Centre for Banking Research
Cass Business School
City University London

WORKING PAPER SERIES

WP 02/09

Competition and risk taking incentives in the lending market: An application to Indian banking

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This version: September 2009

Abstract:

This paper develops a structural model of competition in the lending market to examine the impact of financial reforms both on competition and on banks' risk taking incentives. Drawing on the literature on the uniqueness of bank loans vis-à-vis arms length debt, we estimate an empirical model with reference to the Indian commercial banking reform experience (1992-2004). Our results suggest an increase in competition along with the reform process. The analysis of banks' risk taking incentives, however, fails to detect the existence of a market-based mechanism to support lenders' information acquisition. Banks with lower monitoring and screening capacity appear to be preferred by borrowers when the market becomes more competitive, thus implying an increase in banks' risk taking incentives along with the increase in competition.

Key words: Regulation; Competition; Risk; Product differentiation; Market discipline

JEL Classification: G21; G28; G32; L15

1. Introduction

The relationship between competition and bank risk taking incentives is of particular interest in the wake of the recent financial turmoil. The assumption behind most of the legislation following the 1930s financial crises is that increased competition forces banks to choose more risky portfolios. As a consequence, competition in banking markets has to be restrained in order to preserve stability. During the 1990s this view was questioned and fundamental programmes of liberalisation of the banking and financial sectors were carried out by governments both in developed and developing countries. Nevertheless, financial deregulation has often been accompanied by concomitant prudential re-regulation, as policy-makers were also pursuing risk abatement strategies. The aim was to put in place mechanisms to ensure that bankers take risks, but only risks that are "prudent" (i.e. the stick and the carrot) (Caprio and Klingebiel, 2000). There is a vast literature examining the relationship between competition in banking markets and various proxy measures of bank risk exposure. The empirical findings are however mixed and recent research questions the causal negative link between competition and stability (Boyd and De Nicolo', 2005; Schaeck *et al*, 2009).

Drawing on the literature on the uniqueness of bank loans vis-à-vis arm-length debt, we examine two important aspects of the conduct of banks in an oligopolistic setting: their competitive behaviour and their risk taking incentives. We address these issues with reference to the provision of loans in the Indian commercial banking sector between 1992 and 2004, a time period that encompasses two separate stages of financial reforms.

In line with the New Empirical Industrial Organization (NEIO) oligopoly approach we adopt a structural model, but unlike most empirical work on banking competition we assume product differentiation and define interest rates as banks' strategic variable. In addition, we consider the role of bank-specific monitoring and screening ability in the provision of loans and therefore we assume that bank loans are a heterogeneous product because of differences

in lenders' ability at acquiring information. This bank-specific monitoring and screening ability is strictly related to banks' risk taking incentives and how these change along with changes in competition. The theoretical and empirical literature are divided about the expected link between deregulation and competition, between competition and risk taking incentives as well as on the effect that banks' monitoring and screening abilities have on borrowers demand.

To shed some light on these issues, in this paper we jointly estimate a demand for loans equation allowing for both price and non-price determinants (i.e. lenders' monitoring and screening capacity) and the first-order condition derived from banks' profit-maximisation with respect to interest rates. Adopting a conjectural-variation (CV) framework, we introduce a behavioural parameter into the latter to define the competitive conduct of the market. We evaluate the competitive conduct of Indian banks by allowing for different conjectural variation parameters for the two periods of reform (1992-1997 and 1998-2004). The two periods are separated because of the change in policy focus in 1997, from the enhancement of market-oriented competition via deregulation to the strengthening of stability via prudential re-regulation. To detect the change in banks' risk taking incentives along with changes in competition, we investigate the changes in the responsiveness of demand to banks' monitoring and screening capacity by estimating the two aforementioned equations separately for the periods 1992-1997 and 1998-2004.

The rest of the paper is organised as follows. Section 2 briefly reviews the main characteristics of the Indian banking system. Section 3 discusses the existing literature on the effects of financial reforms on competition and the relationship between competition and banks' risk taking behaviour. Section 4 develops the theoretical model. Section 5 discusses the empirical model and the choice of variables, and Section 6 deals with the data issues. The empirical results and their interpretation are in Section 7, and Section 8 concludes.

2. Indian banking during 1992-2004: a brief overview

Indian banking reforms commenced in 1992. The objective was to promote a diversified, efficient and competitive banking system, with the ultimate target of improving the allocative efficiency of financial resources in the economy. The entire reform process was defined as gradualist and took place in two stages: deregulation characterised the period 1992-1997 and was mainly centred on promoting a market-oriented competitive environment. Prudential re-regulation started in 1998 when the policy focus was switched to the smooth functioning of the banking sector in the long run, with the aim of strengthening the stability of the banking system. These financial reforms transformed the credit market, until then characterised by administered interest rates, mandatory allocation of credit for specific sectors and concessionary interest rates for specific sectors (Arun and Turner, 2002). One of the first policy changes concerned the reduction in the Statutory Liquidity Ratio (SLR) and Cash Reserve Ratio (CRR). In 1993 the Indian banking sector opened to private domestic and foreign ownerships, leading to an increase in the number of participants in the lending market. Finally, prudential norms on assets classification, income recognition, provisioning on non-performing loans and risk-based capital requirements were introduced to control banks' risk taking incentives in an increasingly competitive environment. Among the major prudential policy initiatives introduced post-1997 were annual CAMELS[1] (1997), the increase of the risk-based capital adequacy requirement to 9% (from March 2000), and the introduction of a 90-day delinquency norm for the classification of non-performing loans.

[1] CAMELS refer to supervision of Capital adequacy, Asset quality, Management quality, Earnings, Liquidity and System evaluation.

Table 1 illustrates the changing structure of the Indian banking sector over the whole reform period (1992-2004), for scheduled commercial banks[2] (excluding regional rural banks). The number of banks increases after the opening of the market in 1993 to foreign and private ownership, and it partially decreases again after the tightening of foreign banks' capital requirement in 2001. The five-bank concentration ratio and the Herfindahl-Hirschman Index (HHI) both show a decreasing trend over the sample period, usually an indication of increased competition. Finally, the variance of market shares (σ^2) indicates a decrease in their inequality, a signal of reshuffle within the industry.

