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Banks as 'fat cats': Branching and Price Decisions in a Two-Stage Model of Competition

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Banks as ‘fat cats’: Branching and Price Decisions in a Two-Stage Model of Competition

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Abstract

In this paper we develop an empirical two-stage model of competition for the banking industry that incorporates the choice of capacity in the form of new branches. It is estimated using data on 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 Fudenberg and Tirole (1984)’s taxonomy, banks 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.
JEL Classification: G21, L10, L13

Introduction

In this paper we formulate and estimate a structural model where banks compete in capacity and prices. Unlike the conventional models dealing with the market conduct of firms, which assume that either price or quantity are the only endogenous variables, we try to account also 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 try to emphasize the interactions between competition in output market and specific input markets, such as R&D, advertising, finance, labour, and capacity. For the 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, one can have a clearer idea about several interesting issues, for example the link between endogenous costs and market structure (Sutton, 1991), the optimal antitrust policy in presence of more than one strategic variable (Fershtman and Gandal, 1994), the possibility that endogenous capacity affects the conclusions about product market competition (Roller and Sickles, 2000), the effects that the degree of competition on the demand for inputs exert on competition in the product market (Neven et al., 2006), or the impact of labour supply augmenting investments when oligopsonistic firms set wages (Dewit and Leahy, 2009).

By means of a two-stage set-up, here we investigate whether introducing in the first stage decisions on the branch network (a capacity variable for banks) significantly influences the degree of banks' market power at the loan market level. 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. First, it is a fundamentally regulated industry because of its crucial role in the economy and the presence of notable informational problems, so a significant market power exists.

Secondly, in the last decades the banking markets of many European countries have undergone an intense consolidation process via mergers and acquisitions. Its origin lies especially in the introduction of the single currency, the reduction of cross-border barriers, and the development of the information and communication technologies (ICT). In Italy, a strong reorganization of the industry occurred as well (mainly in terms of deregulation and privatization of banks): the number of credit institutions reduced and their average size increased, while at the same time the number of branches remarkably grew. This generalized concentration wave pushes for an evaluation of whether the degree of competition among banks has changed.

Finally, the set up of brick and mortar bank branches is undoubtedly an important aspect of (non-price) competition among banks. They are long-run decisions that impose considerable (and usually sunk) costs on banks, while the choices on the 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 refund the money. Hence, the physical presence of branches appears unavoidable and to be maintained (Corvoisier and Gropp, 2007, p. 2).

The focus on the Italian context seems appropriate as well. As already mentioned, since the 1980s important transformations occurred in the Italian banking system, in order to foster market competition. Before 1978, credit authorities had followed a quite cautious attitude in evaluating whether to allow the establishment of new local bank offices, and their opening was subject to discretionary economic reasons, without 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 the geographical restrictions on lending and lower the barriers to entry in local markets. Finally, in March 1990 the possibility of setting up new bank offices was fully liberalized.

Since then, there has been a noteworthy increase in the number of branches. They rose from 16,596 in 1990 to 34,036 in 2009 (+105.1%), with outstanding growth rates in the period from 1990 to 2001 (see Table 1). This pattern characterized the whole country, with only slight differences among areas, and caused a notable transformation of the overall financial market. Still in the period 1990-2009, the loans to GDP ratio increased from 57.8% to 102.8%, the share of municipalities with at least one branch from 62.9% to 73.1%, the average number of branches per municipality from 2 to 4.2 (+110%), the average number of branches per bank from 15.6 to 43.2 (+176.9%), and the average number of branches per million inhabitants from 292.6 to 564.8 (+93%).

In parallel with the growth of their average size, in the same period the number of Italian banks declined from 1064 to 788 (-25.9%) as a result of the vigorous consolidation process due to the worldwide deregulation of capital markets, the harmonization of financial legislations (especially within EU), the fast ICT progress, and a generalized reduction of entry barriers.

