Market Power and Merger Simulation in Retail Banking *

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First version: August 2007
This version: November 2007

Abstract

This paper tests market power in the banking industry. First, I calculate price-cost margins predicted by different oligopoly models using discrete-choice demand estimates of own and cross-price elasticities. Second, I compare these predicted price-cost margins to price-cost margins computed with the observed interest rates and estimates of marginal costs. This paper is among the first to apply this methodology on a detailed, bank-level dataset from the retail banking sector. I extend the previous papers and illustrate the advantages of structural modelling by simulating a counterfactual merger experiment among pairs of the biggest banks and studying the unilateral effect of the mergers on the interest rates. I provide another evidence that concentration measures (such as Herfindahl index) could be very misleading indicators of market power.

JEL Classification: G21, L11, L13, Keywords: Demand, discrete choice, product differentiation, banking, market power, merger simulation

*The views expressed in this paper are those of the authors and do not necessarily correspond to the views of the Bank of Finland. I thank Iftekhar Hasan, Esa Jokivuolle, Moshe Kim, Tuomas Takalo, Jouko Vilmunen, Matti Viren and seminar participants at the Bank of Finland for useful comments, Tero Kuusi for research assistance with the data collection and EPSI Finland for data on consumer satisfaction. I am responsible for all the remainig errors.

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1 Introduction

In the banking literature, until recently, the two most popular methodologies to test market power were the Panzar-Rosse (1987) test which infers conduct from the individual firm's input-output cost relationships, and Bresnahan's (1982) conjectural variation (CV) model which focuses on market structure parameters. Degryse and Ongena (2005) summarizes the advantages of the two methods. The Panzar-Rosse test's data requirement is low and and the data are readily available across different countries while the conjectural variation model nicely embeds different types of competitive behaviour. However, Hyde and Perloff (1995) finds, that the Panzar-Rosse test is very sensitive to the specification of the reduced-form revenue function and to which input factors of production are included. Corts (1999) and Nevo (1998) show that the CV methodology has problems related to the interpretation and identification of the theoretical conduct parameter.[1]

The structural framework in this paper avoids some of the above mentioned problems of earlier approaches. The typical structural approach is to map firms' observed pricing decisions into their unobserved costs by estimating a demand function and assuming a particular strategic model of competition. This paper follows a different strategy. Since the main goal is to find the model of competition that describes the data best, I estimate demand and cost functions and try to identify the model of competition which best describes the data. First, I derive price-cost margins predicted by different strategic oligopoly models using discrete-choice demand estimates of own and cross-price elasticities. Demand for different banking services is derived from individual utility maximization and estimated with a characteristics-based discrete choice model in which the product differentiation is explicit. The discrete choice approach helps to overcome the difficulty of estimating a large number of substitution parameters given several banks on the market. Second, I compare these predicted price-cost margins to price-cost margins computed with the observed interest rates and accounting estimates of marginal costs[2]. The pa-

[1] See Reiss and Wolak (2005) for more details about the problems with the reduced-form approach.

[2] There are a few other studies that applied "outside" estimates of marginal costs to test strategic

rameter estimates are immune to the Lucas-critique (i.e. do not change with different policies) so counterfactuals can be tested on them. This is particularly important from a policy perspective (i.e. merger control, see e.g. Ivaldi and Verboven (2005)), where a more complete structural framework might be needed to determine proper regulation. The disadvantage of the structural framework is the rather large data requirement but this paper is fortunate to utilize a fairly detailed, bank-level dataset.

This paper is among the first to apply this methodology to the retail banking sector. I extend the previous papers and illustrate the advantages of structural modelling by simulating a counterfactual merger experiment among pairs of the biggest banks and studying the unilateral effect of the mergers on the interest rates. Dick (2002) was the first to apply a structural demand model based on consumer choice under product differentiation[3] on retail deposit services using data on U.S. commercial banks. She estimates a demand function for total deposits and derives consumer welfare but she does not test market power. Nakane et al. (2006), Ho (2007) and Molnar et al. (2007) employ similar techniques to estimate demand on a more detailed datasets and use the estimated demand elasticities to study market power on the supply side in the Brazilian, Chinese and Hungarian retail banking sector, respectively. All of these papers focus on short term, static competition[4] and infer the form of the strategic conduct from the estimated own and cross-price elasticities and the marginal costs estimates. Nakane et al. (2006) uses outside estimates of marginal cost while Molnar et al. (2007) estimates marginal cost from accounting data. Ho (2007) estimates a system of differentiated product demand and pricing equations jointly under alternative market structures. The system estimation is more efficient if both the cost and demand equations are well specified. Since estimating the cost function could be quite problematic this paper estimates the demand

oligopoly models in different industries, for example Hendricks, Porter and Boudreau (1987) in oil and gas lease auctions, Nevo (2001) in the cereal industry, and Hortacsu and Puller (2007) in the Texas electricity spot market.