< Table 1 around here>

Table 2 presents the descriptive statistics of selected performance indicators. The spread, measured both as the difference between the implicit credit rate and deposit rate, and as the gap between the implicit credit rate and the average price of loanable funds, is decreasing over time. Furthermore, there is evidence of changes in the product mix as banks diversify their activities. In particular, the asset portfolio shifts from loans to safer, more liquid other earning assets, especially government securities. The ratio of other earning assets to total earning assets increases from 40% in 1992 to 49% in 2004. The data also highlight a shift from on-balance-sheet to off-balance-sheet activities, with the ratio of fee-based income to total income increasing from 13.4% in 1992 to 23.7% in 2004. Altogether, the reform process appears to affect market structure and banks behaviour and performance. The increase in the number of banks, the decrease of the concentration ratio and the reduction of the spread are all considered indicators of increased competition in the traditional industrial organization approach, and offer a preliminary indication of the impact of the reform process.

< Table 2 around here>

[2] Scheduled commercial banks have paid up capital and reserves of no less than Rs 500,000 and have met other conditions specified by the Banking Regulation Act of 1965. They consist of public, private, foreign and regional rural banks.

3. The impact of deregulation on competition and of competition on risk taking

It is generally believed that deregulation promotes competition; however this is not always empirically demonstrated. There is a vast body of literature on the link between the observable market structure and firm performance in the traditional Structure-Conduct-Performance (SCP) context. However, these studies typically do not explicitly incorporate the effect of regulation, nor do they analyse whether regulatory changes strengthen or weaken this link (Gilbert, 1984). Similarly, the empirical evidence provided by the NEIO approach is inconclusive, with many studies finding a positive link between deregulation and competition[3] and others finding the opposite instead.[4] The reasons for this conflicting evidence are not clear; regulatory reform is often a mixed process of deregulation and prudential re-regulation, so that the net effect of reforms on competition is uncertain. Moreover, the oligopolistic banking market structure could also be a contributory element (Arestis and Demetriades, 1999).

Similarly, there is little agreement on the effect of competition on bank risk taking. Considering the behaviour of banks as exogenous, a part of the theoretical literature[5] concentrates on the adverse selection problem that banks face. Borrowers are more likely to obtain loans when the number of banks increases; this increases the information asymmetries, hence competition has an adverse effect on banks' solvency. An alternative approach[6] considers bank risk taking behaviour as endogenous, and identifies its link with competition in the change in the private costs and benefits of specialising in information production.

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[3] See for example Angelini and Cetorelli (2003) for Italian banks; Canhoto (2004) for the Portuguese deposit market, Carbo *et al*. (2005) for the Spanish deposit market, Neven and Roller (1999) for the European mortgage market, and finally Claessens and Laeven' s study (2004).

[4] See for example Maudos and Fernandez De Guevara (2004) and Fernandez De Guevara *et al*., (2005) for the EU area, Matthews *et al*. (2007) for the UK and Spiller and Favaro (1984) for Uruguay.

[5] See for example Carletti (2007) and Canoy *et al* (2001).

[6] See for example Boot and Grrenbaum (1993) and Besanko and Thakor (1993).

Information production activities increase the safety and soundness of bank operations but are costly and cannot be recovered at exit. If greater competition reduces banks' private rents associated with information production, then banks' incentives to engage in it will decrease. Some recent studies have suggested that the negative causal link between competition and risk taking is not robust (Allen and Gale, 2004; Boyd and De Nicolo', 2005). In particular, this theoretical literature argues the uniqueness of bank loans vis-à-vis arm length debt, emphasising the higher additional value that borrowers could receive from loans granted by banks with a higher reputation. Consequently, borrowers' preference acts as a market-based incentive mechanism to induce banks to specialise in information production to gain and maintain a reputation. With the involvement of the demand side, the increase in banks effort in gathering information appears to reconcile with an increasingly competitive environment (Boot, 2001). This will be particularly true if banks are competing for good lending opportunities (Allen *et al*., 2006), or if their main competitive pressure comes from inter-bank competition rather than capital market competition (Boot and Thakor, 2000). The implementation of appropriate prudential re-regulation could also correct for excessive risk taking incentives, but only if it coordinates effectively with market-based discipline (Demsetz *et al*., 1996; Galloway *et al*., 1997; Flannery, 2001; Salas and Saurina, 2003).

The empirical evidence on the relationship between competition and risk taking incentives is also mixed. SCP-type studies, that measure competition by observable market structure indicators, find both positive[7] and negative[8] correlations between concentration and risk measures. Similarly conflicting results are obtained by those studies that measure competition indirectly, via the implementation of deregulation policies or the extent of regulatory constraints. For example Jayaratne and Strahan (1998) find that branching relaxation (hence competition) sharply reduced risk for US banks between 1975 and 1992,

[7] See Rhoades and Rutz (1982) and Beck *et al.* (2007).

[8] De Nicolo' *et al.* (2004), Boyd *et al.* (2006).

whereas Dick (2006) finds the opposite for the period 1993-1999[9]. Yeyati and Micco (2007), using the NEIO approach to competition, find a negative correlation between the H-statistic of 8 Latin American countries and bank risk taking. Using a similar approach, Schaek *et al.* (2009) also find that more competitive banking systems seem less prone to systemic crisis. Berget *et al.* (2009) contribute to the "competition-stability" view vs. "competition-fragility" view and find that the two strands of the literature need not necessarily yield opposing predictions regarding the effects of competition on stability. Their empirical results are however mostly consistent with the traditional "competition-fragility" view, that is banks in less competitive markets also have less overall risk exposure.

Finally less controversial results are found in the strand of the literature that follows the charter value hypothesis (CVH). By definition, charter value is the present value of the current and future profit that a firm can earn as a going concern and it represents the opportunity cost of going bankrupt. According to the CVH, an increase in competition leads to a decline in charter value, and is therefore associated with increased risk-taking. The majority of empirical studies in this strand confirm this hypothesis[10]; however the whole approach is not without criticism. For example the effectiveness of charter value as risk deterrent seems to be subject to the diligence of the regulator and the change of economic conditions. A larger charter value may result in a higher-risk interior solution if the regulator is less effective in sorting out the risk position of banks (Park, 1997) and when economic conditions are in the downturn (Saunders and Wilson, 2001).