Thus, it is crucial to carefully assess the degree of competition in the Italian banking sector: the heightened market concentration (caused by the reduction of the number of credit 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 account also for other factors – such as the optimal investment in the branch network – seem helpful for a clear understanding of the strategic choices of banks and their influence on the system as a whole.[1]

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 going to estimate an endogenous conjectural variation parameter that is able to categorize ex post the type of competition among banks.

The organization of the paper is the following. Section 2 reviews the literature on competition models and branching behaviour of banks. Sections 3 and 4 describe the theoretical model and its functional specifications for the banking industry, respectively. Section 5 discusses the data and the empirical results. Section 6 concludes.

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

1. Competition, banking and branching decisions: a review of the literature

To assess the oligopoly conduct, 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 in depth, these models try 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.[2]

NEIO techniques has 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 strongest result.

The investigation of interest margins and Lerner indices is a direct way to get information about 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.

Price-based indicators of competition have been recently 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). Actually, in imperfect competition markets non-price strategies may help firms to differentiate themselves and thus extract market power. Among non-price competition devices, it is regarded as valuable to investigate firms’ choice of capacity, which allows to account for strategic moves. Particularly, banks’ branching decision is a foremost issue.

Branches represent the main interface between banks and clientele. Their territorial distribution is crucial for providing financial services, as they both collect deposits and grant loans. The branch network has also a decisive role in facilitating the provision and processing of information. 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 had an important role in the increase of the rate of real per capita growth in income and output, because branch network proliferation has improved loan monitoring and screening.

Setting up a brick and mortar branch is an investment that can secure profits in the future, but often represents a sunk cost for banks. It could be rewarding in areas where income is either high and expected to grow fast. On the other hand, in a competitive landscape profits can be hard to be precisely estimated, while the wrong choice of locating a branch in a given town or area is quite costly to modify. Hence, a bank that owns many branches in a region has much to lose and would be willing to deter entry; however, if markets are contestable this strategy is hard to be implemented, and one possibility is that incumbent banks saturate the

[2] For an exhaustive survey, see Bresnahan (1989).

market with own branches, also considering the possibility of 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 clientele's preferences over locations thus helps to mitigate interest rates competition. 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 the geographical presence, in order to get higher profits from a wider branch network (Cerasi et al., 2000, 2002).

This close relationship 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 in 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 need to take into account the local market nature of the activity, and hence 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 account of both their own existing network and their expectation of rivals' choices. They set up a non-price oligopolistic model of bank behaviour in the market for loans, at the same time analyzing the role of the branch network in banks' behaviour and testing the oligopolistic conduct in this sector. In their model, banks are able to consider rivals' future reaction to their own introduction of new branches, and 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 the 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 supposed to decide strategically the size of their branching network anticipating the degree of competition faced on interest rates. According to their results, the impact of the various European directives aiming at deregulating the banking industry has led to a general increase of the degree of competition.

Carbo et al. (2009) start from the Kim and Vale (2001)'s analysis and 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 in Spain price competition has decreased in the loan market but has increased in the deposit market over the period 1986-2002, and also that the relative intensity of price versus non-price competition has varied over time.

The choice about the location of *de novo* branches is one of the main strategic devices that Italian banks have employed in the last decades in order to face 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 very 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 have become popular after the branch deregulation occurred in the late Eighties. De Bonis et al. (1998) prove that in the period 1990-1996 branch expansion has reduced concentration in provincial markets, but mergers have increased it at the national level. Calcagnini et al. (2002) propose a model that aims to explain the reasons for which Italian banks decide to open new branches in a province. It is estimated for the years 1992-1996 by means of a tobit regression, and shows that this choice is influenced by the existing market structure, the recent past branch expansion by the bank and its rivals, the past presence of the bank in the province, and 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 has reduced, but the overall degree of competition of each local market has not significantly increased.

Estimating their monopolistic competition two-stage model for the years 1990-1996, Cerasi et al. (2002) find that for the Italian banks there are incentives for opening new branches, as marginal benefits of branching outweigh 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 are 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.

