Banks as ‘fat cats’: branching and price decisions in a two-stage model of competition

Paolo Coccorese

Department of Economics and Statistics, and CELPE – University of Salerno, Italy

ABSTRACT

In this paper we develop an empirical two-stage model of price competition for the banking industry that incorporates the choice of capacity in the form of new branches. This is achieved by supplementing the customary two-equation framework (demand plus first-order condition in the loan market) with the addition of a third equation that endogenizes the investment decision regarding the branch network. The model is estimated using data on a group of large and medium Italian banks for the years 1995-2009. The results show that the conduct of banks is significantly more competitive than a Bertrand-Nash equilibrium, and support the rejection of the simple one-stage specification, which underestimates the degree of competition. In the taxonomy of Fudenberg and Tirole (1984), the banks in the sample are found to behave as ‘fat cats’, overinvesting in the branch network so as to keep prices high and accommodate entry.

KEYWORDS: Bank branch network; Competition; Market structure; Conduct

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Address:

Paolo Coccorese
Università degli Studi di Salerno
Dipartimento di Scienze Economiche e Statistiche
Via Ponte don Melillo, 84084 Fisciano (SA), Italy
Tel.: (+39) 089-962338 - Fax: (+39) 089-962049
E-mail: coccorese@unisa.it

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1. Introduction

In this paper we formulate and estimate a structural model where banks compete in capacity and prices. Unlike conventional models dealing with the market conduct of firms, which assume that price and quantity are the only endogenous variables, we also aim to account for the influence of an important capacity variable for banks – branch network – on the degree of product market competition.

Steps in this direction have been taken by authors who emphasize the interactions between competition in the output market and in specific input markets, such as R&D, advertising, finance, labour, and capacity. For this purpose, they employ a two-stage set-up and evaluate the sensitivity of the estimated market power of firms to the introduction of these input variables. By making them endogenous, we can gain a clearer insight into a number of interesting issues, for example the link between endogenous costs and market structure (Sutton, 1991), optimal antitrust policy in the presence of more than one strategic variable (Fershtman and Gandal, 1994), the possibility that endogenous capacity may affect conclusions regarding product market competition (Roller and Sickles, 2000), the effects that the degree of competition on the demand for inputs exerts on competition in the product market (Neven et al., 2006), and the impact of labour supply augmenting (LSA) investments when oligopsonistic firms set wages (Dewit and Leahy, 2009).

Existing empirical analyses on price-cost margins and competition in the banking industry usually consider investment decisions as exogenous. The standard approach entails the estimation of a simultaneous-equation model comprising a demand equation and a first-order condition which includes a behavioural parameter identifying the average market conduct of banks in the product market (e.g. Coccorese, 2005), whereas the possibility that an input variable – like capacity – may be used strategically before the bank chooses the optimal level of price or quantity is generally not considered.

Since the choice to open new branches can affect the behaviour of rival banks, treating capacity as an exogenous variable might bias the estimation of both price-cost margins and the degree of competition in the product market. In this paper we endogenize the investment decision regarding the branch network by adding a third equation derived from the long-run maximization problem, when banks are able to change their cost structure through changes in capacity.

Thus, we implement a two-stage set-up that allows us to investigate whether introducing decisions on the branch network (a capacity variable for banks) in the first stage significantly influences the degree of banks' market power in the loan market. If this is the case, a correct assessment of market power in banking industries would also require a careful consideration of properly endogenized input markets.

We test our model using data from the Italian banking sector in the years 1995-2009. The choice of the banking industry seems appropriate for at least three reasons.

Firstly, the setting up of brick and mortar bank branches is undoubtedly an important aspect of (non-price) competition among banks. These are long-run decisions that impose considerable (and usually sunk) costs on banks, while choices on interest rates concern the short run. However, in their lending activity banks need to gather information about resident clientele and local economic conditions so as to evaluate the ability of customers to repay their loan. Hence, the physical presence of branches appears unavoidable and they should be maintained (Corvoisier and Gropp, 2007, p. 2).

Secondly, the business of banks and financial intermediaries is subject to extensive regulation by the various national central banks because of their crucial role in the economy and the presence of considerable informational problems. However, regulation also leads to entry barriers, price restrictions and limitations on the forms of business, with the result that an excessive level of regulation could give banks market power and allow them to charge high mark-ups over costs, thus limiting output (Forni et al., 2010, p. 677).

Finally, in the last few decades the banking markets of many European countries have undergone an intense consolidation process via mergers and acquisitions. This has been generated in particular by the introduction of the single currency, the reduction of cross-border barriers, and the development of information and communication technologies (ICT). In Italy a thorough reorganization of the industry has also taken place (mainly in terms of deregulation and privatization of banks): the number of credit institutions has fallen and their average size has increased, while at the same time the number of branches has grown considerably. This generalized concentration wave calls for an evaluation of whether the degree of competition among banks has changed.

This focus on the Italian context also seems appropriate. As already mentioned, starting from the 1980s important transformations have been made to the Italian banking system, in order to foster market competition. Before 1978, credit authorities had followed a rather cautious attitude in evaluating whether to allow the establishment of new local bank offices, and their opening was subject to discretionary economic criteria devoid of any automatic procedure. After the approval of the First European Directive (1977), the Bank of Italy issued three 'branch distribution plans' (1978, 1982, 1986), i.e. regulatory measures for the opening of new branches: they were intended to progressively relax geographical restrictions on lending and lower the barriers to entry in local markets. Finally, in March 1990 the possibility to set up new bank offices was fully liberalized.

Since then, many important changes have taken place in the Italian banking sector. In the early 1990s, there was a large number of small banks operating in limited geographical areas, while public banks (i.e. banks controlled by the Treasury, by municipalities or by other public bodies) held almost 70% of total assets. Regulatory reforms were introduced during the nineties in order to reorganize the industry and improve efficiency and performance.[1] These led to a substantial change in the nature of the national banking system. The share of assets in the hands of public banking entities fell from 68% in 1992 to 9% in 2003. In the period 1998-2007, 300 Italian banks were involved in mergers and acquisitions that concerned more than 50 per cent of the total assets of credit institutions.

This consolidation process brought about an increase in concentration, also due to the worldwide deregulation of capital markets, the harmonization of financial legislations (especially within the EU), the rapid progress of ICT, and a generalized reduction of entry barriers. From 1990 to 2009 the number of Italian banks fell from 1064 to 788 (-25.9%).

In parallel with this reduction, there was a major increase in the number of branches, which led to an increase in banks' presence throughout the country. Branches grew from 16,596 in 1990 to 34,036 in 2009 (+105.1%), with outstanding growth rates in the period 1990-1994 and, to a lesser extent, from 1995 to 2001 (see Table 1). This was a nationwide pattern, with only slight differences between the various regions, and resulted in a marked transformation of the overall financial market. The period 1990-2009 also saw an increase in the loans to GDP ratio from 57.8% to 102.8%, in the share of municipalities with at least one branch from 62.9% to 73.1%, in the average number of branches per municipality from 2 to 4.2 (+110%), in the average number of branches per bank from 15.6 to 43.2 (+176.9%), and in the average number of branches per million inhabitants from 292.6 to 564.8 (+93%).

INSERT TABLE 1 ABOUT HERE

It is therefore crucial that the degree of competition in the Italian banking sector be carefully assessed: this heightened market concentration (caused by the fall in the number of credit

[1] For details, see OECD (2010), pp. 144-151.

institutions) might have increased the market power of incumbent banks. Although previous studies for Italy (and for several other banking markets as well) have rejected this hypothesis, further investigations that also take other factors into account, such as optimal investment in the branch network, seem to help in achieving a clear understanding of the strategic choices of banks and their influence on the system as a whole.[2]

It is also worth noting that our approach is based on a robust theoretical background and, compared to other studies on the Italian banking sector (e.g. Cerasi et al., 2000, 2002), does not assume any predetermined market structure, since we are aim to estimate an endogenous conjectural variation parameter that is able to categorize ex post the type of competition among banks.

This paper is organised as follows. Section 2 reviews the literature on the branching behaviour of banks and competition models. Sections 3 and 4 describe the theoretical model and its functional specifications for the banking industry, respectively. Section 5 presents the data and the estimation procedure, while Section 6 discusses the empirical results. Section 7 concludes.

2. Banking, branching decisions and competition: a review of the literature

2.1. Bank branch decisions

The investigation of interest margins and Lerner indices is a direct way of obtaining information on the average mark-up of prices over costs, and therefore on banks' profitability. For example, Corvoisier and Gropp (2002) and Maudos and Fernandez de Guevara (2007) employ these measures for the European banking system.

Price-based indicators of competition have recently been augmented with non-price measures of competitive behaviour, under the hypothesis that banks may substitute or complement them in certain instances (Carbo et al., 2009). Indeed, non-price strategies in imperfect competition markets may help firms to differentiate themselves and thus extract market power. In the context of non-price competition devices, it is regarded as valuable to investigate firms' choice of capacity, which makes it possible to account for strategic moves. In particular, the banks' branching decision is a critical issue.

Branches represent the main interface between banks and clientele. Their territorial distribution is crucial for the providing of financial services, as they both collect deposits and grant loans. The branch network also plays a decisive role in facilitating the provision and processing of information.

[2] In spite of this marked consolidation, the banking market concentration in Italy still remains relatively small compared to other EU member states: in 2009 the Herfindahl index for Italian credit institutions (calculated on total assets) was 353, the lowest value in Europe after Germany and Luxembourg (ECB, 2010, p. 36).

It helps to obtain and handle borrower-specific information in local geographical areas, improving the overall quality of the loan portfolio. In this respect, Jayaratne and Strahan (1996) show that the relaxation of the US branching regulation has played an important role in the increase in the rate of real per capita growth in income and output, because branch network proliferation has improved loan monitoring and screening.

Setting up a bricks and mortar branch is an investment that can secure profits in the future, but it often represents a sunk cost for banks. It may be rewarding in areas where income is either high or expected to grow fast but, on the other hand, in a competitive landscape profits cannot always be accurately estimated and correcting a wrong choice made in locating a branch in a given town or area is quite costly. Hence, a bank that owns many branches in a region has much to lose and would be willing to deter entry; however, this strategy is not easy to implement in contestable markets and one possibility is that incumbent banks may saturate the market with their own branches, with a view to exploiting economies of scale due to the network effect.

As Gual (1999) notes, banks can compete through both interest rates and service quality. In the latter case, expanding the branch network may facilitate clients' access to the bank, thus improving customer service. Matching the clientele's preferences on locations thus helps to mitigate competition in interest rates. However, these two dimensions of competition are not independent: on the one hand, the larger the number of branches in a market, the tougher the competition on interest rates; on the other hand, the degree of competition on interest rates affects the incentive to expand geographical presence in order to secure higher profits from a wider branch network (Cerasi et al., 2000, 2002).

The choice of location for *de novo* branches is one of the main strategic devices that Italian banks have employed in recent decades in order to face up to competition in the various provincial markets.[3] In Italy the role of banks in the provision of funds is still decisive: since the average size of Italian firms is quite small, entrepreneurs are highly dependent on banks for short-term credit and for funds which allow flexibility in responding to shocks (Calcagnini et al., 2002). Studies on banks' branching behaviour in Italy became popular after branch deregulation was introduced in the late eighties. De Bonis et al. (1998) prove that branch expansion between 1990 and 1996 reduced concentration in provincial markets, but mergers increased it at a national level. Calcagnini et al. (2002) propose a model that aims to explain the reasons why Italian banks decide to open new branches in a province. They find, by means of a tobit regression for the years 1992-1996, that this choice is influenced by the existing market structure, by recent past branch expansion of the bank

[3] In Italy, the province (*provincia*) is an administrative district comprising a larger town or city and several small neighbouring towns. By and large, it corresponds to a US county.

and its rivals, by the bank's previous presence in the province, and by the fact that many municipalities in the province are still unserved.