This paper contributes to the existing literature by looking simultaneously at the relationship between financial reforms, competition and risk taking; we do this by taking

[9] See also the cross country studies of Barth *et al*. (2001, 2004).

[10] Among the most recent studies see for example Anderson and Fraser (2000); Salas and Saurina (2003); Konishi and Yasuda, 2004; Gonzalez 2005.

simultaneously into account the special role that banks play in financial markets, the impact of deregulation on competition and that of competition on banks' risk taking incentives.

4. The model: a conjectural variation approach

The theoretical model of this paper is based on a static partial equilibrium oligopoly with explicit product differentiation (Robert and Samuelson, 1988; Hannan, 1991; Kim and Vale, 2001; and Coccorese, 2005).

We assume that N banks operate in the market for loans, faced by a given loanable fund and other input prices[11]. Loans are a heterogeneous product due to the different monitoring and screening ability of banks. Banks are price setters and compete with each other using price (the interest rate) as their strategic variable. The quantity demanded of loans (q_{it}) faced by the *i-th* bank at time *t* is a function of its own price (p_{it}), rival banks' prices (p_{Rt}), a vector of bank-specific, time varying characteristics (z_{it}), a vector of the corresponding characteristics of rivals (z_{Rt}), a vector of exogenous macro variables affecting demand (z_t), and finally a set of unobserved time invariant, bank-specific effects (z_i):

$$q_{it} = q(p_{it}, p_{Rt}, z_{it}, z_{Rt}, z_t, z_i) \tag{1}$$

The partial derivatives of *q(.)* have the following expected signs:

$$\frac{\partial q_{it}}{\partial p_{it}} < 0;\ \frac{\partial q_{it}}{\partial p_{Rt}} > 0;\ \frac{\partial q_{it}}{\partial z_{it}} \begin{matrix} > \\ = \\ < \end{matrix} 0;\ \frac{\partial q_{it}}{\partial z_{Rt}} \begin{matrix} < \\ = \\ > \end{matrix} 0;\ \frac{\partial q_{it}}{\partial z_i} \begin{matrix} > \\ = \\ < \end{matrix} 0;\ \frac{\partial q_{it}}{\partial z_t} \begin{matrix} > \\ = \\ < \end{matrix} 0$$

That is, we expect the own-price elasticity to be negative, the cross-price elasticity to be positive and the sign of bank-specific characteristics to be opposite to that associated with the same characteristics of rivals.

[11] The standard assumption used by the conjectural variation approach is that firms are price takers on the inputs market.

Furthermore, each bank has a total cost function c_{it} that depends on the amount of loans provided (the output level q_{it}) and on inputs prices (w_{it}), such as:

$$c_{it} = c(q_{it}, w_{it}) \tag{2}$$

The profit function for bank i at time t is therefore defined as the difference between total revenue and total cost:

$$\pi_{it} = p_{it} q(.)_{it} - c(q_{it}, w_{it}) \tag{3}$$

Each bank maximises profit with respect to the interest rate on loans, so the first-order condition for bank i is:

$$\frac{\partial \pi_{it}}{\partial p_{it}} = q_{it} + (p_{it} - \frac{\partial c_{it}}{\partial q_{it}})(\frac{\partial q_{it}}{\partial p_{it}} + \frac{\partial q_{it}}{\partial p_{Rt}} * \frac{\partial p_{Rt}}{\partial p_{it}}) = 0 \tag{4}$$

where $\frac{\partial c_{it}}{\partial q_{it}}$ is the marginal cost of loans (MC_{it}). Adopting a conjectural-variation (CV) framework, we rearrange (4) and get:

$$\frac{p_{it} - MC_{it}}{p_{it}} = -\frac{1}{\frac{\partial \ln q_{it}}{\partial \ln p_{it}} + \frac{\partial \ln q_{it}}{\partial \ln p_{Rt}} * \frac{p_{it}}{p_{Rt}} * \frac{\partial p_{Rt}}{\partial p_{it}}} = -\frac{1}{\varepsilon_{ii} + \varepsilon_{iR} * \lambda * \frac{p_{it}}{p_{Rt}}} \tag{5}$$

Here, $\frac{p_{it} - MC_{it}}{p_{it}}$ is the well-known Lerner Index. $\frac{\partial \ln q_{it}}{\partial \ln p_{it}} = \varepsilon_{ii}$, is the own-price elasticity, $\frac{\partial \ln q_{it}}{\partial \ln p_{Rt}} = \varepsilon_{iR}$, is the cross-price elasticity. The ratio $\frac{\partial p_{Rt}}{\partial p_{it}} = \lambda$, expresses the conjecture made by bank i about how the interest rate of its competitors will react to the change of its own interest rate. Since the Lerner index is a measure of a bank's market power, the relevant elasticity is the bank's perceived elasticity of demand. In (5), the bank's perceived elasticity of demand is composed of its own-price elasticity, the conjectural parameter and the cross-price elasticity. Whether the last two enter into the equation depends

on whether the bank believes there is coordination in a price-setting game, and subsequently incorporates the anticipation of the reaction of its rivals to its price change into its decision when setting the interest rate. A less cooperative behaviour of banks, a signal of increased competitiveness in the market, is associated with an increase of the perceived price elasticity of demand. Once identified, λ is interpreted as a measure of the degree of coordination in a price-setting game. It is used to detect the anti-competitive collusive behaviour on loan pricing among market participants, and to define market structure. Notably, λ does not depend on the firm, and its estimate would represent the behaviour of the average bank. In particular, $\lambda > 0$ is consistent with price collusive behaviour. Joint profit maximization (cartel pricing) is associated with a unit value of λ (i.e. $\lambda = 1$). When $\lambda = 0$, behaviour is characterised by a Bertrand-Nash game in price, i.e. the bank believes its rivals will not react to the change in its own interest rate, and treats the interest rates of its rivals as given when it sets its own. If this is the case, the Lerner index in equation (5) becomes exclusively dependent on its own-price elasticity. When $\lambda < 0$, the conduct is more competitive than the Bertrand-Nash behaviour. In this case, if a bank is considering raising its interest rate, it expects its rivals to react by decreasing theirs. Finally, when $\lambda = -\infty$, price equals marginal cost and the market is perfectly competitive.