Our analysis shares its basic features with the structural model developed by Roller and Sickles (2000) for the European airline industry. Using data for the period of 1976-1990, they have explicitly estimated a three-equation, two-stage structural model that considers competition in 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) still 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 Nash behaviour.

An analogous theoretical background supports the study of Ma (2005), who develops a model in order to explain the excess capacity in the Taiwanese flour industry. Here an expected effect of a firm's first-stage investment on its rivals' outputs in the second stage is

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

introduced, and the empirical evidence is that a large capacity built in the first period can be used strategically to reduce other firms' outputs in the second period. This causes an overinvestment in the first stage and hence a misallocation of resources.
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. So, we 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 to discover the effects of long-run capital investments from an individual bank on short-run price decisions.

2. The theoretical model

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

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

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 supposed to be negative and positive, respectively. The value of the latter is also expected to be high in case 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:

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

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):

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

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:

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

where $\varepsilon_{ii} = \frac{\partial q_i}{\partial p_i}\frac{p_i}{q_i}$ and $\varepsilon_{ij} = \frac{\partial q_i}{\partial p_j}\frac{p_j}{q_i}$ are the own-price elasticity and the cross-price elasticity of demand for loans, respectively, and $\lambda = \frac{\partial p_j}{\partial p_i}$ 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 the rivals will match its price, so cooperating in keeping 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 the 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 rivals' prices through its choice of branches.
In the first stage, banks have to select the capacity level (branches) BR_i that maximizes:

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

The resulting first-order condition (where the superscript * is omitted for notational convenience) is:

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

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

$$q_i = -(p_i - MC_i)\left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial p_i}\right) \tag{8}$$

Then, we substitute (8) into (7). After some manipulations, we get:

$$\frac{\partial \pi_i}{\partial BR_i} = \left[-\frac{\partial C_i^{SR}}{\partial BR_i} - r_i \right] + (p_i - MC_i) \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial BR_i} = 0 \qquad (9)$$

According to Fudenberg and Tirole (1984), 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. $(p_i - MC_i) \frac{\partial q_i}{\partial p_j} \frac{\partial p_j}{\partial BR_i}$, 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 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. Besides, it impacts on the other banks as well, given that it is likely to cause a migration of clients; the rivals could therefore react modifying their decision variable (here, price), which will affect in turn bank *i*'s demand and profits.[4]

The oligopolistic nature of banking markets should ensure that $p_i - MC_i > 0$; furthermore, by definition it is $\partial q_i/\partial p_j > 0$. As a result, the existence and the sign of the strategic effect depend on the term $\partial p_j/\partial BR_i$.

Since in the second stage banks compete in prices, 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 Fudenberg and Tirole (1984)'s terminology, 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 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 non-threatening rivals.

Thus, assessing the value and significance of $\partial p_j/\partial BR_i$ is crucial for understanding 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), we derive the following expressions:

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

$$\frac{\partial^2 \pi_i}{\partial p_i \partial BR_i} = \frac{\partial p_i}{\partial BR_i}\left[\Delta_i\left(1-\frac{\partial MC_i}{\partial q_i}\Delta_i\right)+\Delta_i\right]+\Delta_j\frac{\partial p_j}{\partial BR_i}\left(1-\frac{\partial MC_i}{\partial q_i}\Delta_i\right)-\Delta_i\frac{\partial MC_i}{\partial BR_i}=0 \tag{10a}$$

and

$$\frac{\partial^2 \pi_i}{\partial p_i \partial BR_j} = \frac{\partial p_i}{\partial BR_j}\left[\Delta_i\left(1-\frac{\partial MC_i}{\partial q_i}\Delta_i\right)+\Delta_i\right]+\Delta_j\frac{\partial p_j}{\partial BR_j}\left(1-\frac{\partial MC_i}{\partial q_i}\Delta_i\right)=0 \tag{10b}$$

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 (10b) we obtain

$$\frac{\partial p_j}{\partial BR_i} = \frac{\Delta_j \frac{\partial p_i}{\partial BR_i}\left(\frac{\partial MC_i}{\partial q_i}\Delta_i - 1\right)}{\Delta_i\left(2-\frac{\partial MC_i}{\partial q_i}\Delta_i\right)} \tag{10c}$$

Substituting (10c) into (10a) leads to:

$$\frac{\partial p_i}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i}\Delta_i\frac{A}{A^2-B^2} \tag{11a}$$

and

$$\frac{\partial p_j}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i}\Delta_i\frac{B}{A^2-B^2} \tag{11b}$$

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 the Appendix), 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 rivals' price.