Cerasi et al. (2000) focus on the period 1989-1995, finding that the cost of opening branches fell but the overall degree of competition of each local market did not significantly increase.

While estimating a monopolistic competition two-stage model for the years 1990-1996 (see Section 2.3), Cerasi et al. (2002) find that there were incentives for Italian banks to open new branches, as the marginal benefits of branching outweighed marginal costs.

Using data on 729 individual banks' lending in 95 Italian local markets over the period 1986-1996, Bofondi and Gobbi (2006) find that loan default rates were significantly higher for those banks that entered local markets without opening a branch. This means that having a branch on site may help to reduce the informational disadvantage.

2.2. Banking competition

The measurement of competition in the banking industry is a fundamental issue, especially because the existing literature is divided on whether or not competition in the banking sector promotes stability. The "competition-fragility" view claims that competition among banks reduces market power and profit margins, thus encouraging banks' risk taking, while the alternative "competition-stability" view maintains that a higher degree of market power in the loan market may result in higher bank risk, since higher loan interest rates make it harder to repay loans and hence amplify adverse selection and moral hazard problems (Berger et al., 2009).

Relying on the structure-conduct-performance (SCP) literature, many authors and policymakers have used bank concentration indicators (such as the concentration ratio or the Herfindahl-Hirschman index) as a proxy for competitive conditions: banks in more concentrated markets should be able to charge higher rates on loans (and pay lower rates on deposits), making prices and profits positively correlated with concentration. However, recent studies have shown that concentration is an unsuitable measure to assess the degree of competition; for example, Claessens and Laeven (2004) do not find any empirical evidence supporting the inverse relationship between concentration and competition, while Berger et al. (2004) emphasize that the above concentration measures have only very weak relationships with measures of profitability when the market share of firms is also included in the regression equation. This evidence could be justified by the efficient structure (ES) hypothesis, under which high concentration endogenously reflects the market share gains of efficient firms (Rhoades, 1985; Smirlock, 1985), or by a more general problem of endogeneity in SCP tests, in which prices, profitability, and concentration are all jointly endogenous (Bresnahan, 1989).

In order to assess oligopoly conduct, the latest empirical studies mostly employ the so-called ‘new empirical industrial organization’ (NEIO) approach, which relies on non-structural models inferring market power from the observation of firms’ conduct and requiring the estimation of equations based on theoretical frameworks of price and output determination. More specifically, these models aim to test conduct by directly addressing firms’ behaviour through the estimation of a parameter that can be interpreted as a conjectural variation coefficient (Iwata, 1974; Appelbaum, 1979, 1982; Roberts, 1984) or as the deviation of the perceived marginal revenue schedule of a firm in the industry from the demand schedule (Bresnahan, 1982, 1989; Lau, 1982; Alexander, 1988). However, they generally consider only one strategic variable, usually price or quantity.[4]

NEIO techniques have been applied in banking markets by Shaffer (1989, 1993, 2004), Berg and Kim (1994), Shaffer and DiSalvo (1994), Coccorese (1998, 2005, 2009), Neven and Roller (1999), Toolsema (2002), Angelini and Cetorelli (2003), Canhoto (2004), and Uchida and Tsutsui (2005). These studies cover different countries and provide some mixed evidence; however, imperfect competition in banking markets is the predominant and most noteworthy result.

Panzar and Rosse (1987) propose the calculation of an *H*-statistic, given by the sum of the elasticities of total revenues with respect to input prices. It reflects the degree to which input price changes are passed on to output prices and to changes in output volume. The advantage of this approach lies in the use of more readily available data. Estimations of the *H*-statistic have been recently provided by Claessens and Laeven (2004), Coccorese (2004), Bikker et al. (2006), Bikker et al. (2007), and Bikker et al. (2011).

Boone et al. (2007) and Boone (2008) suggest employing the elasticity of firms’ profits with respect to their cost level as a measure of competition: a higher value of this profit elasticity would indicate more intense competition. They show that it is highly correlated with the price-cost margin, but the latter tends to misrepresent the development of competition over time in markets with few firms and a high concentration, concluding that profit elasticity is a more reliable measure of competition. An application of this competition index to banking has been provided by van Leuvensteijn et al. (2011), who study the lending markets in eight countries (France, Germany, Italy, Netherlands, Spain, UK, US and Japan) over the period 1994-2004.[5]

2.3. “Two-stage” competition

Using data on the European airline industry for the period 1976-1990, Roller and Sickles (2000) have explicitly estimated a three-equation, two-stage structural model that considers competition in

[4] For an exhaustive survey, see Bresnahan (1989).
[5] See Bikker and Spierdijk (2010) for a thorough review on studies concerning competition on financial markets.

capacity and prices: particularly, in the first stage firms make capacity decisions, and a product-differentiated, price-setting game follows in the second stage. Estimation results show that higher investments in stage one induce a softer action by rival firms in stage two. Thus, they reject a simple one-stage specification in favour of a two-stage set-up and find that some degree of market power in the product market exists, although it is significantly lower than in the one-stage model. In other words, firms’ market power in the product market is significantly overestimated if capacity competition is not accounted for.

Neven et al. (2006) also consider the airline industry and estimate price-cost margins when firms bargain over wages. They implement a three-equation model using data for eight European airlines in the years 1976-1994, and show that the treatment of endogenous costs has important implications for the measurement of price-cost margins and the assessment of market power. In particular, their main results are that margins affect costs and vice versa, and that observed prices in Europe are virtually identical to monopoly prices only when costs are regarded as endogenous, even though observed margins are consistent with a Nash behaviour.

An analogous theoretical background supports the study of Ma (2005), who develops a model in order to explain excess capacity in the Taiwanese flour industry. Here the expected effect of a firm’s first-stage investment on its rivals’ output in the second stage is introduced, and the empirical evidence is that a large capacity built in the first period can be used strategically to reduce the other firms’ output in the second period. This causes an overinvestment in the first stage and hence a misallocation of resources.

The close relationship between price competition and geographical location in banking suggests the adoption of a model of bank behaviour that jointly considers the choices on interest rates and branching. Several studies on banks’ behaviour concentrate on the importance of this form of non-price competition and its effects on banking markets.

Within a spatial competition model, Barros (1999) examines pricing decisions in the Portuguese commercial banking sector in the presence of product differentiation induced by location in local markets. He concludes that the measurement of market power and the explanation of margins in the banking industry must take into account the local market nature of the activity, and hence require a deeper understanding of branching strategies and their interactions with price policies.

Pinho (2000) estimates a system of three equations for Portugal, where advertising expenditures and branches are regarded as non-price strategic variables, and finds that, while the combined effects of deregulation and reduced concentration have had a significant and positive impact on the use of advertising as a competitive instrument, no such effect is detected for branching expansion.

Kim and Vale (2001) consider the role of the branch network in the provision of loans in Norway and estimate a model of branching decision where banks explicitly take into account both their own existing network and their expectation of rivals' choices. They set up a non-price oligopolistic model of bank behaviour in the loans market, while also analyzing the role of the branch network in banks' behaviour and testing oligopolistic conduct in this sector. In their model, banks are able to consider their rivals' future reactions to their own introduction of new branches; the analysis provides evidence that banks are interdependent in their branching decisions, taking into consideration the future response from rival banks, and also that branching has a significant effect on banks' market shares, but not on market demand.

Cerasi et al. (2002) employ a monopolistic competition model in order to measure branching costs and competitiveness for nine European banking industries, where banks are assumed to make strategic decisions on the size of their branching network by anticipating the degree of competition on interest rates. According to their results, the impact of the various European directives to deregulate the banking industry has led to a general increase in the degree of competition.

Carbo et al. (2009) start from the analysis of Kim and Vale (2001) to build a model where banks can compete with rivals in prices for deposits and loans as well as in branches. They fit this model to a sample of data for the Spanish banking system, and their results reveal that price competition in Spain decreased in the loan market but increased in the deposit market over the period 1986-2002, and also that the relative intensity of price versus non-price competition varied over time.

Our analysis shares its basic features with the structural model developed by Roller and Sickles (2000) for the European airline industry. In what follows, we estimate a two-stage price-setting model for the Italian banking loan market: banks simultaneously decide whether to set up new branches (capacity) in the first stage, and then choose prices in the second stage. Hence, unlike previous structural models of competition in banking, we add a stage preceding the choice regarding prices, and treat capacity as an endogenous variable (determined in the first stage) that affects both production costs and market competition (in the second stage). This framework should allow us to discover the effects of an individual bank's long-run capital investments on short-run price decisions.

Branches can be regarded as a quasi-fixed input in bank production, and represent a substantial proportion of banks' investment in physical capital. They generally show little variability in the short run as a result of the severity of short-run adjustment costs (Hunter and Timme, 1995, p. 167). Our choice of banks' branches as a measure of capacity is justified by the fact that over-branching is often taken as a good empirical proxy for excess capacity: particularly, over-branching is considered as a simple indicator of the density of the branch network and can be used to a certain extent as a simplified measure to qualify excess capacity (Ayadi and Pujals, 2004, p. 36). Besides, one of the most frequently used indicators of capacity in banking studies is total fixed assets (e.g. Yildirim and Philippatos, 2007), which normally exhibit a high correlation with the number of branches,[6] the latter often being employed also for the calculation of the unit price of banks' capital (e.g. Nathan and Neave, 1989). Of course, our simple measure does not account for real capacity utilization, i.e. the ratio between actual output and capacity output, but this figure is not known and therefore would need to be estimated by means of econometric techniques.[7]

As Table 1 points out, our sample period (1995-2009) does not include the years 1990 to 1994, when the greatest expansion of banks' branches took place at annual growth rates constantly in excess of 5% as a result of the liberalization of branch opening (March 1990). In our opinion, this will allow a better identification of the "real" strategic choices that pushed banks to expand their branch network.

3. The theoretical model

At year t, each bank faces the following demand for loans:

$$q_{it} = q_{it}(p_{it}, p_{jt}, Z_{it}) \quad i = 1,...,N\ , \tag{1}$$

where N is the number of banks at year t, q_{it} is the quantity of loans demanded, p_{it} is the price of loans charged by bank i, p_{jt} is an index of the rivals' prices, and Z_{it} is a vector of exogenous variables affecting loans.

The own-price effect on demand, $\partial q_{it}/\partial p_{it}$, and the cross-price effect on demand, $\partial q_{it}/\partial p_{jt}$, are assumed to be negative and positive, respectively. The value of the latter is also expected to be high provided that loans are considered as good substitutes across banks.

We assume that both short-run and long-run decisions on cost structure are able to affect banks' profitability. In the short run, costs (as well as demand and profits) are influenced only by variations in the price of output (loan rate) through q_{it}; in the long run, banks can vary their cost structure also by means of changes in capacity (branches, here indicated as BR_{it}). As a result, the long-run cost function is:

[6] In a sample of Italian banks drawn from the Bankscope database and covering the years 1995-2009 (4100 observations), the correlation between the number of branches and the value of total fixed assets amounts to +0.9054.
[7] For a constructive discussion on conceptual and empirical aspects of excess capacity in banking, see Davis and Salo (2000).

$$C_{it}^{LR}(q_i(\cdot), BR_{it} \mid r_{it}, \omega_{it}) = C_{it}^{SR}(q_{it}(\cdot) \mid BR_{it}, \omega_i) + r_{it}BR_{it} , \tag{2}$$

where $C_{it}^{LR}(\cdot)$ and $C_{it}^{SR}(\cdot)$ represent the long-run and the short-run specifications of the cost function, respectively. Short-run (variable) costs depend only on quantity, given a level of capacity BR_{it} and other input prices ω_{it}. In the long run, the level of capacity also becomes variable and can be purchased at its price r_{it}.