5. Empirical specification and variables

The implementation of the above conjectural variation approach involves the specification of the demand equation (1), the cost equation (2) and the first-order condition (5): the three are separately discussed hereinafter.

5.1. The demand for loans

Our empirical specification of the demand equation corresponding to (1) is specified in log-linear form:

$$\ln q_{it} = z_i + \beta_1 \ln p_{it} + \beta_2 \ln p_{Rt} + \sum_{j=1}^{j} \phi_j \left(\frac{z_{jit}}{z_{jRt}}\right) + \eta z_t + \varepsilon_{it} \qquad (1b)$$

where q_{it} and p_{it} are the quantity demanded and the price of loans for bank *i* at time *t*. The quantity of loans is measured as the book value of performing loans, calculated as the difference between total loans and non-performing loans. The price of loans is calculated as the ratio of interest received on loans over total performing loans. p_{Rt} is the price charged by the competitors of bank *i* at time *t*. Since we assume there are N banks in the market place, in theory bank *i* is has N-1 competitors at every point in time. However, if we include the interest rate charged by all the other N-1 banks in our empirical demand equation, and allow for the interaction between bank *i* and these N-1 competitors, the parameters to be estimated would substantially increase. For practical considerations, we follow Slade (1986)[12] and measure rivals' prices via an index calculated as the loans weighted average of the N-1 competitors' prices, i.e. $p_{Rt} = \sum_{N \neq i} \frac{q_{Nt}}{\sum_{N \neq i} q_{Nt}} p_{Nt}$. In this way, rivals' prices can be viewed as a summary statistic of their distribution. The estimated coefficient of $\ln p_{it}$ (i.e. β_1) is the own-price elasticity, which should be negative, and the estimated coefficient of $\ln p_{Rt}$ (i.e. β_2) is the cross-price elasticity, which should be positive. $\frac{z_{jit}}{z_{jRt}}$ (j=1,…,j) is the bank-specific characteristic for bank *i* at time *t* in the *j*-dimension (i.e. z_{jit}) relative to that of its rivals (i.e. z_{jRt}). This specification of bank-specific characteristics implies homogeneity of degree zero of demand in the bank-specific characteristics. That is, the change in a bank's own

[12] The same is also done by Roller and Sickles (2000), Canhoto (2004), and Coccorese (2005).

characteristic accompanied by the same change in its rivals' characteristic, *ceteris paribus*, will have no impact on demand. The rivals' characteristics are also computed as the loans weighted average of the N-1 competitor characteristics as $z_{jRt} = \sum_{N \neq i} \frac{q_{Nt}}{\sum_{N \neq i} q_{Nt}} z_{jNt}$. The ϕ_j s are the coefficients of the various characteristics, with positive signs indicating a favourable influence on the demand for loans of bank *i*, induced by the differentiation in the *j*-dimension, and vice versa. The specific variables we use to measure the bank-specific characteristics will be explained next. z_t is the time varying and bank-invariant exogenous demand shifter. For the macro-level influences on demand, we control for the ratio of total assets in the banking system to GDP. By doing so, we jointly allow for the role of the macroeconomic environment as well as for the presence of other forms of financial intermediation (capital markets, non-bank financial institutions) in determining the demand for bank loans. Because the increase of the ratio of banks total assets to GDP is associated with an increased dependence on banking financing, we expect η to be positive. z_i are fixed effects capturing bank-specific time-invariant heterogeneity, and ε_{it} is the disturbance term.

Given our investigation purposes, we consider bank-specific characteristics related to banks' reputation for monitoring and screening capacity. It is difficult to measure banks' reputation for information production activities, because these are largely unobservable. Our variables selection here is guided by the literature on the uniqueness of bank loans vis-à-vis public debt in financial markets. In particular, viewing reputation as a reliable signal that has to be established over a certain period of time, we focus on the variables that are more likely to reflect the lenders' long-run commitment to information acquisition. In line with Johnson (1997, we argue that banks' capitalisation, measured by the capital-to-asset ratio, conveys information about their *ex-ante* motivation to engage in monitoring and screening services. It could be argued that banks carry out a certification activity by granting a loan, and the value

of this activity is analogous to a credit enhancement or a credit rating. However, unlike other information gathering firms, banks issue the certification putting their own financial capital at risk (Cook et al., 2003). Banks with higher capitalisation put more own wealth at stake when they lend, and thus are expected to conduct more intensive information gathering, processing and higher quality risk control activities (Keely and Furlong, 1990; Gennotte and Pyle, 1991). A positive sign on capitalisation in (6) indicates that borrowers value the lenders' *ex-ante* commitment to certification and monitoring. Secondly, we use the loan loss provision ratio, measured by the ratio of loan loss provision to total loans, to indicate the *ex-post* result of the monitoring and screening activities. A change in the loan loss provision would reflect a change in the outcome of the monitoring and screening process[13], and we expect a negative sign for this variable in equation (6) if borrowers are concerned with the *ex-post* result of lenders' monitoring and other risk control activities, *ceteris paribus* .

Finally, we control for bank-specific asset size to capture a bank's distributional network impact on its own demand for loans: banks with a larger asset size are more likely to attract borrowers because they have a larger number of branches[14]. Bank size could also influence lending activities because larger banks may be under the implicit protection of the government (too big to fail). Overall, we expect a positive impact of size on the demand for loans.

In the product differentiation literature model (1) and its empirical specification (1b) have been described as a "short-run view on product differentiation" resulting from a two-

[13] We are aware of the argument about whether the loan loss provision can be used as an indicator of the lenders' capacity for certification and monitoring. As pointed out by Cook *et al.*, (2003), more capable banks might reserve conservatively for loan losses, while less reputable ones might need a higher reserve level for loan losses, so that the relation between loan loss provision and the quality and intensity of monitoring is unpredictable. In the Indian case, however, we argue that the association between the loan loss provision and the conservative attitude of banks for loan losses could be less relevant. According to the Indian accounting standards during our sample period, banks' loan loss provision is based on the materialised non-performing loans. The backward looking characteristic of the loan loss provision in the Indian case makes it a good indicator of the deterioration of the quality of the loan portfolio.