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 $sign\{\partial MC_i/\partial BR_i\} = sign\{\partial p_i/\partial BR_i\} = sign\{\partial p_j/\partial BR_i\}$. Therefore, when $\partial p_j/\partial BR_i < 0$ it is also $\partial MC_i/\partial BR_i < 0$, meaning that an increase in BR_i

pushes marginal costs downwards, while they move upwards in case $\partial MC_i/\partial BR_i > 0$ 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), 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 must be $\partial MC_i/\partial BR_i > \partial p_i/\partial BR_i$: see Appendix), 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. Actually, when $\partial MC_i/\partial BR_i < 0$ the price-cost margin is larger in case of a one-stage game, and it lowers 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 remark 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 to a 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 (9). By considering only Equations (1) and (5), one 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 $\partial p_j/\partial BR_i \neq 0$.

3. Empirical specification

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

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

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 to take into account the size of banks' branch network.[5] 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:

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

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:

$$MC_{it} = \frac{\partial C_{it}^{SR}}{\partial q_{it}} = b_0 + b_1 BR_{it} + b_2 \omega_{1it} + b_3 \omega_{2it} + b_4 EMPLBR_{it} + b_5 PROVPRES_{it} + b_6 t \tag{12}$$

It 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 supposed 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). Actually, more workers 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 amount of loans per worker (because of the better quality), but also impose more costs to the branch if this business growth is not enough.
The share of provinces in which the bank operates, $PROVPRES_{it}$, should capture the level of geographic diversification: being linked to the size of the overall bank network – hence to the convenience to the consumer – this attribute has been already 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.

[5] 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.

Substituting (12) into (5a) yields

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

The third equation to be estimated within our two-stage model is the first-order condition of stage 1, as rearranged in (9) so as to consider also the optimality condition of stage 2 and emphasize both the direct and the strategic effect of a capacity investment:

$$\left[-\frac{\partial C_{it}^{SR}}{\partial BR_{it}} - r_{it}\right] + \left[(p_{it} - MC_{it})\left(a_2 \frac{q_{it}}{p_{jt}}\right)\alpha\right] + \phi_{it} = 0 \tag{9a}$$

where ϕ is the error term. The price of capital r_{it} is computed dividing all the operating costs different from those related to deposits and labour by the number of branches. MC_{it} is again given by (12), 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 whole 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 supposed to work as follows:

$$\frac{\partial C_{it}^{SR}}{\partial BR_{it}} = c_0 + c_1 q_{it} + c_2 BRFQLOAN_{it} + c_3 BRPOP_{it} + c_4 t \tag{13}$$

It is presumed linear in the level of output, q_{it}, and other two characteristics measuring the potential productivity of capital: the percentage of each bank's branches that are located in those provinces that belong to the first quartile of the loans distribution over the country ($BRFQLOAN_{it}$), and the number of branches per million of inhabitants ($BRPOP_{it}$). 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 *BRPOP* is used as a proxy for branch density: it is likely that more branches per each million of inhabitants guarantee more business, but they should also impose higher costs on banks. Hence, we expect a positive coefficient for this variable.

We can substitute (12) and (13) into (9a), getting

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

$$+\left[p_{it} - \left(b_0 + b_1 BR_{it} + b_2 \omega_{1it} + b_3 \omega_{2it} + b_4 EMPLBR_{it} + b_5 PROVPRES_{it} + b_6 t\right)\right]\left(a_2 \frac{q_{it}}{p_{jt}}\right)\alpha + \phi_{it} = 0 \qquad (9b)$$

To sum up, we estimate a system of three equations: (1a), (5b) and (9b). As Roller and Sickles (2000) 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; additionally, 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.

