < 0	(3) *ED* > 0	(4)	(5)	(6)
CR3ED	−0.239	1.466	−15.962*			
	0.980	1.348	7.917			
CR3ED2			46.592**			
			22.263			
CR3EDp				−0.006	−0.001	0.120*
				0.008	0.026	0.064
CR3EDp2					−0.000	−0.003*
					0.000	0.002
CR3EDp3						0.000
						0.000
Share_VA	16.576***	20.765**	16.484***	16.614***	16.620***	16.551***
	2.015	6.290	2.233	2.012	2.016	2.018
Dom_cre	0.014***	0.007	0.018***	0.014***	0.014***	0.013***
	0.003	0.008	0.003	0.003	0.003	0.003
Priv_cre	−0.011***	−0.004	−0.016***	−0.011***	−0.011***	−0.012***
	0.004	0.009	0.004	0.004	0.004	0.004
Mar_cap	0.003***	0.002	0.004***	0.003***	0.003***	0.002***
	0.001	0.001	0.001	0.001	0.001	0.001
Gdp_pc	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	0.000	0.000	0.000	0.000	0.000	0.000
Floans	−0.226	−0.404	−0.332	−0.305	−0.281	0.055
	0.158	0.316	0.195	0.209	0.264	0.282
R-squared	0.663	0.679	0.663	0.664	0.664	0.666
N	5052	1425	3627	5052	5052	5052

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; cluster-robust standard errors reported in the second row; country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (the external financial dependency for each industry i). The top and bottom 1 percent of the *ED* distribution is excluded. *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed. *Share_VA* is the share of industry i in total manufacturing value added for each country j and year t. *Dom_cre* is domestic credit as a percentage of GDP. *Priv_cre* is domestic credit to the private sector as a percentage of GDP. *Mar_cap* is the market capitalisation of listed companies as a percentage of GDP. *Gdp_pc* is GDP per capita in USD. *Floans* is the ratio of foreign loans to non-banking organisations to GDP.

Table 3.15: *Robustness check: outlier countries*

Panel A: Bulgaria excluded

	(1)	(2) $ED < 0$	(3) $ED > 0$	(4)	(5)	(6)
CR3ED	0.782∗	1.461∗∗∗	−14.242 ∗ ∗			
	0.425	0.393	5.857			
CR3ED2			38.504 ∗ ∗			
			13.850			
CR3EDp				0.000	0.011	0.155∗∗∗
				0.007	0.024	0.045
CR3EDp2					−0.000	−0.004∗∗∗
					0.000	0.001
CR3EDp3						0.000∗∗∗
						0.000
R-squared	0.629	0.624	0.636	0.628	0.628	0.633
N	5224	1537	3687	5224	5224	5224

Panel B: Luxembourg excluded

	(1)	(2) $ED < 0$	(3) $ED > 0$	(4)	(5)	(6)
CR3ED	0.735	1.563∗∗∗	−8.034			
	0.452	0.382	6.564			
CR3ED2			19.265			
			16.133			
CR3EDp				−0.001	0.019	0.130 ∗ ∗
				0.007	0.023	0.050
CR3EDp2					−0.000	−0.003 ∗ ∗
					0.000	0.001
CR3EDp3						0.000∗
						0.000
R-squared	0.659	0.652	0.664	0.658	0.658	0.661
N	5268	1554	3714	5268	5268	5268

Notes: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$; cluster-robust standard errors reported in the second row; control variables, country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (the external financial dependency for each industry i). *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed.

Table 3.16: *Robustness check: outlier countries, continued*

Panel C: Slovakia excluded

	(1)	(2) $ED < 0$	(3) $ED > 0$	(4)	(5)	(6)
CR3ED	0.815*	1.602***	−13.277**			
	0.437	0.380	5.791			
CR3ED2			36.217**			
			13.770			
CR3EDp				−0.000	0.010	0.156***
				0.007	0.025	0.045
CR3EDp2					−0.000	−0.004***
					0.000	0.001
CR3EDp3						0.000***
						0.000
R-squared	0.661	0.662	0.665	0.659	0.659	0.664
N	5217	1543	3674	5217	5217	5217

Notes: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$; cluster-robust standard errors reported in the second row; control variables, country-year and sector fixed effects included, but not reported. The dependent variable is *LNVA* (the natural logarithm of value added per firm for each industry i, country j, and year t). *CR3ED* is the interaction term between *CR3* (the share of the three largest banks' total assets for each country j and year t) and *ED* (the external financial dependency for each industry i). *CR3ED2* is *CR3ED* squared. *CR3EDp* is the interaction term between *CR3* and *ED_percent* (percentile in the distribution of the external financial dependency for each industry i); *CR3EDp2* is *CR3EDp* squared; *CR3EDp3* is *CR3EDp* cubed.