[14] See Bhaumik and Piesse (2008). In our sample the correlation coefficient between asset size and number of branches is 0.92.

stage framework. Reputation for specialisation in information production among banks is established in the first-stage, before banks set their interest rate on loans in the second-stage. To accommodate for this lag in our empirical setting, bank-specific characteristics z_{jit} ,and their rivals' z_{jRt} are measured at the beginning of period *t*, whereas the demand for loans is measured at the end of period *t*. Thus, in our empirical model, there is a lag of 1 year between differentiation and lending.

5.2. The cost system

The marginal cost of loans is computed by the simultaneous estimation of a translog cost function (2b) and factor cost share equation (2c):

$$\ln VC_{it} = \alpha_0 + \sum_m \alpha_m \ln y_{mit} + \sum_k \delta_k \ln w_{kit} + \sum_m \sum_r \alpha_{mr} \ln y_{mit} \ln y_{rit} + \sum_k \sum_s \delta_{ks} \ln w_{kit} \ln w_{sit} + \\ + \sum_m \sum_k \rho_{mk} \ln y_{mit} \ln w_{kit} + \theta_1 T + \theta_2 T^2 + v_{it} \qquad (2b)$$

Broadly following the intermediation approach, equation (2b) models a two-input, three-output production process[15]. VC is total operating cost, measured as the sum of interest and non-interest operating expenses. The first output (y_1) is the book value of performing loans, measured as the difference between total loans and non-performing loans. Other earning assets[16] are the second output (y_2), to capture their increase on banks' balance sheet. Finally, we define fee-based income as the third output (y_3) to accommodate the shift of banks' business focus from traditional on-balance-sheet activities to non-traditional off-balance-sheet activities. The two inputs are total loanable funds (the sum of deposits and money market funding) and non-interest operating costs (which aggregates the expenditure

[15] Although our central interest is the competitive conduct in the lending market, we control for other products along with the provision of loans in our cost function specification to allow for the multi-product nature of banks. The aim is to enhance the estimation of the marginal cost of loans since an appropriate representation and measurement of the cost function is crucial for estimating marginal cost (Morrison Paul, 1999).

[16] Other earning assets aggregates government securities, other approved securities, share, debentures and bonds, subsidiaries and joint ventures and other investment outside India (i.e. total investment).

associated with labour and physical capital); their prices are calculated respectively as the ratio of total interest expenditure to total loanable funds (w_1) and the ratio of non-interest operating cost to total assets (w_2). Finally, T is a time trend variable, introduced quadratically as a proxy for non-monotonic changes in cost technology, and v_{it} is the disturbance term.

Linear homogeneity of degree one in input prices is imposed prior to estimation, Young's symmetry applies. Following standard practice, we normalise each output quantity and input price variable by its geometric mean to facilitate the interpretation of results and the test of hypotheses.

The cost share equation of input one is derived by applying Shephard's lemma to (2b) as:

$$\frac{\partial \ln VC_{it}}{\partial \ln w_{1it}} = s_{1it} = \delta_1 + \delta_{11} \ln w_{1it} + \delta_{12} \ln w_{2it} + \rho_{11} y_{1it} + \rho_{12} y_{2it} + \rho_{13} y_{3it} + \vartheta_{it} \qquad (2c)$$

where s_1 is the cost share of the first input and all other variables are defined as before. ϑ_{it} is the error term.

Finally, estimates of the marginal cost of loans are obtained as:

$$MC_{it} = \frac{VC_{it}}{y_{1it}} * \frac{\partial \ln VC_{it}}{\partial \ln y_{1it}} = \frac{VC_{it}}{y_{1it}} * (\alpha_1 + \alpha_{11} + \alpha_{12} \ln y_{2it} + \alpha_{13} \ln y_{3it} + \rho_{11} \ln w_{1it} + \rho_{12} \ln w_{2it}) \quad 6)$$

5.3 The first-order condition for profit maximisation

Bringing (1b) and (6) together, the first-order condition corresponding to equation (5) is given as:

$$\frac{p_{it} - MC_{it}}{p_{it}} = \zeta_0 - \frac{1}{\beta_1 + \beta_2 * \lambda * \frac{p_{it}}{p_{Rt}}} + \zeta_i + \tau_{it} \qquad (5b)$$

β_1 and β_2 are the own-price elasticity and cross-price elasticity respectively, whose coefficients are estimated in (1b). p_{it} and p_{Rt} are the own-price and rivals' price as defined in section 5.1. ζ_i (i=1,….N) are the bank-specific time-invariant fixed effects. λ is the conjectural variation parameter to be estimated. τ_{it} is the disturbance term.

To investigate the evolution of competition in the lending market, we separate the whole sample period into two sub-periods, 1992-1997 and 1998-2004, because of the shift in the policy focus during the reform period. The specified bilateral policy-shift dummy R, which takes value 0 for 1992-1997 and value 1 for 1998-2004, is introduced into equation (5b) to allow for a different conjectural variation before and after 1997. The modified first-order condition is then:

$$\frac{p_{it} - MC_{it}}{p_{it}} = \zeta_i - \frac{1}{\beta_1 + \beta_2 * \frac{p_{it}}{p_{Rt}}(\lambda + \gamma R)} + \tau_{it} \qquad (5c)$$

In equation (5c), λ is the estimated conjectural variation for the period 1992-1997, and $\lambda + \gamma$ is the estimated conjectural variation for the period 1998-2004. A significantly negative γ suggests a decrease of the degree of coordination among market participants, a signal of increased competition. All other variables are defined as in equation (5b).