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. Because of the endogeneity of BR_i, q_i and p_i, we 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. We also include all the exogenous variables as instruments, together with banks' total assets, time trend and bank dummies.

4. 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", "big" or "medium" by the Central Bank of Italy. Furthermore, we have dropped banks whose absolute percentage variation of branches with respect to the previous year exceeds 50%: this allows to keep the capacity choices separate from other operations like mergers, acquisitions or reorganizations.

After this screening, we have been 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 are 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.

We estimate our model for the whole sample, as well as for two geographical sub-samples (North vs. Center and South) and for the group of largest banks, identified as those having branches in at least a half of the 20 Italian regions. The results of system estimations are shown in Table 3. When not otherwise specified, our reference estimation will be the one regarding the whole sample of banks (first column of Table 3).

As expected, in the demand equation the coefficients of p_i and p_j have always a negative and 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 for customers loans have poor 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 little extent in their respective market niches.

The cross-price elasticity, a_2, is generally larger than the absolute own-price elasticity (this does not happen for the North). However, we can reject the hypothesis that $|a_1| \geq a_2$ only for Central and Southern regions and for the group of the largest banks: in these sub-samples, the fact that loans appear to be more sensitive to variation in p_j rather 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.

Turning to the whole sample, the absolute own-demand effect Δ_i is only slightly lower than the cross-demand effect Δ_j (–679.7 vs. +741.3). Overall, the fact that the output of a bank is affected by an own-price change in a broadly similar way as by a rival's price change further confirms the good degree of competitiveness of the loan market in the period under investigation.

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 of 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 widespread presence over the territory, guarantees a larger demand for loans. The effect of time on loans is significant, and points to an increase in their demand during years.

Regarding the short-run marginal cost (stage 2), b_1 is positive and significant at the 1% level in two over four 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 marginal costs of production. However, we shall discuss this later on.

The prices of deposits and labour appear not to affect marginal costs in the reference model. On the contrary, in Northern regions the first price exhibits a negative and significant coefficient. One explanation for this result is that deposits are characterized by a high degree of factor substitution, so that banks react to an increase in their prices by shifting to other inputs that are less costly (Neven and Roller, 1999, p. 1070).

In two over four 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 equal, impose less costs as loans increase, possibly because their better service quality provides access to larger flows of both new and existing customers.

The coefficient related to the provincial presence (*PROVPRES*) is also negative but is again significant only in two 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 negative and highly significant in all regressions. It amounts to -0.17 in the reference model.[6] As a result, we are able to reject the hypothesis that there is monopoly power or coordination among the Italian banks. Quite to contrary, 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 1.7%,

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

while in a Bertrand-Nash game they would have left it unchanged, and in a cooperative framework they would have raised it as well.[7] This outcome is comparable with the evidence of other studies that have investigated the market power of Italian credit institutions in analogous periods of time.[8] Actually, many of them suggest that monopolistic competition is the best description of the Italian banking industry.[9]

By means of the right-hand side of Equation (5b), we can calculate the average mark-up over marginal costs, which amounts to 108.6% for the whole sample. Given that the Bertrand-Nash behaviour ($\lambda = 0$) would imply a mark-up of 132.8% (and even higher values in case of monopolization), pricing in the Italian banking market appears rather competitive.

It is worth noting that the value of the conjectural parameter notably differs within the country. Competition appears stronger in the North (-0.29) than in the Center and South of Italy (-0.11). Once more, it turns out that in Italy less wealthy regions are characterized by a lower degree of banking competition (Coccorese, 2004, 2008).

As for the marginal cost of capital (stage 1), parameter estimates are generally 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 Southern regions).

The coefficient of *BRFQLOAN* is negative, confirming that marginal costs are lower for banks whose branches are mainly located where the volume of the demand for loans is more considerable. This parameter is not significant only for the biggest banks, probably because all of them do operate in the most central areas.