In the second stage, each bank has to choose p_{it} such that it maximizes the following profit function (we omit the subscript t for convenience's sake):

$$\pi_i = q_i(\cdot)p_i - C_i^{SR}(q_i(\cdot) \mid BR_i, \omega_i) . \tag{3}$$

The corresponding first-order condition is:

$$\frac{\partial \pi_i}{\partial p_i} = q_i + \left(p_i - MC_i\right)\left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial p_i}\right) = 0 \ , \tag{4}$$

where $MC_i = \partial C_i^{SR}/\partial q_i$ is the short-run marginal cost.

Rearranging (4), we get:

$$\frac{p_i - MC_i}{p_i} = -\frac{1}{\varepsilon_{ii} + \lambda \varepsilon_{ij}\dfrac{p_i}{pj}} \ , \tag{5}$$

where $\varepsilon_{ii} = \dfrac{\partial q_i}{\partial p_i}\dfrac{p_i}{q_i}$ and $\varepsilon_{ij} = \dfrac{\partial q_i}{\partial p_j}\dfrac{p_j}{q_i}$ are the own-price elasticity and the cross-price elasticity of demand for loans, respectively, and $\lambda = \dfrac{\partial p_j}{\partial p_i}$ is the conjectural variation parameter of firm i. If correctly identified, λ expresses the degree of coordination of banks. When $\lambda > 0$, a bank expects its rivals to match its price, thus helping to keep revenues at a profitable level; perfectly collusive behaviour implies that λ equals one. When $\lambda = 0$, the behaviour foreshadows a Nash equilibrium in prices: each bank neither considers rivals' choices when setting its price nor reacts when they change their behaviour. Finally, if $\lambda < 0$, a bank wishing to increase its price expects its rivals to react competitively and therefore reduce their prices (Martin, 1993, p. 25): perfect competition requires that $\lambda = -\infty$, so that (5) turns into the well-known $p = MC$ condition. In line with the relevant literature (e.g.: Farrell and Shapiro, 1990; Roller and Sickles, 2000), we assume that the conjectural variation is the same across all banks.

Let us indicate the solution of this (second-stage) maximization problem as $p_i^* = p_i(BR_i, BR_j)$, where BR_j represents the capacity choice of the other banks. Since capacity is committed before a bank chooses its price, the investment decision can be used strategically: one bank can influence its rivals' prices through its choice of branches.

In the first stage, banks have to select the capacity level (branches) BR_i that maximizes:

$$\pi_i = q_i(\cdot)p^*_i - C_i^{LR}(C_i^{SR}, BR_i) = q_i(p^*_i, p^*_j, Z_i)p^*_i - C_i^{SR}(q_i(p^*_i, p^*_j, Z_i) \mid BR_i, \omega_i) - r_i BR_i\ . \quad (6)$$

After some manipulations (see Appendix A), we get:

$$\frac{\partial \pi_i}{\partial BR_i} = \left[-\frac{\partial C_i^{SR}}{\partial BR_i} - r_i \right] + \left(p_i - MC_i \right) \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial BR_i} = 0\ . \quad (7)$$

In line with Fudenberg and Tirole (1984), the above formula states that the total effect of a capacity investment BR_i by bank i on its own profits can be decomposed into two effects. By changing BR_i, bank i has a *direct* effect on π_i, i.e. $-\frac{\partial C_i^{SR}}{\partial BR_i} - r_i$, which is linked to the amount of the first-stage investment: more in depth, it depends on how short-run costs are affected by this investment as well as on the price of a unit of capacity. Clearly, this effect has no influence on the price of rival banks.

In addition, because of the two-stage specification there is also a *strategic* effect, i.e. $\left(p_i - MC_i \right) \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial BR_i}$, which accounts for the influence of bank i's capacity investment on the price of bank j in the second stage. Whenever this strategic effect is zero, there is no need to specify a two-stage framework, and the sole direct effect is able to capture the impact of capacity decisions on profits (by way of a one-stage simultaneous-move price game). On the other hand, if the strategic effect does exist, the first-stage investment of bank i can be used to strategically affect the other firms' choice in the second stage.

In our framework, the decision of bank i to open a new branch depends on how this choice will affect its own profits (direct effect), but also on how the other competitors will react (strategic effect). Opening a new office affects bank i's fixed costs because of the expenses it entails, but it may have an additional (either positive or negative) effect on short-run costs, e.g. due to productive reorganisation or factor reallocation that a greater clientele can generate. Moreover, it impacts on the other banks as well, given that it is likely to cause a migration of clients; the rivals could therefore react by modifying their decision variable (here, price), which will in turn affect bank *i*'s demand and profits.[8]

The hypothesis that the Italian banking sector is characterized by an oligopolistic structure is well established today. Previous studies have shown that the largest credit institutions are characterised by a conduct close to the Bertrand-Nash outcome (Coccorese, 2005), and that the Lerner index is normally positive for banks (Angelini and Cetorelli, 2003). These findings ensure that $p_i - MC_i > 0$; furthermore, by definition $\partial q_i/\partial p_j > 0$. As a result, the existence and the sign of the strategic effect depend on the term $\partial p_j/\partial BR_i$.

Since banks compete in prices in the second stage, choice variables are strategic complements. If $\partial p_j/\partial BR_i < 0$, an increase in BR_i causes a drop in both p_j and π_i: in the terminology of Fudenberg and Tirole (1984), the investment in capacity makes banks 'tough', and they must adopt a 'puppy dog' strategy, i.e. underinvest in capacity if they want to look like non-aggressive rivals. If $\partial p_j/\partial BR_i > 0$, an increase in BR_i produces an increase in both p_j and π_i; now the investment in capacity makes banks 'soft', so that they need to adopt a 'fat cat' strategy, i.e. overinvest in capacity in order to look like non-threatening rivals.

Therefore, assessing the value and significance of $\partial p_j/\partial BR_i$ is crucial in order to understand the right formulation of the game. Should it be zero, the strategic variable (capacity) of stage 1 does not affect the choices of stage 2, and there would be no need to specify a two-stage game because banks make simultaneous choices. In the opposite case, a two-stage set-up becomes necessary.

Starting from (4), it is possible to derive the following expressions (see Appendix B):

$$\frac{\partial p_i}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i} \Delta_i \frac{A}{A^2 - B^2} \tag{8a}$$

and

$$\frac{\partial p_j}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i} \Delta_i \frac{B}{A^2 - B^2}, \tag{8b}$$

[8] In their model, Cerasi et al. (2002) discuss an 'expansive effect' and a 'competitive effect' which are linked to the decision to open branches.

where $A = \Delta_i \left(2 - \frac{\partial MC_i}{\partial q_i} \Delta_i \right) = \frac{\partial^2 \pi_i}{\partial p_i^2}$ is the second-order condition for p_i to be a local maximum (see also Appendix C), and $B = \Delta_j \left(\frac{\partial MC_i}{\partial q_i} \Delta_i - 1 \right) = -\frac{\partial^2 \pi_i}{\partial p_i \partial p_j}$ is the negative of the cross-partial derivative of bank *i*'s profit function, i.e. the derivative of bank *i*'s marginal profit with respect to its rivals' price, while $\Delta_i = \frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j} \lambda$ and $\Delta_j = \frac{\partial q_i}{\partial p_j}$ (see Appendix B).

Note that $A < 0$ (each bank's profit function needs to be strictly concave in its own prices) and $B < 0$ (the cross-partial derivative of each bank's profit function must be positive in case of strategic complements, like prices, which means that the reaction functions are upward sloping).

As $\Delta_i < 0$, it is straightforward that $sign\{\partial MC_i/\partial BR_i\} = sign\{\partial p_i/\partial BR_i\} = sign\{\partial p_j/\partial BR_i\}$ (see also Appendix B). Therefore, when $\partial p_j/\partial BR_i < 0$ we also find that $\partial MC_i/\partial BR_i < 0$, meaning that an increase in BR_i pushes marginal costs downwards, while they move upwards if $\partial MC_i/\partial BR_i > 0$ and $\partial p_j/\partial BR_i > 0$.

Roller and Sickles (2000) emphasize that the sign of $\partial MC_i/\partial BR_i$ – and hence of $\partial p_j/\partial BR_i$ – is able to indicate the direction of the bias that characterizes the conduct parameter λ in case a two-stage formulation is not used.

In particular, in a two-stage 'puppy dog' game ($\partial MC_i/\partial BR_i < 0$) the capacity investment lowers MC_i and p_i, but marginal costs decline more than prices (as the second-order condition of stage 1 requires that $\partial MC_i/\partial BR_i < \partial p_i/\partial BR_i$: see Appendix C), so that a larger price-cost margin is associated to the same λ; this implies that a one-stage game would ignore this effect, leading to an upward bias in the measurement of market conduct (actually, for a lower price-cost margin there should be a lower λ).

When dealing with a two-stage 'fat cat' game ($\partial MC_i/\partial BR_i > 0$), an increase in BR_i causes marginal costs to increase more than prices (in this case, it is necessary that $\partial MC_i/\partial BR_i > \partial p_i/\partial BR_i$: see Appendix C), implying that a smaller price-cost margin is associated with a given λ; therefore, a one-stage game would result in a downward bias in the value of the conduct parameter (a higher price-cost margin would require a higher λ).

Of course if $\partial MC_i/\partial BR_i = 0$, no bias exists.

However, all the above is true for any $\lambda > 0$. When $\lambda < 0$, i.e. when conduct is more competitive than a Nash behaviour, the reverse reasoning applies. Indeed, when $\partial MC_i/\partial BR_i < 0$ the price-cost margin is larger in case of a one-stage game, and it decreases only when λ increases (or also when the absolute value of λ decreases): in this instance, therefore, market conduct is underestimated. Conversely, for $\partial MC_i/\partial BR_i > 0$, there will be an overestimation of the degree of market power.

Therefore, the observation of Roller and Sickles (2000, p. 853) needs to be reformulated as follows.

Proposition 1. *Whenever the capacity game can be categorized as a 'puppy dog' (i.e. $\partial MC_i/\partial BR_i < 0$), then a one-stage game would result in an upward bias in the measurement of market conduct if $\lambda > 0$, and to a downward bias if $\lambda < 0$. Whenever the capacity game can be categorized as a 'fat cat' (i.e. $\partial MC_i/\partial BR_i > 0$), then a one-stage game would result in a downward bias in the measurement of market conduct if $\lambda > 0$, and in an upward bias if $\lambda < 0$. Finally, whenever $\partial MC_i/\partial BR_i = 0$, no bias exists.*

Estimating the two-stage model requires the simultaneous estimation of Equations (1), (5) and (7). By considering only Equations (1) and (5), we would implicitly assume that investments in capacity are exogenous (i.e. a one-stage set-up), at the same time getting a biased estimation of the conduct parameter λ whenever $\partial p_j/\partial BR_i \neq 0$.

4. Empirical specification

In our three-equation model, the demand is the following:

$$\ln q_{it} = a_1 \ln p_{it} + a_2 \ln p_{jt} + a_3 \ln GDP_{it} + a_4 \ln BRSHARE_{it} + a_5 t + \gamma_i + \tau_{it} \ , \tag{1a}$$

where τ is the error term. The dependent variable q_{it} is the amount of loans of bank i at year t. Among the exogenous variables, we include bank i's loan rate (p_{it}), a weighted average of rivals' loan rates (p_{jt}), a measure of Gross Domestic Product that takes into account the regional distribution of bank i's branches (GDP_{it}), the share of branches that bank i manages in the country ($BRSHARE_{it}$), and a time trend t. In order to capture other possible characteristics of banks that do not change over time and affect the demand for loans, we also add a dummy γ_i for each bank in the sample.