In the empirical implementation, the models presented above are estimated in two steps. First the cost equation (2b) and the cost share equation (2c) are simultaneously estimated to derive the marginal cost of loans, via Zellner's seemingly unrelated regression (ISUR) (Zellner, 1962). In the second stage the estimated marginal cost of loans is used as data when the demand equation (1b) and the first-order condition (5c) are simultaneously estimated via non-linear three-stage least squares (NL3SLS). Furthermore, to study how the responsiveness

of demand to banks' monitoring and screening capacity changes with changes in competition we jointly estimate (1b) and (5b) on the two sub-periods 1992-1997 and 1998-2004 separately. The definition of the variables used by our empirical models is shown in Table 3.

<Table 3 around here>

6. The data

The data is drawn from balance sheet and profit loss account statements of Indian scheduled commercial banks (excluding regional rural banks) from 1992 to 2004, and is collected from the Reserve Bank of India. Prior to the analysis, some data issues needed to be clarified. First, because our model assumes that banks operate in a uniform market, we restrict our sample to banks with more than three branches and more than three years operating record. In a sense these can be viewed as serious market players and would work in a national lending market. Secondly, we follow De Graeve *et al.*, (2007) in the treatment of mergers and acquisitions (M&A) and consider the banks as different units before the M&A and as one unit thereafter: since we assume that price is the strategic variable, it is reasonable to argue that the pricing policy of a bank before and after M&A will differ. Finally, we eliminate the extreme 2.5% of observations on the implicit interest rate of loans. Our final dataset is an unbalanced panel of 804 observations, and it accounts for about 90% of the total lending operations. All data were deflated using the GDP deflator using 1994 as the base year. The descriptive statistics of the variables are presented in Table 4.

<Table 4 around here>

7. Estimation and results

The results of the estimation of the cost function (2b) and the cost share equation (2c) are given in Table 5, which shows that 10 out of 16 parameters are significant at a 2% level or less. All three output cost elasticities are positive and statistically significant at a 5% level or less. The magnitude of the estimated coefficient of the interaction between inputs' prices (0.0864) is economically consistent[17], despite being positive and significant. Overall our estimated cost function meets all the necessary regularity conditions. The marginal cost of loans is then computed using equation (6)[18].

<Table 5 around here>

We then estimate the demand for loans (1b) and the first-order condition of profit maximization (5b) using the derived marginal cost as input. Since p_{it} in equation (1b) is endogenous[19], it has to be instrumented. We choose its one time period lag $p_{i,t-1}$ and the price of labour[20]. To accommodate the same own-price elasticity and cross-price elasticity shared by the demand equation (1b) and the first order condition (5c), and to take into account the possible contemporaneous correlation of the disturbances from the two equations, we estimate them simultaneously via NL3SLS. Moreover, to study the change of banks' risk taking incentives along with the change in competition, we examine the change of the demand response to lenders' monitoring and screening capacity by estimating the demand

[17] As shown by Salvanes and Tjotta (1998), the consistency region for the translog cost model with 2 inputs is determined jointly by the positive cost elasticity with respect to output and $\frac{1-\sqrt{1-8\gamma_{11}}}{2} \leq \hat{S}_1 \leq \frac{1+\sqrt{1-8\gamma_{11}}}{2}$, where r_{11} is the estimated coefficient of the interactive term between the two inputs' prices, and $\hat{S}_1$ is the estimated cost share of the first input.

[18] The mean over the 804 observations is 0.103, and the standard deviation is 0.031.

[19] The endogeneity is confirmed by a Durbin–Wu–Hausman test at the 5% level of significance.

[20] Cost variables, such as input prices, are appropriate instruments for output price in both homogeneous and differentiated markets (Berry, 1995). We measure labour price by the ratio of the payments and provisions for employees to the total number of employees.

equation (1b) and first order condition (5b) separately on the two periods 1992-1997 and 1998-2004. All results are reported in Table 6.

<Table 5 around here>

As shown in Table 6, the estimated own-price elasticity (β_1) is always negative and the cross-price elasticity (β_2) is always positive. This is consistent with economic theory and it indicates respectively that banks face a downward sloping demand curve and a degree of substitutability between their loans. The absolute magnitude of these elasticities is different for the whole sample period and the two sub-periods, indicating that the price ratio is not the only determinant of demand because the loans offered by different banks are not perfect substitutes. In particular, the own-price elasticity is always larger in absolute value than the cross-price elasticity, i.e. demand is more sensitive to changes in p_i than in p_R. This may be a result of banks' effort to soften competition by providing fringe services along lending (Coccorese, 2005). The existence of switching costs could also be another explanation. Furthermore our estimated own-price elasticity of demand for the periods 1992-1997, 1998-2004 and 1992-2004 are -0.782, -1.396 and -1.202 respectively, consistently with our assumption of profit maximisation and hence pricing in the elastic part of the demand equation (although -0.782 is larger than -1, we fail to reject the hypothesis that the estimated own-price elasticity ≤ -1 at 5% significant level).

Turning to the evolution of competition in the market place, the conjectural parameter for 1992-1997 is 0.157 (λ) and for 1998-2004 is 0.087 ($\lambda + \gamma$), both significantly different from 0 and from one another; this leads us to reject the hypothesis of Nash equilibrium. The hypothesis of cartel behaviour is also rejected since λ is significantly different from 1. Therefore, the conduct of banks in the lending market during 1992-1997 seems to be less competitive than a Nash equilibrium in price but certainly more competitive than full

collusion. In 1998-2004, the significantly negative γ indicates lower market coordination, therefore implying an increase in competition after 1997. Similar conclusions arise from the separate estimation of the two sub-periods. Overall the results suggest that the introduction of tighter prudential norms may not hinder competition[21].