3.6 Discussion

The empirical results give support for the main hypothesis: the relationship between banking and product market concentration is not uniform across industries, but is moderated by an industry's alpha (as proxied by the industry's external financial dependency). The cut-off values between positive and negative effects seem to be around the 30th and 75th percentile of the observed external financial dependency distribution. For an easier discussion of results, I will denote the levels below the 30th percentile as low and levels above the 75th percentile as high, but we should bear in mind that these are not absolute criteria.

In industries with low levels of alpha (or external financial dependency), the link between concentration in both markets is positive. This means that an increase in banking concentration increases the product market concentration, i.e. there is a smaller number of larger firms. Specifically, my results show that industries with external financial dependency at the 30th percentile (i.e. -0.02; firms generating cash flows from operations that are 2 percent above their capital expenditures) are affected by changes in banking concentration in this way: a change from a low CR3 at 46 percent to a high at 77 percent is associated with an increase in average firm size that corresponds to 43 percent of one standard deviation in this sample. Based on the theoretical model developed in Chapter 2, I can explain this result as follows. Generally, at low levels of alpha, firms cannot significantly increase their market shares with enlargements and are therefore dependent on providers of external financial sources, including banks, only to obtain funds for financing the entry cost. Banks compete to finance the entry of such companies, but because there is less opportunity for interest-rate smoothing over a longer-term period banks maximise profits in what is essentially a one-period game by charging the maximum interest rates possible. If banking concentration increases, banks have more market power and charge higher interest rates. There is less entry into the industry and hence more concentration. This is consistent with the results of Bertrand, Schoar and Thesmar (2007), Black and Strahan (2002), and Beck, Demirgüç-Kunt and Maksimovic (2004), who find that increased banking concentration provides obstacles to firm financing, entry and growth.

In industries with medium levels of alpha, firms find the enlargement is worthwhile to increase their market shares. Banks can thus compete not only to finance the entry, but also to finance future enlargement operations and interest-rate smoothing across time periods is possible. In more concentrated banking markets, banks have more market power and can therefore exploit interest-rate smoothing: they charge lower interest rates in early periods and higher rates in later periods. This increases entry, but also deflates growth in later stages. The result can be a smaller number of larger firms (a positive link) or a higher number of smaller firms (a negative link), depending on which effect prevails. My empirical results suggest that for industries with medium level of external financial dependency between the 30th and 75th percentile (i.e. industries where typically less than 18 percent of capital expenditure is financed by external sources, but where internally generated cash flows are not more than 2 percent above capital expenditure), the link is negative: product market concentration is reduced because the effect of more entry prevails.

As such, the empirical results are to some extent consistent with the previous findings of Cetorelli and Gambera (2001), Kim, Kristiansen and Vale (2005), and Bonacorsi di Patti and Dell'Arricia (2004), who find that increased banking concentration is favourable for entry in general. In addition, Delis, Kokas and Ongena (2015) find that bank market power has positive real effects, except in the case of very high levels of market power and few loan facilities. The conclusions by Tabak, Guerra and DeSouza Penaloza (2009), Ratti, Lee and Seol (2008), and especially Hoxha (2013) are also consistent with my results.

In industries with higher needs for external financing (i.e. typically more than 18 percent of capital expenditure), the link is positive: product market concentration is increased because the effect of second-stage financing prevails and there are fewer, but larger firms. The magnitude of the effect changes depending on the industry's external financial dependency, but for a median industry (i.e. around 9 percent of capital expenditures financed by external sources) a change from banking market CR3 46 percent to 77 percent is associated with a reduction in average firm size by 40 percent of one standard deviation of the sample.

The main contribution of this chapter to the ongoing discussion of banking markets role in stimulating or abating firm entry and growth is new empirical evidence pointing out the important role of external financial dependency and, more generally, an industry's alpha in studying these effects. The empirical implications are therefore clear: studies of banking market effects in product markets need to take account of the inherent distinctions in technologies, business models, and products of different industries that affect their needs for external financial sources. Although I rely on an established methodology provided by the related literature to obtain comparable results, there are limitations that should be mentioned. First, the results of my study are conditional on the particular time period and sample used for estimations. Future studies could investigate whether these findings can be corroborated in other economic settings. Second, there is potential measurement error in external financial dependency (as a proxy for an industry's alpha) and average firm size (as a proxy for product market concentration). Studies with improved measurement of these variables of interest would thus be welcomed. Future studies could also disentangle the effects on product market concentration through entry and subsequent growth, or other dimensions of market structure (e.g. the toughness of price competition).