In contrast, the positive sign of *BRPOP* means that more branch offices per inhabitant raise the marginal cost of capital. Finally, the time trend captures an increase in this type of costs for the years under consideration (except for the largest banks, for which the marginal cost of capital appears to have decreased).

One key aspect of this analysis is to assess whether a two-stage formulation of the competition model is correct (and also desirable). To this purpose, we need to study the effect of capital (i.e. branches) on short-run marginal costs. As observed beforehand, the coefficient of *BR* in the short-run marginal cost equation (b_1) is always positive, and also significant at the 1% level in two over four 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 earlier we have 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 clear that the capacity variable of stage 1 has a major impact on the choices of the following stage. So, the one-stage specification must be rejected in favour of a two-stage model.

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 the branch opening all over the country in 1990, making much easier to get the relevant authorizations, incumbent banks realized that new

[7] 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, being the value of the estimated conjectural variation parameters positive and significant.

[8] Among others, see Coccorese (2005) and van Leuvensteijn et al. (2007).

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

entries in the various local markets would have been inevitable. Finding entry deterrence too costly, they opted for accommodation and concentrated on maximizing their own profits.

Since prices are supposed 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 competitors' profits. Our empirical evidence that $\partial MC_j/\partial BR_i > 0$ and $\partial p_i/\partial BR_i > 0$[10] means that the investment BR_i increases both marginal cost and 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 look aggressive and trigger an aggressive reaction by rivals. We may also say that a bank competing in prices in an accommodation framework ought to look inoffensive in order not to induce its rivals to cut their prices. To pursue this aim, it needs to take actions that commit it to charge 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 in 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).

There is another important result deriving from our estimations. As formerly discussed, since we are dealing with a 'fat cat' game (as $\partial MC_j/\partial BR_i > 0$) where the conjectural variation parameter λ is negative, 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.

To check empirically this result, and also quantify the magnitude and direction of the bias, we have estimated another group of systems where the endogeneity of branching decisions has been ignored. Particularly, 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 marginal cost function:

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

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

The new models are composed by 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 only 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 to our conjecture about the direction of bias (see Proposition 1). Particularly, 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 it increases from -0.1667 to -0.0178 (still statistically significant at the 1% level). This means that, as $\lambda < 0$, in our 'fat cat' game the

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

two-stage framework significantly adjusts downward the value of the market conduct parameter and the measurement of the market power of incumbent firms.

In order that the results of our two-stage model be economically meaningful, we need that the second-order conditions of stages 2 and 1 are satisfied. As shown in the Appendix, for stage 2 it must be $\Delta_i < 0$, i.e. $\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j}\lambda < 0$. This always holds, given that – according to the functional form of demand here adopted as well as to the estimated parameters – 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 $\lambda < 0$.

With regard to stage 1, since $b_1 = \partial MC_i/\partial BR_i > 0$, we need that $\partial p_i/\partial BR_i - \partial MC_i/\partial BR_i < 0$. This condition is also satisfied at the sample means for all specifications: for example, in the model concerning the whole sample of banks we have that $\frac{\partial p_i}{\partial BR_i} = \frac{\partial MC_i}{\partial BR_i}\Delta_i \frac{A}{A^2 - B^2} = 0.00027$, while $\frac{\partial MC_i}{\partial BR_i} = b_1 = 0.00039$, so that the difference between them amounts to -0.00012 (for the other models, the corresponding differences are -0.00013, -0.00002 and -0.00001).

Another restriction that must be met is the first-order condition of stage 1, namely (9). In our framework, it is $(p_i - MC_i)\frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial BR_i} > 0$, 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 -87.45 in the reference sample).

5. Conclusions

This paper has focused on estimating the conduct of Italian banks in presence of endogenous branching decisions, which are among the most studied measures of non-price competition in banking. Methodologically, this has been done by adding to the typical two-equation model (a demand function plus a first-order condition in the loan market) 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. In the recent years there have been both a deregulation wave and a sharp increase in the number of branches, while at the same time the number of banks has reduced. Hence, an endogenous treatment of branch decisions appears appropriate.