We next analyse the characteristics of the demand response to lenders' information acquisition capacity. Since our focus is on the change of this response along with the change in competition, our attention is centred on the results derived from the separate estimation of the two sub-periods. The estimated coefficients of the relative capital position and of the relative loan loss provision ratio are both insignificant in 1992-1997, indicating that borrowers do not seem to worry about these banks' characteristics in the early stages of the reform. The results derived for the period 1998-2004 give a different picture, notably in contrast with the literature on the uniqueness of banks loans. The estimated coefficient of the relative capital position is significantly negative whereas that of the relative loan loss provision ratio is significantly positive (both at a 1% level). Therefore, the higher the intensity and quality of monitoring and screening by a bank, the lower the demand it faces, *ceteris paribus*. Put differently, borrowers tend to favour banks with lower information acquisition capacity by shifting up their demand curve and giving these banks room to increase prices. As a whole, our results suggest that demand negatively responds to lenders' information acquisition capacity, and can treat it as an "unwelcome quality" when the lending market becomes more competitive. This therefore implies an increase of risk taking incentives of banks along with the increase in competition. The result on the change in demand's responsiveness could be a reflection of the asymmetry of the credit policy of banks in an increasingly competitive environment with more stringent prudential norms. It is reasonable to expect that banks with a higher capital position and better loan portfolios may

[21] The same conclusions are reached by Zhao *et al.* (2009).

show a tighter lending attitude to sustain their reputation, especially when competition becomes more intense and borrowers have more chances to "shop around". As it is well known, the standard loan contract not only includes the contracted interest rate (pure price) but also the non-interest rate conditions, such as collateral, security, periodic monitoring, reporting, and in extreme cases, a representative of the bank on the firm's board of directors. These non-interest elements can make the true price of loans unaffordable and lead borrowers to self-ration (Hansen and Thatcher, 1983). Vice versa, banks setting less demanding conditions on the supply of loans will attract more customers (Bolt and Tieman, 2004).

Finally, the results on the effect of bank size and availability of other sources of finance are positive and significant as expected, both for the whole sample period and the two sub-periods.

Putting together all the evidence presented in this paper, there appears to be an increase in competition in the lending market along with the reform process. This stronger competition is concurrent with the introduction of tighter prudential norms, implying that these may not necessarily hinder competition. Our results also find a significantly negative response of demand to lenders monitoring and screening capacity when the market becomes more competitive, suggesting that banks' risk taking incentives will increase along with the increase in competition. Since in our sample the increase in competition is concurrent with the introduction of tighter prudential norms, increased risk taking incentives therefore coexist with the latter. The underlying implication is that tighter prudential norms may not automatically correct for excessive risk taking if there is no appropriate incentive structure in place. The statutory compliance with prudential standards does not guarantee the creation of an appropriate incentive mechanism or the strengthening of the banking system. The institutional framework that induces economic agents to behave in the manner desired by the regulator goes beyond the prudential norms in a deregulated operational environment. A

well-functioning legal system that effectively enforces contracts and property rights, effective bankruptcy laws and procedures, and effective private market-discipline on the asset side (the demand) are very important when competition increases.

8. Conclusion

In this paper we develop a structural model of competition in the lending market to examine the impact of financial reforms on competition and the change that this induces in banks' risk taking incentives. Following the NEIO literature, we define the interest rate as banks' strategic variable, and base the test of the degree of competition on the estimated conjectural variation parameter. The specified model is estimated on an unbalanced panel of Indian scheduled commercial banks from 1992 to 2004, which encompasses two separate stages of the reform of the sector.

Our results show that competition in the lending market increased along with the reform process and concurrently with the introduction of tighter prudential norms therefore implying that these may not necessarily hinder competition. We base the analysis of banks risk-taking incentives on the change of demand's responsiveness to lenders' monitoring and screening capacity. This analysis reveals that borrowers appear to favour lenders with lower monitoring and screening capacity when the market becomes more competitive. This supports the view that competition increases banks' risk taking incentives. Given the concurrent introduction of tighter prudential norms in the later stages of the reform process, the underlying implication is that prudential re-regulation may not automatically correct for banks excessive risk taking.

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Table 1: Summary statistics of the Indian banking industry (1992 – 2004)

	N.of banks	Defined by total assets			Defined by total loans		
		HHI	CR5	σ^2	HHI	CR5	σ^2
1992	77	0.102	0.516	0.00116	0.104	0.526	0.001152
1995	86	0.079	0.463	0.00078	0.078	0.469	0.000772
1998	103	0.072	0.446	0.00060	0.074	0.459	0.000624
2000	101	0.072	0.445	0.00061	0.069	0.437	0.000585
2004	90	0.064	0.415	0.00059	0.058	0.418	0.000521

Note: σ^2 measures the market shares' variance about the mean, i.e. 1/n. The Herfindahl-Hirschman Index (HH) and Five-firm Concentration Ratio (CR5) are calculated relative to total assets and total loans respectively. Data source: Reserve Bank of India, author's calculation.

Table 2: Descriptive statistics of selected banking indicators

	1992	1995	1998	2002	2004
(1) Implicit deposit rate [a]	0.065	0.056	0.076	0.074	0.048
(2) Implicit credit rate [b]	0.155	0.11	0.136	0.108	0.095
(3) Loanable fund price [c]	0.080	0.063	0.081	0.075	0.052
Spread A = (2)-(1)	0.093	0.053	0.06	0.034	0.047
Spread B = (2)-(3)	0.075	0.047	0.055	0.033	0.043
Total loans/total earning assets [d]	0.603	0.588	0.578	0.541	0.510
Government security/total investment [e]	0.629	0.664	0.664	0.726	0.793
Fee-based income/ total income [f]	0.134	0.138	0.154	0.196	0.237

Notes: [a] implicit deposit rate = interest paid on deposits/ total deposits
[b] implicit credit rate = interest income received on loans/total loans.
[c] loanable fund price = total interest rate payment/total deposits and money market borrowing.
[d] total earning assets = total loans and total investment.
[e] total investment = government securities, other approved securities, shares, debentures and bonds, subsidiaries and joint ventures and other investment outside India.
[f] total income = fee-based income and total interest income.