[3] As developed by Berry (1994).

[4] There is a growing literature on spatial competition on banking using reduced form models. Kim and Vale (2001) and Dick(2006) study banks' branching decisions. de Juan (2004) and Berger and Dick (2007) study dynamic bank decisions of the entry and exit.

and cost functions separately using the instrumentation techniques developed by Berry et al. (1995) and Nevo(2001). This paper also extends the previous ones by analyzing the unilateral effects of some counterfactual mergers in the industry.

The rest of the paper is organized as follows. Section 2 describes the building blocks of the structural model. In section 3 the merger simulation, in section 4 the data is discussed. Section 5 discusses the estimation strategy along with the identifying assumptions. Section 6 presents the results of the estimation Finally, section 7 provides discussion of the results and conclusion.

2 The building blocks

The main building blocks of the structural approach are the demand function, the supply models and the cost function. The demand estimation follows Dick (2002). She estimates demand for deposit services of commercial banks by aggregating heterogenous consumers' discrete choices, a standard methodology in the discrete choice literature (see Berry; 1994). Besides demand for deposit services, I also estimate demand for loans. For the supply side, I consider two extreme models of the banking industry: a static, differentiated product Nash-Bertrand oligopoly and a cartel. For each supply model the pricing decisions of the banks depend on the individual bank-level demands. I use the estimated price elasticities to calculate price-cost margins implied by the two supply models. Finally, I estimate a translog cost function to get an empirical estimates of the marginal costs of deposit services and loans. With the estimated parameters I conduct a counterfactual experiment to measure the unilateral effects of some hypothetical bank mergers.

2.1 Demand for deposit services and loans

The logit demand specification is the simplest discrete-choice model in which an individual consumes one unit of a brand that yields the highest utility. In this application, consumers $i = 1, ..., I_t$ maximize their indirect utility by purchasing deposit services or taking a loan from a bank $j = 0, 1, .., J_t$ in $t = 1, ...T$ time period. $j = 0$ choice indicates the outside option of not choosing a commercial bank, which is defined as the total households' savings (loans) in all financial institutions minus the deposits (loans) in the commercial bank sector. The conditional indirect utility function of consumer i from choosing bank j's deposit services at time t includes a mean utility δ_{jt}^{d} and an individual specific, iid, mean zero random disturbance ϵ_{ijt}:

$$u_{ijt}^{d} = \delta_{jt}^{d} + \epsilon_{ijt} = r_{jt}^{d}\alpha^{d} - r_{jt}^{sd}\alpha^{s} + x_{jt}\beta^{d} + \xi_{jt}^{d} + \epsilon_{ijt}, \tag{1}$$

where r_{jt}^{d} and r_{jt}^{sd} represent interest rates paid by banks on deposits and fees on deposits respectively, x_{jt} is a K dimensional vector of observed bank characteristics other than interest rates, ξ_{jt} represents bank characteristics unobserved to the econometrician (depicted as mean across consumers and independent across banks), and $\theta_D = (\alpha^{d}, \alpha^{s}, \beta^{d})$ is the $K+2$ dimensional vector of the mean level of taste parameters to be estimated. Note that the parameters of the utility function do not depend on individual i's characteristics. Assume that variation in consumers' taste enters only through the additive term ϵ_{ijt}. Consumers maximize their utility and choose bank j whenever it gives them the highest utility, i.e. $U\left(r_{jt}^{d}, r_{jt}^{sd}, x_{jt}, \xi_{jt}, \epsilon_{ijt}; \theta_D\right) \geq U\left(r_{lt}^{d}, r_{lt}^{sd}, x_{lt}, \xi_{lt}, \epsilon_{ijt}; \theta_D\right)$ for all $l \neq j$ and t, where ϵ_{ijt} captures consumer specific terms that are not observed by the econometrician. The closed form solution of the multinomial logit model (assuming that the unobservables' distribution is a type-I extreme value) yields bank j's market share in market d at time t as:

$$s_{jt}^{d}\left(\delta_{t}^{d}\right) = \frac{\exp\left(\delta_{jt}^{d}\right)}{\sum_{r=0}^{J}\exp\left(\delta_{rt}^{d}\right)}, \qquad j = 1, ...J. \tag{2}$$