For all banks, p_{it} is calculated as the ratio between interest revenues and customer loans, while p_{jt} has been built starting from the regional loan rates (as provided by the Bank of Italy), each weighted by the number of branches of bank i in that region. A similar procedure has been used for the level of GDP, which is inserted as a proxy for aggregate demand. Finally, *BRSHARE* allows us to take into account the size of the banks' branch network.[9] Apart from p_{it}, all the above variables are expected to be positively correlated with loans.

The second equation of the model corresponds to the first-order condition of stage 2:

$$\frac{p_{it} - MC_{it}}{p_{it}} = -\frac{1}{a_1 + \lambda a_2 \dfrac{p_i}{p_j}} + \varphi_{it} \quad , \tag{5a}$$

where φ is the error term, a_1 and a_2 are the own-price and the cross-price elasticities, respectively, as derived from Equation (1a), and MC_{it} is the (linear) short-run marginal cost, specified as:

$$MC_{it} = \frac{\partial C_{it}^{SR}}{\partial q_{it}} = b_0 + b_1 BR_{it} + b_2 \omega_{1it} + b_3 \omega_{2it} + b_4 EMPLBR_{it} + b_5 PROVPRES_{it} + b_6 t \,. \tag{9}$$

This is assumed to be dependent on branches (BR_{it}, the capacity variable), two factor prices – namely, deposits (ω_{1it}, calculated as the ratio between interest expenses and customer deposits) and labour (ω_{2it}, given by the ratio between personnel expenses and the number of employees) – and two other characteristics that are assumed to affect short-run costs: the number of employees per branch ($EMPLBR_{it}$) and the percentage of provinces where the bank owns at least one branch ($PROVPRES_{it}$). A time trend is also added.

The variable $EMPLBR_{it}$ is used as a measure of service quality (and therefore to account for service competition). More employees per branch should ensure a more accurate service for customers, because they allow shorter waiting times and foster valued human interactions (Dick, 2007, p. 64). The expected sign of this variable is however unpredictable: a higher ratio could allow an expansion of the number of loans per employee (because of the improved quality), but also impose more costs to the branch if this business growth is not sufficient.

The share of provinces in which the bank operates, $PROVPRES_{it}$, should capture the level of geographic diversification: as it is linked to the size of the overall bank network – and hence to the convenience to the consumer – this attribute has already been found to significantly affect the customer's choice of a bank (Dick, 2008). For this reason, it should have a favourable impact on costs, and therefore be negatively correlated with marginal costs.

Substituting (9) into (5a) yields

[9] Note that *BRSHARE* can be regarded as an exogenous variable (unlike *BR*), since it depends on the choices of *all* banks operating in the industry at any given year.

$$\frac{p_{it} - \left(b_0 + b_1 BR_{it} + b_2\omega_{1it} + b_3\omega_{2it} + b_4 EMPLBR_{it} + b_5 PROVPRES_{it} + b_6 t\right)}{p_{it}} = -\frac{1}{a_1 + \lambda a_2 \dfrac{p_i}{p_j}} + \varphi_{it} \ . \quad (5b)$$

The third equation to be estimated within our two-stage model is the first-order condition of stage 1, as rearranged in (7) so as to consider also the optimality condition of stage 2 and emphasize both the direct and the strategic effects of a capacity investment:

$$\left[-\frac{\partial C_{it}^{SR}}{\partial BR_{it}} - r_{it}\right] + \left[\left(p_{it} - MC_{it}\right)\left(a_2 \frac{q_{it}}{p_{jt}}\right)\alpha\right] + \phi_{it} = 0 \ , \quad (7a)$$

where ϕ is the error term. The price of capital r_{it} is computed by dividing all operating costs different from those related to deposits and labour by the number of branches. MC_{it} is again given by (9), while the term $a_2 \frac{q_{it}}{p_{jt}}$ corresponds to $\frac{\partial q_i}{\partial p_j}$ as calculated from (1a). Finally, the parameter $\alpha = \frac{\partial p_j}{\partial BR_i}$ plays a key role in the model, as its estimated value (and significance) will indicate if the two-stage formulation of this game is correct.

The effect of adding capacity (BR_{it}) to the short-run costs, $\frac{\partial C_{it}^{SR}}{\partial BR_{it}}$, is assumed to work as follows:

$$\frac{\partial C_{it}^{SR}}{\partial BR_{it}} = c_0 + c_1 q_{it} + c_2 BRFQLOAN_{it} + c_3 POPBR_{it} + c_4 t \ . \quad (10)$$

It is presumed to be linear in the level of output, q_{it}, and in two other characteristics measuring the potential productivity of capital: the percentage of each bank's branches that are located in those provinces belonging to the first quartile of the loans distribution over the country ($BRFQLOAN_{it}$), and the number of thousand inhabitants per branch ($POPBR_{it}$). A time trend is again included.

The variable *BRFQLOAN* takes into account the geographical location of branches: if a higher share of local offices operates in areas where loan contracts are frequent, the same resources needed for some inputs (e.g. labour or running costs) should generate more lending activity, with a beneficial impact on costs; as a result, the sign of the related coefficient is expected to be negative.

The variable *POPBR* is used as a proxy for population density: it is likely that more inhabitants per branch guarantee more business, affording at the same time a reduction in unit overhead costs. Hence, we expect a negative coefficient for this variable.

We can substitute (9) and (10) into (7a), getting

$$\left[-\left(c_0 + c_1 q_{it} + c_2 BRFQLOAN_{it} + c_3 POPBR_{it} + c_4 t\right) - r_{it}\right] +$$

$$+\left[p_{it} - \left(b_0 + b_1 BR_{it} + b_2 \omega_{1it} + b_3 \omega_{2it} + b_4 EMPLBR_{it} + b_5 PROVPRES_{it} + b_6 t\right)\right]\left(a_2 \frac{q_{it}}{p_{jt}}\right)\alpha + \phi_{it} = 0 \, . \quad (7b)$$

To sum up, we estimate a system of three equations: (1a), (5b) and (7b). In particular, equation (7b) represents the main novelty of this paper compared to the existing literature on banking competition, because it makes it possible to endogenize the capacity (branch) choice within the model.

Indeed, as Roller and Sickles (2000) also note, estimating a two-equation system with the demand function and the first-order condition of stage 2 (i.e. with capacity investment treated as exogenous) could introduce potential simultaneity bias and lead to less efficient estimates; furthermore, introducing the first-order condition of stage 1 as a third equation where the strategic two-stage set-up is, however, ignored could imply its misspecification.

5. Data and estimation

Our banks' income statement and balance sheet figures are drawn from ABI Banking Data, the database managed by the Italian Banking Association, and cover the period 1995-2009.

Given that this study aims to incorporate the capacity decisions of banks and their impact on rivals, we need to consider sizeable credit institutions that operate in geographically large areas. As a consequence, for each year we have selected only those banks whose size was classified either as "main", "large" or "medium" by the Central Bank of Italy. Furthermore, we have excluded banks whose absolute percentage variation of branches with respect to the previous year exceeds 50%: this allows us to keep the capacity choices separate from other operations like mergers, acquisitions or reorganizations.

After this screening, we were left with 1417 observations regarding 117 banks. Table 2 reports some descriptive statistics of the sample. Official data on the geographical distribution of branches and loans, as well as regional data on loan rates, come from the Bank of Italy, while the information regarding GDP and population is made available by ISTAT (the Italian National Institute of Statistics). All economic figures have been deflated using the GDP deflator with 2000 as the base year.

INSERT TABLE 2 ABOUT HERE

In simultaneous equation models, some explanatory variables are determined by the equilibrium between equations, i.e. they are endogenous. For example, in demand and supply models price is determined simultaneously with quantity by the intersection of these curves. However, any exogenous variable that shifts one of the equations changes also the values of endogenous variables, which means that the latter are correlated with the disturbance term of more equations. In this case, an OLS regression would provide biased and inconsistent estimates.

Therefore, here we use nonlinear three-stage least squares, thus endogenizing banks' capital stock (BR_i), output (q_i) and price (p_i), and securing precise and efficient estimates, which are further improved by the simultaneous estimation of the three equations and the various cross-equation restrictions. The choice of instruments in non-linear estimations is not a straightforward issue, so we conform to the customary practice and use all exogenous variables as instruments (including time trend and bank dummies). Because of the endogeneity of BR_i, q_i and p_i, we also use their first and second lagged values as instruments, together with the lagged values of p_j at t–1 and t–2, in order to deal with possible problems of correlation between these variables and the error terms. Additional instruments are banks' total assets, the Herfindahl-Hirschman index (HHI), population and the number of banks in the market (the last three variables are weighted averages of regional values), which help to resolve the potential endogeneity of the market structure of the banking industry (Cetorelli and Gambera, 2001, p. 627). In particular, total assets proxy for the size of incumbent banks, HHI and population proxy for market size, while the number of banks in the market proxy for the number of potential entrants.

We estimate our model for the whole sample, as well as for two geographical sub-samples (North vs. Centre and South). We also consider sub-samples according to the branch network size – two groups: banks with branches in at least 11 of the 20 Italian regions, or less – and the overall size, measured by the total assets – three groups: more than 10 billion euro, between 2.5 and 10 billion euro, less than 2.5 billion euro.

6. Empirical results

6.1. Analysis and interpretation of estimated parameters

The results of system estimations are shown in Table 3. Unless otherwise specified, our reference estimation will be the one regarding the whole sample of banks (first column of Table 3).

INSERT TABLE 3 ABOUT HERE

As expected, in the demand equation the coefficients of p_i and p_j always have a negative and a positive sign, respectively, and are statistically significant at the 1% level. This confirms a downward-sloping demand function as well as a positive cross-price elasticity for loans.

The (relatively) small own-price elasticity, a_1 suggests that, as far as customers are concerned, loans have few substitutes. Since a monopolistic firm sets its price on the elastic portion of the demand function, we deduce that banks are generally able to exercise their market power only to a small extent in their respective market niches.

The cross-price elasticity, a_2, is generally larger than the absolute own-price elasticity (this is not the case for the North and for the largest banks). However, we can reject the hypothesis that $|a_1| \geq a_2$ at the 5% level only for the smallest banks (i.e. both those operating in 10 or less regions and those managing less than 2.5 billion euro): in these sub-samples, the fact that loans appear to be more sensitive to variations in p_j than in p_i indicates that they are regarded as good substitutes across banks, a signal of a considerable level of competition among credit institutions.

The variable *GDP* has a positive and statistically significant coefficient. However, its impact on loans is not particularly high: a one percent growth in the level of GDP in the areas where banks operate causes a 0.51% increase in their loan demand. The coefficient of *BRSHARE* is also positive and significant, suggesting that a larger size of the branch network, and hence a more widespread presence in the geographical area, guarantees a larger demand for loans. The effect of time on loans is significant in five regressions, and points to an increase in their demand over the years.

Regarding the short-run marginal cost (stage 2), b_1 is positive and significant at the 1% level in seven out of eight regressions. In these samples, there is evidence that the number of branches (i.e. capital) has a positive effect on *MC*: adding capacity causes an increase in the marginal costs of production. However, we shall discuss this below.

Overall, the prices of deposits and labour do not appear to affect marginal costs to any particular extent. When significant, the price of labour exhibits a negative coefficient. One explanation for this result is that this input is characterized by a high degree of factor substitution, so that banks react to an increase in its price by substituting capital for labour on a large scale (Neven and Roller, 1999, p. 1070).

In seven out of eight regressions, the ratio between employees and branches (*EMPLBR*) is found to significantly lower marginal costs. This should mean that more labour-intensive offices are better managed and, all else being equal, impose lower costs as loans increase, possibly because their better service quality provides access to larger flows of both new and existing customers.