Table 3: Definition of the variables in equations (1b), (2b) and (5c)

Variables	***Description***
Demand equation (1b)	
Quantity of loans (q_i)	Book value of performing loans = total loans-non-performing loans
Own price (p_i)	Implicit interest rate for loans = interest income on loans / book value of performing loans
Rivals' price (p_R)	A loan-weighted index of rivals' price $= \sum_{N \neq i} \frac{q_{Nt}}{\sum_{N \neq i} q_{Nt}} p_{Nt}$. $\frac{q_{Nt}}{\sum_{N \neq i} q_{Nt}}$ is the share of each rival bank in terms of loans supplied.
Bank-specific characteristics [g] • capital position (CAR) • size (TA) • loan loss provisions (LOSS)	= Capital/total assets = Total assets = Loan loss provision/total loans
Industry-level condition: • dependence on bank financing (B)	Total assets of the banking system/GDP
Cost equation (7)	
Total operating cost (VC)	Interest expended +operating expenses
Outputs: • Performing loans (y_1) • Other earning assets (y_2) • Fee-based income (y_3)	= Total loans-non-performing loans = Total investment = Non-interest income
Inputs' prices: • Loanable funds price (w_1) • Non-interest operating price (w_2)	= Interest expended/(deposits+ borrowing from the central bank and inter-bank market + others) = Operating expenditure/total assets
S_1	Cost share of the loanable funds = interest expended/total operating cost
Cost technology change (T)	= time trend
First-order condition (10')	
Policy shift dummy (R)	Set equal to 1 for 1998-2004, 0 otherwise

Notes: [g] A bank-specific characteristic is calculated as $\frac{z_i}{z_R}$, z_i is bank-own characteristic and z_R is the rivals' characteristic.

$z_R = \sum_{N \neq i} \frac{q_{Nt}}{\sum_{N \neq i} q_{Nt}} z_{Nt}$, a loan-weighted index of rivals' characteristic. $\frac{z_i}{z_R}$ of year t is measured at the beginning of the year.

Table 4: Descriptive Statistics of the variables in equations (1b), (2b) and (5c)

Variables	***Mean***	***S.E***	***Minimum***	***Maximum***
q_i [i]	16.6674	1.4580	10.7889	20.5804
p_i [i]	-2.1182	.2518	-4.0537	-1.1799
p_R [i]	-2.1661	.1596	-2.5107	-1.8872
CAR [i]	.0054	.5072	-1.8814	2.3983
TA [i]	-2.4583	1.4919	-7.8432	2.1999
LOSS [i]	-.1651	.8071	-9.0619	3.4065
B [i]	-.9393	.1865	-1.1338	-.6136
VC [h]	15.0565	1.4858	9.5373	18.9755
y_1 [h]	16.5784	1.5027	10.7889	20.5804
y_2 [h]	16.4043	1.6105	10.3727	20.7773
y_3 [h]	13.2705	1.7125	-4.5249	17.5831
w_1 [h]	.0722	.0156	.0040	.1574
w_2 [h]	.0273	.0142	.0019	.3346
S_1 [h]	.7003	.0735	.1644	.8723

Note: data are deflated using 1994 as the base year. All variables except w_1, w_2 and S are reported in natural logarithms. q_i, VC, y_1, y_2 and y_3 are all measured in Rs.

[h] The total number of observations is 804.

[i] Since in our empirical model there is a 1 year lag year between bank-specific characteristics and lending, the observations in 1992 are excluded in the demand equation and first-order condition, leaving 728 observations. For variables definitions see Table 3.

Table 5: Parameter estimates of the cost function (2b) and cost share equation (2c)

Variables	*Coeff.*	*Robust Std. err.*	*P-Value*
Constant	17.8959***	0.0107	0.000
Lny1	0.5377***	0.0190	0.000
Lny2	0.4219***	0.0137	0.000
Lny3	0.0209*	0.0119	0.039
Ln(w1/w2)	0.7777***	0.0026	0.000
Lny1*lny1	0.0994***	0.0173	0.000
Lny1*lny2	-0.1997***	0.0437	0.000
Lny1*lny3	0.0282	0.0462	0.541
Lny2*lny2	0.1042***	0.0280	0.000
Lny2*lny3	-0.0264	0.0312	0.397
Lny3*lny3	-0.0009	0.0033	0.785
Ln(w1/w2)*ln(w1/w2)	0.0864***	0.0007	0.000
Ln(w1/w2)*lny1	-0.0043	0.0050	0.389
Ln(w1/w2)*lny2	0.0082*	0.0047	0.082
Ln(w1/w2)*lny3	-0.0026	0.0019	0.170
T	0.0085**	0.0037	0.020
T*T	-0.0013***	0.0003	0.000
R^2 of (7)	0.99		
R^2 of (8)	0.99		
No. obs	804		

Note: the standard error reported is White (1980) heterogeneity adjusted.
*, **, ***, indicates significance at 10%, 5% and 1% levels respectively.

Table 6: Parameter estimates of the demand equation and the first order condition

Parameters	Estimates					
	1992-2004		**1992-1997**		**1998-2004**	
Demand equation						
	Coeff	***S.E***	***Coeff***	***S.E***	***Coeff***	***S.E***
$\ln p_i$ (β_1)	-1.203***	0.463	-0.782***	0.207	-1.396***	0.268
$\ln p_R$ (β_2)	0.920**	0.426	0.544***	0.217	0.953***	0.246
lnB (η)	1.076***	0.084	1.276**	0.659	0.884***	0.175
lnTA (ϕ_1)	0.775***	0.035	0.689***	0.041	0.896***	0.030
lnCAR(ϕ_2)	-0.047	0.041	-0.006	0.029	-0.167***	0.048
lnLOSS(ϕ_3)	-0.017	0.013	-0.013	0.012	0.049***	0.020
Durbin-Watson	1.314		2.031		1.660	
R-squared	0.985		0.992		0.985	
First-order condition						
	Coeff	***S.E***	***Coeff***	***S.E***	***Coeff***	***S.E***
C.V.: λ (separate equations)			0.298***	0.059	-0.459	1.063
C.V.: λ, γ (joint equation)			0.157*	0.096	-0.070***	0.025
Durbin-Watson	2.100		2.298		2.350	
R-squared	0.451		0.671		0.407	
No. obs	728		278		450	

Note: CV: conjectural variation parameter. S.E: Standard errors. Since the Durbin-Watson test for the period 1992-2004 indicates the presence of serial correlation for the estimated demand equation, the standard errors for 1992-2004 are robust to autocorrelation.
*, **, ***, indicates significance at 10%, 5% and 1% levels respectively.
Bank-specific fixed effects are included in the estimation, but not reported.