We have estimate this model using data on a group of (large-size 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 as well as than that coming from a one-stage formulation. Finally, the strategic behaviour of banks toward branches is such that, in the Fudenberg and Tirole (1984)'s terminology, 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.

Appendix – 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 (12) does not depend on the variable q_i, it is $\partial MC_i / \partial q_i = 0$. So the above second-order condition holds whenever $\Delta_i < 0$.

Stage 1

Starting from (9), and assuming our two-stage functional specification (13) 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:

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

Recall 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 $\partial p_i / \partial BR_i - \partial MC_i / \partial BR_i < 0$.

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Tables

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

Variable	**Mean**	**Std. Dev.**	**Minimum**	**Maximum**	**Median**
q	7140.5	14349.5	191.6	168307.8	2203.4
p_i	9.67	5.14	1.68	32.71	7.76
BR	226.36	325.77	14	3142	98
p_j	7.64	2.41	4.66	15.76	6.83
GDP	102954.2	62236.4	19922.1	267467.7	98091.5
BRSHARE	0.77	1.08	0.06	9.46	0.32
ω_1	4.31	2.39	0.53	17.27	3.60
ω_2	56.95	7.22	16.27	99.10	56.49
r	421.12	166.91	153.64	2413.10	387.92
EMPLBR	10.85	3.63	5.67	37.61	10.09
PROVPRES	18.70	24.12	0.93	100	7.77
BRFQLOAN	51.96	32.35	0	100	60.82
BRPOP	3.91	5.61	0.25	53.14	1.69

Table 2 – Sample descriptive statistics (1995-2009)

Note:
q = total customer loans (millions of 2000 euro)
p_i = interest revenue / total customer loans (percentage)
BR = number of branches (units)
p_j = interest revenue / total customer loans (percentage)
GDP = weighted Gross Domestic Product (millions of 2000 euro)
BRSHARE = number of branches of the bank / total number of branches in the country (percentage)
ω_1 = interest expenses / total deposits (percentage)
ω_2 = labour costs / number of employees (thousands of 2000 euro)
r = other operating costs / number of branches (thousands of 2000 euro)
EMPLBR = employees per branch (units)
PROVPRES = share of provinces where the bank owns at least one branch (percentage)
BRFQLOAN = share of branches in local markets with loans over the first quartile (percentage)
BRPOP = branches per million of inhabitants (units)
Number of banks in the sample: 117
Number of observations: 1417