The provincial presence coefficient (*PROVPRES*) is also negative and is significant in six models: here, as expected, banks with a wider geographic diversification are characterized by lower marginal costs.

Finally, short-run marginal costs show a downward trend over time only for the whole sample.

The value of the conjectural parameter λ is generally negative and highly significant in all regressions. It amounts to -0.21 in the reference model.[10] As a result, we are able to reject the hypothesis that there is monopoly power or coordination among Italian banks. Quite the opposite, their behaviour appears to be more competitive than in a Bertrand-Nash equilibrium in prices. The above estimated value means that if bank *i* increases its loan market rate by, say, 10% with respect to the previous value, it expects that rivals will react by lowering their rate by 2.1%, while in a Bertrand-Nash game they would have left it unchanged, and in a cooperative framework they would even have raised it.[11] This outcome is comparable with the evidence of other studies investigating the market power of Italian credit institutions in analogous periods of time.[12] Indeed, many of them suggest that monopolistic competition is the best description of the Italian banking industry.[13]

By means of the right-hand side of Equation (5b), we can calculate the average mark-up over marginal costs, which amounts to 110.5% for the whole sample. Given that the Bertrand-Nash behaviour ($\lambda = 0$) would imply a mark-up of 141% (and even higher values in the case of monopolization), pricing in the Italian banking market appears, rather, to be fairly competitive.

It is worth noting that the value of the conjectural parameter differs considerably within the country. Competition appears stronger in the North (-0.53) than in the Centre and South of Italy (-0.10). Once again it turns out that in Italy less wealthy regions are characterized by a lower degree of banking competition (Coccorese, 2004, 2008).

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[10] Our findings are in line with Coccorese (2005), who obtains negative conjectural parameters for the Italian banking sector.

[11] On the contrary, Carbo et al. (2009) find evidence of a strong matching behaviour in terms of price competition for the Spanish banking industry in the period 1986-2002, as the value of the estimated conjectural variation parameters are positive and significant.

[12] Among others, see Angelini and Cetorelli (2003) and Coccorese (2005). By estimating the Boone indicator, van Leuvensteijn et al. (2011) also show that competition in the Italian loan market declined significantly in the period 1994-2004.

[13] As examples, see Bikker and Haaf (2002), Coccorese (2004), and Casu and Girardone (2009).

In terms of branch network, banks operating in more than 10 regions are characterized by a lower degree of competition than less widespread banks (-0.10 vs -0.63). However, competition decreases with the sample banks' size: the conjectural parameter amounts to -0.47 for the largest banks, -0.19 for medium-size banks, and +0.53 for smaller banks.

The above (seemingly contradictory) results may be due to the fact that in Italy there is often a "size effect" in lending: large banks mainly serve medium and large companies, while small banks are usually specialized in lending to small businesses. As a result, there is some market power for smaller banks deriving from closer ties and repeated contacts with (geographically nearer) borrowers, but large network banks can exercise competitive pressures, or even gain market power, thanks to their possibility to enjoy scale economies, which may balance their poor territorial roots (Coccorese, 2009, p. 1201).

As our sample period ranges from 1995 to 2009, it covers two important events in the Italian economy, i.e. the adoption of the single European currency (2002) and the wake of the most recent world financial crisis (2007). To ascertain whether these occurrences have exerted some influence on banking competition in Italy, we have estimated yearly λ's for the whole sample. As Figure 1 shows, there was no particular change in the degree of competition among banks after 2002, while we note a considerable increase in λ in 2009, which indicates a worsening of competitive conditions. Again, this evidence confirms the positive link between economic performance and competition in the banking sector.

INSERT FIGURE 1 ABOUT HERE

The behavioural index does not appear to have a definite connection with the concentration of the market. Figures 2 and 3 point out that for the Italian banking industry neither HHI nor CR5 are closely correlated with the estimated yearly values of λ. The correlation coefficients for the period 1997-2009[14] are +0.497 and +0.312, respectively, and neither of them is statistically significant at the 5% level, which also means that the linkage between market structure and performance is low.

INSERT FIGURES 2 AND 3 ABOUT HERE

As far as the marginal cost of capital (stage 1) is concerned, the parameter estimates are mostly significant. This type of cost increases as the level of output (q) grows: more loans are therefore coupled with higher expenditures for branches (however, this does not happen for Central and

[14] The source for the data on HHI and CR5 is the European Central Bank, which does not provide this information for the years prior to 1997.

Southern regions, while for banks managing less than 2.5 billion euro the estimated sign is negative).

The coefficient of *BRFQLOAN* is negative and significant in six regressions, confirming that marginal costs are lower for banks whose branches are mainly located where the volume of the demand for loans is greater.

The negative sign of *POPBR* implies that a higher number of inhabitants per branch office lowers the marginal cost of capital. Finally, the time trend captures an increase in this type of cost for the years under consideration in three out of eight regressions.

6.2. The effect of branching on price competition

One key aspect of this analysis is to assess whether a two-stage formulation of the competition model is correct (and also desirable). To determine this, we need to study the effect of capital (i.e. branches) on short-run marginal costs. As observed above, the coefficient of *BR* in the short-run marginal cost equation (b_1) is always positive, and also significant at the 1% level in seven out of eight models; in addition, the estimated coefficient of the variable $\alpha = \partial p_j/\partial BR_i$ is also positive and highly significant in all specifications. This evidence is in line with our expectations, as we have earlier demonstrated that it must be $sign\{\partial MC_i/\partial BR_i\} = sign\{\partial p_j/\partial BR_i\}$. Besides, the (high) significance of the above coefficients makes it clear that the capacity variable of stage 1 has a major impact on the choices of the following stage. Thus, the one-stage specification must be rejected in favour of a two-stage model.[15]

The positive sign of both b_1 and α suggests that setting up new branches makes banks ‘soft’: they overinvest in capacity in order to be less aggressive. Thus, they follow a ‘fat cat’ strategy. The intuition behind this result appears quite interesting, and can be explained as follows. When the Bank of Italy deregulated branch opening all over the country in 1990, making it much easier to obtain the relevant authorizations, incumbent banks realized that ‘new entries’ in the various local markets would be inevitable. Finding entry deterrence too costly, they opted for accommodation and concentrated on maximizing their own profits. Hence, while the consolidation process caused a reduction in the number of banks and an increase in market concentration at the national level (see Section 1), in local credit markets the average concentration decreased because of the increase in the number of branches and the corresponding growth in the average number of banks per province and municipality (see Table 1). This also explains why the average degree of competition in the Italian banking market did not substantially change over the years.

[15] For the results of our two-stage model to be economically meaningful, we need the second-order conditions of stages 2 and 1 to be satisfied. This issue is discussed in Appendix C.

Since prices are assumed to be strategic complements for banks (Bulow et al., 1985), an investment in capacity (branches) from bank *i* would have the same effect on both its own and its competitors' profits. Our empirical evidence that $\partial MC_i/\partial BR_i > 0$ and $\partial p_i/\partial BR_i > 0$[16] means that the investment BR_i increases both the marginal cost and the price of bank *i*. In turn, a higher price for bank *i* forces the other banks to charge a higher price as well (because of strategic complementarity of prices), which helps bank *i*'s profits. As a result, the optimal choice for bank *i* is to overinvest (keeping a 'fat cat' profile) so as not to appear aggressive and trigger an aggressive reaction by rivals. We may also say that a bank competing in prices in an accommodation framework ought to appear inoffensive in order not to induce its rivals to cut their prices. In order to pursue this aim, it needs to take actions that commit it to charging a high price, i.e. investments that increase production costs, here corresponding to the opening of new branches (Tirole, 1988, pp. 326-328). This 'fat cat' strategy consists of an overinvestment in capacity in the first stage that accommodates entry by committing the incumbent to play less aggressively in the (post-entry) second stage (Fudenberg and Tirole, 1984, p. 365).

This result seems in contrast with the idea that in the 1990s excess capacity characterized many of the European banking markets and that consolidation has been an effective way to eliminate it (Davis and Salo, 2000; De Bandt and Davis, 2000; Casu and Girardone, 2009). As we learnt from Table 1, the important reduction in the number of banks makes it clear that a consolidation wave has occurred in the Italian banking sector. However, it parallels the increase in branches.

Our empirical evidence shows that Italian banks chose to expand their branch network in order to soften price competition with the new entrants in their local markets, instead of closing local offices and cutting jobs (as happened in other EU countries: see Ayadi and Pujals, 2005, pp. 84-85). Hence, this strategy exhibited definite advantages over the network reduction.[17]

With reference to regulation (another recognized feature of the banking sector), this should not have played any remarkable role in banks' behaviour in Italy during the sample period (1995-2009), because, as we pointed out, since 1990 all regulatory rules concerning the opening of new branches have been removed.[18]

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[16] Remember that $sign\{\partial p_i/\partial BR_i\} = sign\{\partial p_j/\partial BR_i\}$: see Section 3.

[17] To check whether consolidation has played some role in the choice of capacity, we have introduced HHI as an explanatory variable in the marginal cost of capital and re-estimated our system. Given that the coefficient associated to HHI is never significant, the level of local market concentration does not affect the cost of branches.

[18] One important issue regarding the banking industry is leverage, which allows banks to increase the potential gains deriving from their activity beyond what they would get by investing just their own capital. They borrow money to obtain more assets, with the aim of increasing their return on equity. To check whether leverage has been an important factor guiding banks' choices, we have performed some additional estimations. We have first calculated a proxy of the leverage ratio by dividing the sum of capital and reserves by total assets. The higher this value, the more a bank can be regarded as well capitalized. We have used this ratio to split our sample into two sub-groups, below and above its median value, and so have estimated the new systems of equations. As an alternative test, we have estimated the system for the whole sample introducing leverage as a variable alternatively in the short-run marginal cost and in the marginal

An important restriction that must be met is the first-order condition of stage 1, namely (7). In our framework $\left(p_i - MC_i\right)\frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial BR_i} > 0$, because each term of this strategic effect on π_i of an investment in capacity (i.e. $p_i - MC_i$, $\frac{\partial q_i}{\partial p_j} = a_2\frac{q_i}{p_j}$ and $\frac{\partial p_j}{\partial BR_i} = \alpha$) is greater than zero. A positive strategic effect means that investing in branches from bank *i* causes an increase in the rivals' price (the 'fat cat' effect), and this generates an increase in bank *i*'s loans as well as in the gap between the price and marginal costs. So we need that $-\frac{\partial C_i^{SR}}{\partial BR_i} - r_i < 0$, indicating that the direct effect of investing in capacity (branches) must be negative: this means that setting up a branch is unprofitable by itself (i.e. costly) for bank *i*, and that the incentive to invest in capacity is entirely attributable to the strategic effect. According to our empirical results, this direct effect is always negative at the sample means (and amounts to -129.87 in the reference sample).

6.3. Misspecification of one-stage model

There is another remarkable result deriving from our estimations. As previously discussed, since we are dealing with a 'fat cat' game (as $\partial MC_i/\partial BR_i > 0$) where the conjectural variation parameter λ is negative (with only one exception), employing a one-stage framework that does not include the capacity choice would produce an upward bias in the estimate of market conduct (i.e. its absolute value would be lower). Strictly speaking, ignoring the strategic linkages between competition in capacity and prices makes the competition look weaker than it actually is.