The consumer loan demand is specified similarly to the deposit services demand. Assume that there are $m = 1, ..., M_t$ consumers interested in borrowing from a bank. Let each consumer's utility function be linear such that the conditional indirect utility of consumer i from choosing bank j's services is

$$u_{mjt} = \delta^l_{jt} + \epsilon_{mjt} = -r^l_{jt}\alpha^l - r^{sl}_{jt}\alpha^{sl} + x_{jt}\beta^l + \xi^l_j + \epsilon_{mjt}, \quad (3)$$

where r^l_{jt} and r^{sl}_{jt} represents interest rates paid by consumers on loans and fees on loans respectively, and the other variables are defined as in equation (1).

The logit model has its well-known problems. It restricts consumers to substitute towards other brands in portion to market shares regardless of the characteristics. Moreover if the share of the outside good is too large it also biases the substitution to the inside goods downwards. Unfortunately data limitations prevent the application of more flexible models but in this sample these problems are perhaps not as serious because the share of the outside good is fairly small, the number of banks is quite limited and there are no huge quality differences among them so it seems not too unreasonable that the market share drives the substitution patterns.

2.2 Supply of deposit services and loans

In the supply models, similarly to Nakane et al (2006) and Molnar et al. (2007), I consider two static models of banking. First, I derive first-order conditions in a differentiated product Bertrand model. Second, I derive first-order conditions for a cartel. These models are at the two extreme ends of competitive conduct. Most likely neither one is the true model of banking competition but they could serve as useful benchmarks. Assume that there are J profit-maximizing banks that produce deposit and loan services using labor and physical capital as input. They choose interest rates and fees to maximize their profits both on the deposit and on the loan markets separately[5] (i.e. no bundling) under liquidity constraint:

$$\underset{r^{sd}_{jt},r^d_{jt},r^l_{jt},r^{sl}_{jt}}{\text{Max}} \pi_j = \left(r^{sd}_{jt} - r^d_{jt}\right) I_t s^d_{jt}\left(\delta^d\right) + \left(r^l_{jt} + r^{sl}_{jt}\right) M_t s^l_{jt}\left(\delta^l\right) - C_{jt}\left(I_t s^d_{jt}\left(\delta^d\right), M_t s^l_{jt}\left(\delta^l\right)\right) + R_{jt} r_t, \quad (4)$$

[5] Adams et al (2002) provides some evidence that in banking this separability assumption does not cause significant misspecification error.

$$\text{s.t.} \qquad I_t s^d_{jt}\left(\delta^d\right) = M_t s^l_{jt}\left(\delta^l\right) + R_{jt} + E_{jt}$$

where R_{jt} is the net interbank exposure at r_t interest rate. I_t and M_t are the deposit and loan market size. E_{jt} is the bank's capital. The profit function consist of the revenue from the deposit markets, the revenue from the loan markets, minus the non-interest cost (C_{jt}), and finally a net balance of interbank transactions (R_{jt}). The balance sheet constraint states that the total deposit amounts should be equal to the total loan amount plus the net interbank exposure. I assume that the interbank market is perfectly competitive and banks can borrow and lend at the same interest rate r_t. The cost function consists of non-interest costs such as wages and capital costs. I assume that deposit interest rates have no effect on the loan market share and vice versa. The interest rate first-order conditions for bank j are the following:

$$\left(r^{sd}_{jt} - r^d_{jt} + r_t - c^d_{jt}\right) = \frac{s^d_{jt}\left(\delta^d\right)}{\frac{\partial s^d_{jt}\left(\delta^d\right)}{\partial r^d_{jt}}}, \tag{5}$$

$$\left(r^l_{jt} + r^{sl}_{jt} - r_t - c^l_{jt}\right) = -\frac{s^l_{jt}\left(\delta^l\right)}{\frac{\partial s^l_{jt}\left(\delta^l\right)}{\partial r^l_{jt}}}, \tag{6}$$

The first-order conditions can be easily transformed to the familiar Lerner-indices by dividing both sides with the appropriate interest rate. The Lerner-index states that the marginal revenue minus the marginal cost of the banks, divided by the price should be equal to the inverse of the residual demand elasticicities. In our case the marginal revenue on deposits is equal to the sum of service fee and interbank interest rate. The marginal cost on deposits is equal to the paid interest rate plus the non-interest marginal cost, (c_{jt}). On loans the marginal revenue is the sum of the charged interest rate and service fees. The marginal cost on loans is the sum of interbank interest rate and non-interest marginal costs.