CONCLUSION

Recent developments in financial and banking systems around the world demonstrate how important they are for the evolution of firms, industries and economies. Banking market power, competition and concentration are similar, yet distinct, concepts that have been extensively studied in many settings. Nevertheless, relatively little is known about the real effects of banking concentration on market structures in other (non-financial) industries. The common belief is that banking concentration is harmful because it lowers competition and this hinders the entry and growth of firms. However, there is also a strand of literature that documents beneficial effects of banking market power arising due to more concentrated banking markets. The aim of this book is thus to investigate the relationship between market concentrations in banking and product markets, theoretically and empirically. I posed four research questions to guide my work.

First, I asked which determinants of product market structure are affected by conditions in the banking market (RQ1). Contrary to most of the related (theoretical) literature, I approached this question primarily from the perspective of product markets and not banking markets. I based my study on industrial organisation literature, particularly the works of John Sutton (1991, 1998) who models product market structure (concentration) endogenously as a function of three main effects: the toughness of price competition, the externalities effect, and the escalation effect. Of these, I focus on the latter and study how it moderates the effect of banking market concentration.

Second, I asked how different proposed mechanisms explain the link between the market structures of banking and product markets (RQ2). The related literature provides several mechanisms, each explaining either a positive or a negative relationship between the two market structures. To introduce the identified market structure determinants in the analysis, I had to develop a new theoretical model of this relationship based on industrial organisation literature and focused on product market structure. The proposed model acknowledges that the nature of product market competition and the evolution of market structure are significantly shaped by investments in product quality through advertising and R&D. The banking market is introduced as an upstream market, providing financial sources for market entry, as well as for investments in increased product quality aimed at enlarging market share. As such, the conditions in the banking market affect product market concentration differently in markets with various escalation effects.

Third, I questioned how greater banking market concentration affects the structure of product markets (RQ3). The main finding of this theoretical analysis is that the relationship between both market structures is not monotonic but moderated by the industry-specific relationship between exogenous and endogenous fixed and sunk costs. Specifically, my results show that in zero-alpha industries (mainly characterised by exogenous fixed and sunk entry costs), greater banking concentration increases product market concentration. On the other hand, in industries that are characterised by endogenous fixed and sunk cost of enlargement that follow the initial entry cost, greater banking concentration can increase or decrease product market concentration depending on the relationship between the cost of entry and the cost of enlargement. Greater banking concentration reduces product market concentration if the cost of enlargement operations exceeds the initial (exogenous) entry cost. In the opposite case, it increases product market concentration provided that entry cost is above a critical level. The model also shows that large product markets will not experience significant changes in entry and structure when banking concentration is increased.

Fourth, I asked whether there is empirical evidence for the proposed model (RQ4). Indeed, the results of the empirical analysis support the main hypothesis: the relationship between banking and product market concentration is not uniform across industries, but is moderated by an industry's alpha (as proxied by the industry's external financial dependency). Roughly interpreted, the results indicate that industries with either low or high needs for external financial sources for capital expenditure are more concentrated if banking markets are more concentrated. On the other hand, industries with medium needs are less concentrated if banking markets are more concentrated.

The primary policy implications of these results are the following. Particularly small and medium countries' banking authorities should consider the effects that banking concentration brings to different product markets. Banking concentration is not necessarily bad, especially not in markets characterised by endogenous fixed and sunk costs. Therefore, policies and practices regarding entry (licensing), exit, mergers and acquisitions in banking need not *a priori* be restrictive or permissive. For example, the effects of state interventions to stabilise banking and financial systems should also be analysed from the product markets structures perspective. Likewise, the supervision of banks should involve careful monitoring of potentially detrimental competitive pressures that could result from an excessively fragmented banking market. Above all, policymakers should take into account that changes in banking concentrations differently affect the evolution of various industries in the long term. In less concentrated banking markets, some industries could prosper more, but others less.

A large body of related literature has already established that banking concentration importantly affects product market structures and growth. Empirical studies have also shown that firm size and age moderate the effects of banking concentration. My findings contribute to this literature, theoretically as well as empirically, by exposing the moderating role of external financial dependency in this relationship. This line of research can be pursued in various directions to overcome some of the limitations of this study and to gain a deeper understanding of the causal relationships involved. Future theoretical papers could analyse the effects of free entry and capacity constraints in banking markets on entry and growth in product markets. Another possible line of research would entail investigating the role of relationship banking in this respect. More empirical papers studying the roles of particular dimensions of market structure, such as the toughness of price competition and the escalation effect, in other economic settings (time and space) would also be welcomed.

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