In order to check this result empirically, and also to quantify the magnitude and the direction of the bias, we have estimated another group of systems where the endogeneity of branching decisions has been ignored. In particular, we have considered a one-stage simultaneous model where the equations of both the short-run marginal cost and the marginal cost of capital have been replaced by the following equation:

$$\frac{p_{it} - \left(b_0 + b_1 r_{it} + b_2\omega_{1it} + b_3\omega_{2it} + b_4 EMPLBR_{it} + b_5 PROVPRES_{it} + b_6 q_{it} + b_7 t\right)}{p_{it}} =$$

cost of capital. The evidence is that leverage does not affect our previous findings: there is no outstanding difference between the results of the two sub-samples, while the coefficients of the leverage ratio is never significant in either marginal cost.

$$= -\frac{1}{a_1 + \lambda a_2 \frac{p_i}{p_j}} + \varphi_{it} . \qquad (5c)$$

In the marginal cost of (5c), the capacity variable BR_{it} has been replaced by the price of capital r_{it}, and the output variable q_{it} has also been added. In this way, we come back to a well-specified marginal cost function, and there is no longer any difference between short-run and long-run costs (Roller and Sickles, 2000, p. 858).

The new models are composed of Equations (1a) and (5c), and correspond to the customary structural models that are often employed when studying industries with market power.

Table 4 reports the estimation results. The sign and significance of the coefficients of the demand equation do not change. It is worth noting that the absolute values of both a_1 and a_2 are slightly higher than before.

Regarding the behavioural index, we find a strong confirmation of our conjecture on the direction of bias (see Proposition 1). In particular, the conjectural derivative λ is always higher in the one-stage estimation than in the two-stage framework: as an example, for the whole sample the corresponding values are -0.0186 and -0.2091, respectively (both statistically significant at the 1% level). This means that, as $\lambda < 0$, in our 'fat cat' game the two-stage framework significantly adjusts downwards the value of the market conduct parameter and the measurement of the market power of incumbent firms.

Furthermore, even when the conjectural derivative is positive in the two-stage estimation, our Proposition 1 holds. Indeed, for banks managing less than 2.5 billion euro, λ passes from +0.53 in the two-stage game to -0.03 in the one-stage game (still statistically different from 0 at the 1% level), i.e. the one-stage framework produces a downward bias in the measurement of market conduct. Here we also observe a reduction in magnitude of a_1 and a_2.

INSERT TABLE 4 ABOUT HERE

7. Conclusions

This paper has focused on estimating the conduct of a sample of Italian banks in the presence of endogenous branching decisions, which are among the most studied measures of non-price competition in banking. Methodologically, this has been achieved by supplementing the typical two-equation model (a demand function plus a first-order condition in the loan market) with the addition of a third equation that records how capacity decisions (regarding *de novo* branches) affect short-run marginal costs.

The Italian banking industry represents an ideal testing ground for our model. Recent years have seen both a deregulation wave and a sharp increase in the number of branches, while at the same time the number of banks has fallen. Hence, an endogenous treatment of branch decisions appears appropriate.

We have estimated this model using data on a group of (large and medium-size) Italian banks for the years 1995-2009. Our results point toward a rejection of the simple one-stage specification, thus confirming the role of non-price strategic behaviour as a key attribute of firms' conduct that stems from their interdependence in an imperfectly competitive context. Moreover, we show that the market conduct of banks in the two-stage model is significantly more competitive than a Bertrand-Nash game and than that coming from a one-stage formulation. Finally, the strategic behaviour of banks toward branches is such that, in the terminology of Fudenberg and Tirole (1984), they behave as 'fat cats', overinvesting in their office network (which causes an increase in marginal costs) so as to keep prices high and, as a consequence, accommodate entry.

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Appendix A – Solution to the first-stage maximization problem

Given the first-stage profit function

$$\pi_i = q_i(\cdot)p^*_i - C_i^{LR}(C_i^{SR}, BR_i) = q_i(p^*_i, p^*_j, Z_i)p^*_i - C_i^{SR}(q_i(p^*_i, p^*_j, Z_i) \mid BR_i, \omega_i) - r_i BR_i \;\;, \quad (6)$$

the first-order condition with respect to BR_i (where the superscript * is omitted for notational convenience) is:

$$\frac{\partial \pi_i}{\partial BR_i} = q_i \frac{\partial p_i}{\partial BR_i} + \left(p_i - MC_i\right)\left(\frac{\partial q_i}{\partial p_i}\frac{\partial p_i}{\partial BR_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial p_i}\frac{\partial p_i}{\partial BR_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial BR_i}\right) - \frac{\partial C_i^{SR}}{\partial BR_i} - r_i = 0 \;\; . \qquad \text{(A1)}$$

We can now bring the first-order conditions of stage 1 and stage 2 together. In particular, we first derive q_i from the optimality condition of stage 2, i.e. (4), obtaining:

$$q_i = -\left(p_i - MC_i\right)\left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial p_i}\right) \;\; . \qquad \text{(A2)}$$

Then, we substitute (A2) into (A1). Rearranging, we get:

$$\frac{\partial \pi_i}{\partial BR_i} = \left[-\frac{\partial C_i^{SR}}{\partial BR_i} - r_i\right] + \left(p_i - MC_i\right)\frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial BR_i} = 0 \;\; . \qquad (7)$$

Appendix B – Derivation of the relationship between the choice variables

Since the first-order condition in the second stage is

$$\frac{\partial \pi_i}{\partial p_i} = q_i + \left(p_i - MC_i\right)\left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial p_i}\right) = 0 \ , \tag{4}$$

we can write that

$$\frac{\partial^2 \pi_i}{\partial p_i \partial BR_i} = \frac{\partial p_i}{\partial BR_i}\left[\Delta_i\left(1 - \frac{\partial MC_i}{\partial q_i}\Delta_i\right) + \Delta_i\right] + \Delta_j \frac{\partial p_j}{\partial BR_i}\left(1 - \frac{\partial MC_i}{\partial q_i}\Delta_i\right) - \Delta_i \frac{\partial MC_i}{\partial BR_i} = 0 \tag{B1}$$

and that

$$\frac{\partial^2 \pi_i}{\partial p_i \partial BR_j} = \frac{\partial p_i}{\partial BR_j}\left[\Delta_i\left(1 - \frac{\partial MC_i}{\partial q_i}\Delta_i\right) + \Delta_i\right] + \Delta_j \frac{\partial p_j}{\partial BR_j}\left(1 - \frac{\partial MC_i}{\partial q_i}\Delta_i\right) = 0 \ , \tag{B2}$$

where $\Delta_i = \frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial p_i} = \frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\lambda$ is the own-demand effect that includes the conjectural variation (with $\Delta_i < 0$), and $\Delta_j = \frac{\partial q_i}{\partial p_j}$ is the cross-demand effect (hence, $\Delta_j > 0$).

Assuming symmetry, i.e. $\frac{\partial p_i}{\partial BR_j} = \frac{\partial p_j}{\partial BR_i}$ and $\frac{\partial p_j}{\partial BR_j} = \frac{\partial p_i}{\partial BR_i}$, from (B2) we obtain

$$\frac{\partial p_j}{\partial BR_i} = \frac{\Delta_j \frac{\partial p_i}{\partial BR_i}\left(\frac{\partial MC_i}{\partial q_i}\Delta_i - 1\right)}{\Delta_i\left(2 - \frac{\partial MC_i}{\partial q_i}\Delta_i\right)} . \tag{B3}$$

Substituting (B3) into (B2) leads to:

$$\frac{\partial p_i}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i}\Delta_i \frac{A}{A^2 - B^2} \tag{8a}$$

and

$$\frac{\partial p_j}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i} \Delta_i \frac{B}{A^2 - B^2}, \tag{8b}$$

with $A = \Delta_i \left(2 - \frac{\partial MC_i}{\partial q_i} \Delta_i \right) = \frac{\partial^2 \pi_i}{\partial p_i^2}$ and $B = \Delta_j \left(\frac{\partial MC_i}{\partial q_i} \Delta_i - 1 \right) = -\frac{\partial^2 \pi_i}{\partial p_i \partial p_j}$.

Assuming that the own-demand effect is larger than the cross-demand effect (Roller and Sickles, 2000, p. 852), i.e. $-\Delta_i > \Delta_j$, it is $A^2 > B^2$. Given that $A < 0$ and $B < 0$, it follows that $\frac{A}{A^2 - B^2} < 0$ and $\frac{B}{A^2 - B^2} < 0$.

Appendix C – Second-order conditions

Stage 2

From (4) we can calculate the second derivative with respect to p_i:

$$\frac{\partial^2 \pi_i}{\partial p_i^2} = \left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial p_i} \right) \left[2 - \frac{\partial MC_i}{\partial q_i} \left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial p_i} \right) \right] = \Delta_i \left(2 - \frac{\partial MC_i}{\partial q_i} \Delta_i \right).$$

Since our two-stage marginal cost function (9) does not depend on the variable q_i, we have $\partial MC_i / \partial q_i = 0$. So the above second-order condition holds whenever $\Delta_i < 0$, i.e. $\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j} \lambda < 0$.

This is always true, given that, according to the functional form of demand adopted in the paper as well as to the estimated parameters (see Section 6), we have $\frac{\partial q_i}{\partial p_i} = a_1 \frac{q_i}{p_i} < 0$, $\frac{\partial q_i}{\partial p_j} = a_2 \frac{q_i}{p_j} > 0$, and $\lambda < 0$.

Stage 1

Starting from (7), and assuming our two-stage functional specification (10) of $\partial C_i^{SR}/\partial BR_i$, which does not depend on BR_i, we can write the second derivative with respect to BR_i as follows:

$$\frac{\partial^2 \pi_i}{\partial BR_i^2} = \left(\frac{\partial p_i}{\partial BR_i} - \frac{\partial MC_i}{\partial BR_i} \right) \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial BR_i}.$$

It should be remembered that $\partial q_i / \partial p_j > 0$, and also that $sign\{\partial MC_i / \partial BR_i\} = sign\{\partial p_i / \partial BR_i\} = sign\{\partial p_j / \partial BR_i\}$. This means that: a) when $\partial MC_i / \partial BR_i < 0$, the above second-order condition is satisfied for $\partial p_i / \partial BR_i - \partial MC_i / \partial BR_i > 0$; b) when $\partial MC_i / \partial BR_i > 0$, we need that $\partial p_i / \partial BR_i - \partial MC_i / \partial BR_i < 0$.

Since our estimations show that $b_1 = \partial MC_i/\partial BR_i > 0$ (see Section 6), the relevant condition to be fulfilled is $\partial p_i/\partial BR_i - \partial MC_i/\partial BR_i < 0$. This holds at the sample means for all specifications: for example, in the model concerning the whole sample of banks we find that $\frac{\partial p_i}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i} \Delta_i \frac{A}{A^2 - B^2} = 0.4840$, while $\frac{\partial MC_i}{\partial BR_i} = b_1 = 0.7082$, so that the difference between them amounts to -0.2242 (for the other models, the corresponding differences range between -65.7794 and -0.0791).