		Whole sample			North			Center & 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	-0.75324	-26.20	***	-0.61511	-17.75	***	-0.81430	-14.29	***	-0.58733	-8.89	***
$\ln p_j$	a_2	0.79316	19.65	***	0.61096	13.18	***	0.96903	12.16	***	0.87805	8.56	***
$\ln GDP_i$	a_3	0.51432	8.52	***	0.54436	7.05	***	0.76424	60.06	***	0.69649	35.40	***
$\ln BRSHARE_i$	a_4	0.89906	29.45	***	0.81835	21.29	***	0.67934	15.26	***	0.91908	13.17	***
t	a_5	0.01836	8.24	***	0.02978	10.59	***	0.01451	3.84	***	0.01762	2.60	***
						Short-run marginal cost (stage 2)							
Constant	b_0	-0.03098	-0.12		-0.57681	-1.73	*	-0.86659	-1.47		0.99213	1.25	
BR_i	b_1	0.00039	4.17	***	0.00035	2.95	***	0.00014	0.30		0.00010	0.55	
ω_{1i}	b_2	0.00862	0.39		-0.08391	-2.58	***	0.02679	0.55		-0.06355	-0.69	
ω_{2i}	b_3	-0.00355	-1.10		-0.00416	-0.88		0.00120	0.18		-0.01186	-1.44	
$EMPLBR_i$	b_4	-0.02391	-2.41	**	-0.01229	-0.80		0.03102	1.43		-0.07940	-3.40	***
$PROVPRES_i$	b_5	-0.00334	-2.16	**	-0.00490	-2.47	**	-0.00407	-0.71		-0.00219	-0.45	
t	b_6	-0.02861	-2.73	***	-0.02549	-1.82	*	-0.00988	-0.41		-0.03775	-0.99	
						Marginal cost of capital (stage 1)							
Constant	c_0	-388.13240	-30.13	***	-389.55595	-20.62	***	-395.09975	-23.78	***	-510.32980	-3.85	***
q_i	c_1	0.01043	4.85	***	0.01032	3.18	***	0.00303	1.24		0.01790	4.37	***
$BRFQLOAN_i$	c_2	-0.92760	-7.32	***	-0.82281	-4.71	***	-1.45437	-6.50	***	1.10102	0.61	
$BRPOP_i$	c_3	13.60211	8.53	***	10.81521	5.56	***	23.95357	8.19	***	21.43891	6.05	***
t	c_4	2.10316	2.03	**	1.95626	1.35		3.08207	2.26	**	-19.87231	-3.81	***
						Parameters							
Conjectural derivative	λ	-0.16662	-6.57	***	-0.28877	-6.39	***	-0.10827	-2.82	***	-0.23584	-4.11	***
$\partial p_j / \partial BR_i$	α	0.01916	7.44	***	0.02039	4.63	***	0.01378	5.05	***	0.02045	5.05	***
N. of observations		*1417*			*862*			*555*			*226*		
N. of banks		*117*			*74*			*43*			*25*		

Table 3 – Two-stage simultaneous equation model: estimation results

Note:

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, $EMPLBR_i$, $PROVPRES_i$, $BRFQLOAN_i$, $BRPOP_i$ and total assets; 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).

		Whole sample			North			Center & 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	-0.95595	-85.36	***	-0.86308	-44.73	***	-0.98839	-84.68	***	-0.81762	-23.21	***
$\ln p_j$	a_2	1.01624	35.66	***	0.87928	25.61	***	1.18442	23.11	***	1.08306	12.78	***
$\ln GDP_i$	a_3	0.51683	8.36	***	0.58224	7.47	***	0.77530	61.62	***	0.71269	39.66	***
$\ln BRSHARE_i$	a_4	0.89144	28.53	***	0.82955	21.31	***	0.56844	12.81	***	0.92172	14.30	***
t	a_5	0.00984	4.97	***	0.01823	7.22	***	0.00989	3.19	***	0.00846	1.44	
						Marginal cost							
Constant	b_0	-0.03168	-0.44		-0.21345	-1.72	*	-0.00844	-0.11		-0.50050	-1.76	*
BR_i	b_1	0.00001	-0.13		0.00010	0.83		-0.00004	-0.76		-0.00016	-0.90	
ω_{1i}	b_2	-0.02238	-3.62	***	-0.06549	-5.51	***	-0.00708	-1.21	***	-0.13018	-3.86	***
ω_{2i}	b_3	-0.00099	-1.02		-0.00238	-1.38		-0.00012	-0.13		-0.00441	-1.49	
$EMPLBR_i$	b_4	-0.00053	-0.16		-0.00209	-0.30		0.00012	0.04		0.01226	1.27	
$PROVPRES_i$	b_5	0.00025	0.76		-0.00033	-0.58		0.00022	0.67		-0.01529	-0.23	
t	b_6	-0.00020	-0.07		0.00122	0.24		-0.00001	0.00		0.01529	1.17	
						Behavioural parameter							
Conjectural derivative	λ	-0.01777	-3.28	***	-0.06158	-5.56	***	-0.00382	-0.80		-0.04890	-3.84	***
N. of observations		*1417*			*862*			*555*			*226*		
N. of banks		*117*			*74*			*43*			*25*		

Table 4 – One-stage simultaneous equation model: estimation results

Note:

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, $EMPLBR_i$, $PROVPRES_i$, $BRFQLOAN_i$, $BRPOP_i$ and total assets; 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).

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