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TABLE 1 – *Structural changes in the Italian banking industry (1990-2009)*

Year	Branches	Banks	Branches per bank	Branch variation (%)	Branches per municipality	Municipalities with at least one branch (%)	Branches per million inhabitants	Loans to GDP ratio (%)
1990	16596	1064	15.6	6.6	2	62.9	292.6	57.8
1991	18396	1043	17.6	10.8	2.3	64.6	324.1	60.6
1992	19822	1025	19.3	7.8	2.4	66.7	349.0	66.3
1993	22004	992	21.5	7.4	2.6	67.6	387.2	67.2
1994	23000	965	23.3	5.4	2.8	69	404.6	64
1995	24040	976	24	4.3	2.9	69.6	422.9	65.3
1996	24406	938	26	4.2	3	70.1	429.2	64.3
1997	25250	935	27	3.5	3.1	70.4	443.8	65.1
1998	26258	922	28.5	4	3.2	73.1	461.4	68.1
1999	27134	875	31	3.3	3.4	73.4	476.7	72.1
2000	28177	841	33.5	3.9	3.5	73.3	494.8	76.5
2001	29270	830	35.3	3.8	3.6	73.4	513.7	77.8
2002	29926	814	36.8	2.2	3.7	73.3	523.6	79.3
2003	30480	789	38.7	1.8	3.8	73.2	529.1	81.7
2004	30944	778	39.8	1.5	3.8	73.1	531.9	82.7
2005	31501	783	40.2	1.8	3.9	73.1	537.5	86.7
2006	32338	793	40.8	2.7	4	73.1	548.6	92.3
2007	33229	806	41.2	2.8	4.1	73	559.6	97.1
2008	34146	799	42.7	2.8	4.2	73.1	570.7	99.6
2009	34036	788	43.2	-0.3	4.2	73.1	564.8	102.8

TABLE 2 – *Sample descriptive statistics (1995-2009)*

Variable	Description	Mean	Std. Dev.	Minimum	Maximum	Median
q	Total customer loans (*million euro at 2000 constant prices*)	7140.5	14349.5	191.6	168307.8	2203.4
p_i	Interest revenue / Total customer loans (*percentage*)	9.67	5.14	1.68	32.71	7.76
BR	Number of branches (*thousand units*)	0.226	0.326	0.014	3.142	0.098
p_j	Interest revenue / Total customer loans (*percentage*)	7.64	2.41	4.66	15.76	6.83
GDP	Weighted Gross Domestic Product (*billion euro at 2000 constant prices*)	102.95	62.24	19.92	267.47	98.09
BRSHARE	Number of branches of the bank / Total number of branches in the country (*percentage*)	0.77	1.08	0.06	9.46	0.32
ω_1	Interest expenses / Total deposits (*percentage*)	4.31	2.39	0.53	17.27	3.60
ω_2	Labour costs / Number of employees (*thousand euro at 2000 constant prices*)	56.95	7.22	16.27	99.10	56.49
r	Other operating costs / Number of branches (*thousand euro at 2000 constant prices*)	421.12	166.91	153.64	2413.10	387.92
EMPLBR	Employees per branch (*units*)	10.85	3.63	5.67	37.61	10.09
PROVPRES	Share of provinces where the bank owns at least one branch (*percentage*)	18.70	24.12	0.93	100	7.77
BRFQLOAN	Share of branches in local markets with loans over the first quartile (*percentage*)	51.96	32.35	0	100	60.82
POPBR	Inhabitants per branch (*thousand units*)	651.28	491.42	18.82	4060.32	651.28
HHI	Weighted Herfindahl-Hirschman index (*calculated on banks' branches*)	677.79	376.25	291.37	3608.03	639.66
BANKS	Weighted number of banks in the market (*units*)	120.20	53.57	19	258	117.01
POPULATION	Weighted population in the market (*thousand units*)	4419.58	2167.20	904.40	9795.90	4306.90

Number of banks in the sample: 117
Number of observations: 1417

TABLE 3 – *Two-stage simultaneous equation model: estimation results*

		Whole sample			**North**			**Centre & South**			**Banks operating in more than 10 regions**		
Variable		Coefficient	*t*-value		Coefficient	*t*-value		Coefficient	*t*-value		Coefficient	*t*-value	
		Demand equation											
$\ln p_i$	a_1	-0.70909	-24.37	***	-0.49977	-14.33	***	-0.83097	-17.01	***	-0.78724	-11.60	***
$\ln p_j$	a_2	0.74154	18.54	***	0.48537	10.75	***	0.91219	13.16	***	0.87296	7.84	***
$\ln GDP_i$	a_3	0.51137	8.45	***	0.44732	6.08	***	0.55383	5.63	***	1.04402	2.69	***
$\ln BRSHARE_i$	a_4	0.90524	29.58	***	0.81763	22.01	***	0.96204	18.90	***	0.87473	9.66	***
t	a_5	0.02007	8.92	***	0.03593	12.68	***	0.00643	1.79	*	-0.00585	-0.86	
		Short-run marginal cost (stage 2)											
Constant	b_0	0.64254	2.29	**	0.61939	1.47		0.18658	0.37		-0.35088	-0.49	
BR_i	b_1	0.70819	7.05	***	0.85111	7.51	***	0.44275	1.14		0.42083	2.58	***
ω_{1t}	b_2	-0.00746	-0.30		-0.07446	-1.79	*	0.00083	0.02		0.06041	0.76	
ω_{2t}	b_3	-0.00784	-2.16	**	-0.00086	-0.14		-0.00735	-1.32		-0.01367	-1.88	*
$EMPLBR_i$	b_4	-0.05730	-5.24	***	-0.08910	-4.97	***	-0.02311	-1.15		-0.05394	-2.58	***
$PROVPRES_i$	b_5	-0.00429	-2.51	**	-0.00813	-3.44	***	-0.00207	-0.43		0.00055	0.13	
t	b_6	-0.05093	-4.30	***	-0.10940	-6.10	***	-0.01549	-0.77		0.03325	0.96	
		Marginal cost of capital (stage 1)											
Constant	c_0	-329.16690	-18.24	***	-324.64850	-11.65	***	-333.67280	-19.45	***	-172.12090	-2.12	**
q_i	c_1	0.01375	6.21	***	0.02790	6.38	***	0.00165	0.97		0.00627	2.64	***
$BRFQLOAN_i$	c_2	-0.96046	-7.43	***	-0.79099	-3.96	***	-1.18192	-7.57	***	-0.23549	-0.20	
$POPBR_i$	c_3	-0.03983	-3.98	***	-0.02362	-1.46		-0.06230	-6.63	***	-1.43980	-18.55	***
t	c_4	1.56081	1.45		-1.23031	-0.76		5.30483	5.22	***	-0.97276	-0.29	
		Parameters											
Conjectural derivative	λ	-0.20910	-7.03	***	-0.52802	-6.63	***	-0.09512	-2.82	***	-0.09745	-2.39	**
$\partial p_j / \partial BR_i$	α	0.01962	7.28	***	0.04691	5.94	***	0.00636	3.70	***	0.01069	4.14	***
$\theta_1 = \ldots = \theta_{19} = 0$		192586.2		***	136844.9		***	63584.4		***	21955.4		***
$\gamma_1 = \ldots = \gamma_N = 0$		16430.1		***	12834.3		***	5476.5		***	1168.8		***
N. of observations		*1417*			*869*			*548*			*232*		
N. of banks		*117*			*74*			*43*			*25*		

The system has been estimated with three-stage least squares.
The instruments used are: levels and logs of first-lagged and second-lagged q_i, p_i, p_j and BR_i; levels and logs of GDP_i, $BRSHARE_i$, ω_{1i}, ω_{2i}, r_i, $EMPLBR_i$, $PROVPRES_i$, $BRFQLOAN_i$, $POPBR_i$, total assets, local HHI, population and banks in the market; time trend; bank dummies.
Significance for the parameter estimates: *** = 1% level; ** = 5% level; * = 10% level.
In the demand equation a set of dummy variables γ_i capturing bank effects is also added (coefficient estimates are not reported).
The statistics for the joint significance of the estimated equation coefficients (θ_k) and the bank-specific dummy variables coefficients (γ_i) are based on chi-square (Wald) tests.

TABLE 3 – *Two-stage simultaneous equation model: estimation results* (continued)

Variable		Banks operating in 10 regions or less: Coefficient	t-value		Banks with total assets over 10 billion euro: Coefficient	t-value		Banks with total assets between 2.5 and 10 billion euro: Coefficient	t-value		Banks with total assets less than 2.5 billion euro: Coefficient	t-value	
		Demand equation											
$\ln p_i$	a_1	-0.41793	-9.68	***	-0.62521	-12.27	***	-0.75416	-11.34	***	-6.51265	-15.99	***
$\ln p_j$	a_2	0.54740	10.09	***	0.59169	8.16	***	0.76250	8.63	***	7.09801	13.47	***
$\ln GDP_i$	a_3	1.44339	41.35	***	0.71181	5.93	***	0.36768	2.86	***	1.41015	1.66	*
$\ln BRSHARE_i$	a_4	1.02024	27.97	***	0.96862	18.68	***	0.64036	8.76	***	0.54540	1.08	
t	a_5	0.02600	8.98	***	0.00132	0.32		0.03275	5.83	***	-0.24123	-8.07	***
		Short-run marginal cost (stage 2)											
Constant	b_0	3.77954	4.74	***	1.71026	3.74	***	3.24710	4.11	***	10.01777	4.89	***
BR_i	b_1	3.80076	4.86	***	1.08768	10.71	***	2.71620	2.64	***	60.95272	6.87	***
$\omega_{1\iota}$	b_2	0.01030	0.19		0.08793	1.86	*	0.14049	2.46	**	0.82916	9.86	***
$\omega_{2\iota}$	b_3	-0.01084	-1.05		-0.01006	-1.78	*	-0.01787	-1.82	*	-0.04991	-2.38	**
$EMPLBR_i$	b_4	-0.24468	-7.08	***	-0.07134	-4.34	***	-0.20045	-7.28	***	-0.60659	-5.05	***
$PROVPRES_i$	b_5	-0.01736	-2.07	**	-0.00762	-3.23	***	-0.02880	-5.28	***	-0.13679	-4.10	***
t	b_6	-0.25553	-9.23	***	-0.11660	-5.21	***	-0.10494	-3.81	***	-0.16729	-2.77	***
		Marginal cost of capital (stage 1)											
Constant	c_0	-356.09970	-27.78	***	-171.75710	-4.67	***	4.30699	0.11		-88.99892	-2.90	***
q_i	c_1	0.02857	6.30	***	0.01397	7.25	***	0.10177	9.07	***	-0.13529	-6.46	***
$BRFQLOAN_i$	c_2	-0.52558	-6.72	***	-0.84005	-2.11	**	-0.22409	-1.25		-0.23795	-2.98	***
$POPBR_i$	c_3	-0.04954	-6.61	***	-0.63338	-7.52	***	-0.35222	-12.48	***	-0.09715	-9.13	***
t	c_4	6.90349	9.51	***	-3.29575	-1.85	*	-7.06796	-3.44	***	3.36342	2.10	**
		Parameters											
Conjectural derivative	λ	-0.63032	-5.93	***	-0.47256	-4.70	***	-0.19362	-2.89	***	0.53361	24.98	***
$\partial p_j / \partial BR_i$	α	0.05631	6.54	***	0.02881	6.35	***	0.16896	7.62	***	0.02436	7.21	***
$\theta_1 = ... = \theta_{19} = 0$		124671.6		***	66600.5		***	54389.2		***	1824264.0		***
$\gamma_1 = ... = \gamma_N = 0$		12027.2		***	3137.3		***	2990.9		***	220.5		***
N. of observations		*1185*			*402*			*518*			*497*		
N. of banks		*92*			*35*			*46*			*36*		

The system has been estimated with three-stage least squares.
The instruments used are: levels and logs of first-lagged and second-lagged q_i, p_i, p_j and BR_i; levels and logs of GDP_i, $BRSHARE_i$, ω_{1i}, ω_{2i}, r_i, $EMPLBR_i$, $PROVPRES_i$, $BRFQLOAN_i$, $POPBR_i$, total assets, local HHI, population and banks in the market; time trend; bank dummies.
Significance for the parameter estimates: *** = 1% level; ** = 5% level; * = 10% level.
In the demand equation a set of dummy variables capturing bank effects is also added (coefficient estimates are not reported).
The statistics for the joint significance of the estimated equation coefficients (θ_k) and the bank-specific dummy variables coefficients (γ_i) are based on chi-square (Wald) tests.

TABLE 4 – *One-stage simultaneous equation model: estimation results*

		Whole sample			**North**			**Centre & South**			**Banks operating in more than 10 regions**		
Variable		Coefficient	*t*-value		Coefficient	*t*-value		Coefficient	*t*-value		Coefficient	*t*-value	
		Demand equation											
lnp_i	a_1	-0.95406	-86.37	***	-0.86057	-47.19	***	-0.98371	-80.86	***	-0.93899	-36.33	***
lnp_j	a_2	1.00495	35.73	***	0.86246	25.99	***	1.09018	22.84	***	1.01825	11.01	***
lnGDP_i	a_3	0.51437	8.33	***	0.49299	6.61	***	0.50992	5.06	***	0.93854	2.51	**
ln$BRSHARE_i$	a_4	0.89131	28.55	***	0.84343	22.38	***	0.89784	17.40	***	0.89192	10.21	***
t	a_5	0.00958	4.85	***	0.01872	7.51	***	0.00259	0.82		-0.00971	-1.53	
		Marginal cost											
Constant	b_0	-0.01968	-0.26		-0.16578	-1.30		-0.00768	-0.09		-0.05121	-0.24	
r_i	b_1	0.00000	-0.05		0.00010	0.87		-0.00006	-0.82		-0.00004	-0.32	
$\omega_{1\,i}$	b_2	-0.02361	-3.77	***	-0.06981	-5.91	***	-0.00995	-1.62		-0.05007	-2.37	**
$\omega_{2\,i}$	b_3	-0.00116	-1.17		-0.00279	-1.61		-0.00006	-0.06		-0.00197	-0.98	
$EMPLBR_i$	b_4	-0.00130	-0.37		-0.00496	-0.70		0.00035	0.09		0.00262	0.41	
$PROVPRES_i$	b_5	0.00002	0.05		-0.00081	-1.13		0.00005	0.05		-0.00029	-0.28	
q_i	b_6	0.00000	0.73		0.00000	1.12		0.00000	0.18		0.00000	0.71	
t	b_7	-0.00033	-0.12		0.00095	0.19		-0.00052	-0.19		0.00124	0.14	
		Behavioural parameter											
Conjectural derivative	λ	-0.01856	-3.44	***	-0.06271	-5.89	***	-0.00618	-1.13		-0.01677	-1.86	*
$\theta_1 = ... = \theta_{14} = 0$		1377871.6		***	594082.7		***	1332851.1		***	94306.8		***
$\gamma_1 = ... = \gamma_N = 0$		15752.0		***	12152.1		***	5229.7		***	1216.9		***
N. of observations		*1417*			*869*			*548*			*232*		
N. of banks		*117*			*74*			*43*			*25*		

The system has been estimated with three-stage least squares.

The instruments used are: levels and logs of first-lagged and second-lagged q_i, p_i, p_j and BR_i; levels and logs of GDP_i, $BRSHARE_i$, ω_{1i}, ω_{2i}, r_i, $EMPLBR_i$, $PROVPRES_i$, $BRFQLOAN_i$, $POPBR_i$, total assets, local HHI, population and banks in the market; time trend; bank dummies.

Significance for the parameter estimates: *** = 1% level; ** = 5% level; * = 10% level.

In the demand equation a set of dummy variables capturing bank effects is also added (coefficient estimates are not reported).

The statistics for the joint significance of the estimated equation coefficients (θ_k) and the bank-specific dummy variables coefficients (γ_i) are based on chi-square (Wald) tests.

TABLE 4 – *One-stage simultaneous equation model: estimation results* (continued)

		Banks operating in 10 regions or less			**Banks with total assets over 10 billion euro**			**Banks with total assets between 2.5 and 10 billion euro**			**Banks with total assets less than 2.5 billion euro**		
Variable		Coefficient	*t*-value		Coefficient	*t*-value		Coefficient	*t*-value		Coefficient	*t*-value	
		Demand equation											
lnp_i	a_1	-0.92821	-59.72	***	-0.90342	-38.16	***	-0.92878	-51.28	***	-0.92364	-46.81	***
lnp_j	a_2	1.11220	34.55	***	0.87139	15.58	***	0.93729	21.13	***	1.02052	25.34	***
lnGDP_i	a_3	1.49913	42.31	***	0.65436	5.62	***	0.37346	4.09	***	0.38133	3.69	***
ln$BRSHARE_i$	a_4	1.00587	26.89	***	0.95532	18.94	***	0.63763	12.24	***	1.06042	17.08	***
t	a_5	0.00377	1.64		-0.00842	-2.27	**	0.02463	7.38	***	0.01649	5.46	***
		Marginal cost											
Constant	b_0	-0.04698	-0.44		-0.06596	-0.44		-0.16644	-0.93		-0.02901	-0.18	
r_i	b_1	-0.00005	-0.39		0.00004	0.27		0.00003	0.23		-0.00017	-0.93	
$\omega_{1\iota}$	b_2	-0.02116	-2.70	***	-0.04244	-2.83	***	-0.03960	-2.80	***	-0.02628	-2.42	**
$\omega_{2\iota}$	b_3	-0.00098	-0.67		-0.00316	-1.53		-0.00053	-0.23		0.00081	0.35	
$EMPLBR_i$	b_4	-0.00334	-0.59		0.00004	0.01		-0.00080	-0.09		-0.00997	-1.04	
$PROVPRES_i$	b_5	-0.00058	-0.47		-0.00063	-0.86		-0.00035	-0.27		-0.00348	-0.88	
q_i	b_6	0.00000	1.19		0.00000	0.73		0.00000	0.19		0.00002	0.55	
t	b_7	-0.00289	-0.78		0.00076	0.11		0.00206	0.35		-0.00473	-0.98	
		Behavioural parameter											
Conjectural derivative	λ	-0.02982	-4.02	***	-0.04464	-3.16	***	-0.02883	-3.33	***	-0.03439	-3.40	***
$\theta_1 = ... = \theta_{14} = 0$		968837.0		***	180633.1		***	347277.8		***	702588.8		***
$\gamma_1 = ... = \gamma_N = 0$		11375.2		***	3317.5		***	5781.7		***	6098.9		***
N. of observations		*1185*			*402*			*518*			*497*		
N. of banks		*92*			*35*			*46*			*36*		

The system has been estimated with three-stage least squares.
The instruments used are: levels and logs of first-lagged and second-lagged q_i, p_i, p_j and BR_i; levels and logs of GDP_i, $BRSHARE_i$, ω_{1i}, ω_{2i}, r_i, $EMPLBR_i$, $PROVPRES_i$, $BRFQLOAN_i$, $POPBR_i$, total assets, local HHI, population and banks in the market; time trend; bank dummies.
Significance for the parameter estimates: *** = 1% level; ** = 5% level; * = 10% level.
In the demand equation a set of dummy variables capturing bank effects is also added (coefficient estimates are not reported).
The statistics for the joint significance of the estimated equation coefficients (θ_k) and the bank-specific dummy variables coefficients (γ_i) are based on chi-square (Wald) tests.

FIGURE 1 – *Yearly estimated conjectural parameter λ for the Italian banking industry* (1995-2009)

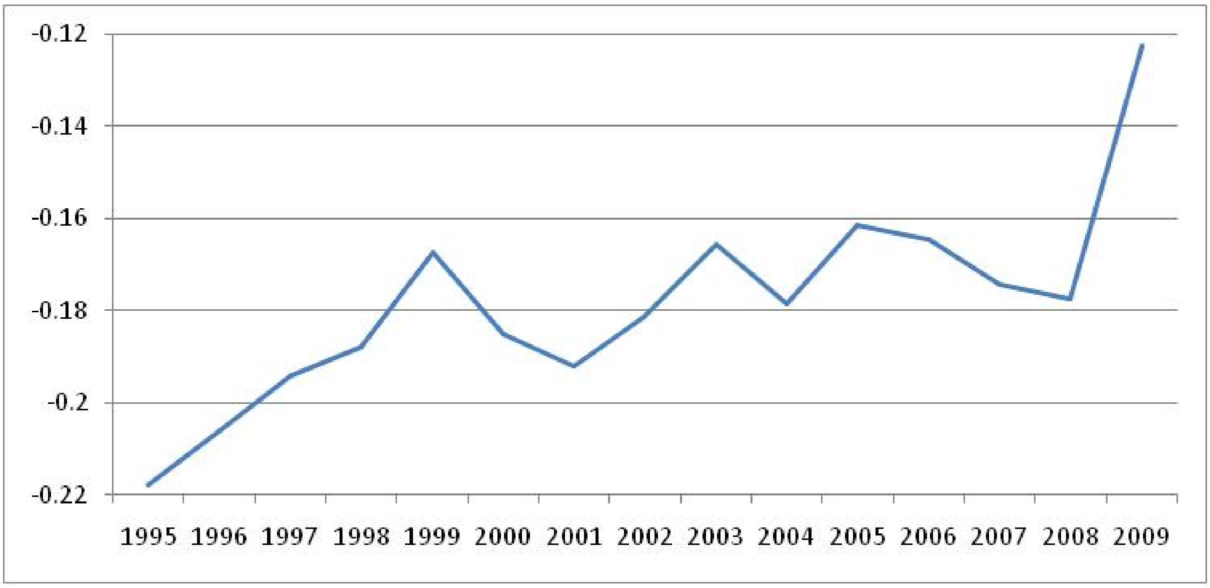

FIGURE 2 – *Market concentration (HHI) and estimated conjectural parameter (λ) for the Italian banking industry* (1997-2009)

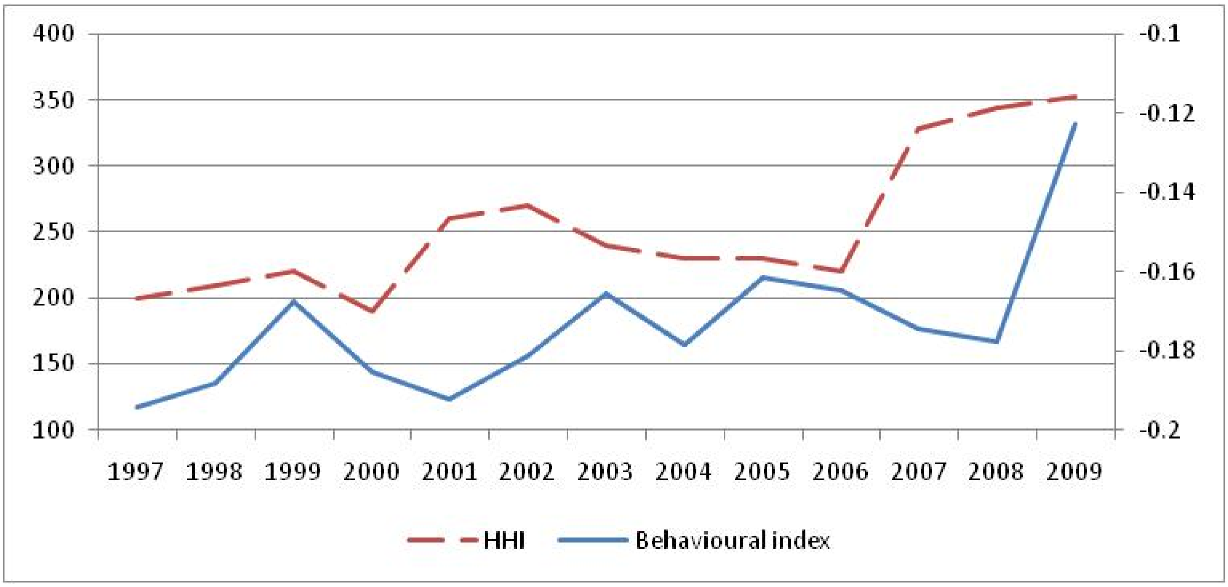

FIGURE 3 – *5-bank concentration ratio (CR5) and estimated conjectural parameter (λ) for the Italian banking industry* (1997-2009)