In case of cartel the banks maximize their joint profit. The profit function is the sum of the individual banks' profit.

$$\underset{r^{sd}_{jt},r^{d}_{jt},r^{l}_{jt},r^{sl}_{jt}\ j=1,..J}{\text{Max}} \sum_{j=1}^{J} \pi_j = \sum_{j=1}^{J} \left(\begin{array}{c} \left(r^{sd}_{jt} - r^{d}_{jt}\right) I_t s^{d}_{jt}\left(\delta^{d}\right) + \left(r^{l}_{jt} + r^{sl}_{jt}\right) M_t s^{l}_{jt}\left(\delta^{l}\right) \\ -C_{jt}\left(I_t s^{d}_{jt}\left(\delta^{d}\right), M_t s^{l}_{jt}\left(\delta^{l}\right)\right) + R_{jt} r_t \end{array} \right) \tag{7}$$

$$\text{s.t.} \qquad I_t s^{d}_{jt}\left(\delta^{d}\right) = M_t s^{l}_{jt}\left(\delta^{l}\right) + R_{jt} + E_{jt} \text{ for every } j$$

where R_{jt} is the net interbank exposure at r_t interest rate. I_t and M_t are the deposit and loan market size. The interest rate first-order conditions for bank j:

$$\left(r^{sd}_{jt} - r^{d}_{jt} + r_t - c^{d}_{jt}\right) = \frac{s^{d}_{jt}\left(\delta^{d}\right)}{\frac{\partial s^{d}_{jt}\left(\delta^{d}\right)}{\partial r^{d}_{jt}}} - \sum_{k \neq j} \left(r^{sd}_{kt} - r^{d}_{kt} + r_t - c^{d}_{kt}\right) \frac{\frac{\partial s^{d}_{kt}\left(\delta^{d}\right)}{\partial r^{d}_{jt}}}{\frac{\partial s^{d}_{jt}\left(\delta^{d}\right)}{\partial r^{d}_{jt}}}, \tag{8}$$

$$\left(r^{sl}_{jt} + r^{l}_{jt} - r_t - c^{l}_{jt}\right) = -\frac{s^{l}_{jt}\left(\delta^{l}\right)}{\frac{\partial s^{l}_{jt}\left(\delta^{l}\right)}{\partial r^{l}_{jt}}} - \sum_{k \neq j} \left(r^{sl}_{kt} + r^{l}_{kt} - r_t - c^{l}_{kt}\right) \frac{\frac{\partial s^{l}_{kt}\left(\delta^{l}\right)}{\partial r^{l}_{jt}}}{\frac{\partial s^{l}_{jt}\left(\delta^{l}\right)}{\partial r^{l}_{jt}}}, \tag{9}$$

In a collusive equilibrium the profit-maximizing banks internalize the negative business stealing effect they have on other banks and charge a higher price (higher (lower) interest rates in case of loans (deposits).)

2.3 Cost function

The price-cost margins of course depend on the marginal costs of the banks. I estimate marginal cost using a translog cost function. I use instruments for the endogenous output variables since outputs are the choice of the bank and it can correlate with supply shocks that are in the error term. The implicit assumption in the literature is the banks operate in a perfectly competitive market so this endogeneity is usually ignored.

The first output is defined as the production of a bank in a certain sub-market (loan or deposit respectively), while the second output is the rest of its total assets. Inputs consist of labour and physical capital. Labour cost is approximated by the ratio of personnel expenses to the number of employees, while the price of physical capital is proxied by the ratio of the difference between all non-interest and personnel expenses to fixed assets. The total cost is the sum of the non-interest expenses. Following Kim (1985) the cost system consists of the translog cost function and cost share equations for the inputs (Shephard's lemma):

$$\ln(TC_{jt}) = \lambda + \sum_n \tau^n \ln Q_{jt}^n + \sum_m \upsilon^m \ln P_{jt}^m + \frac{1}{2}\sum_n\sum_p \phi_{np}(\ln Q_{jt}^n \ln Q_{jt}^p) + (\frac{1}{2})\sum_m\sum_r \varphi_{mr}(\ln P_{jt}^m \ln P_{jt}^r) + \sum_n\sum_m \chi_{nm} \ln Q_{jt}^n \ln P_{jt}^m + \eta_{it}, \tag{10}$$

$$S_{jt}^m = \upsilon^m + \sum_r \varphi_{mr} \ln P_{jt}^r + \sum_n \chi_{nm} \ln Q_{jt}^n + \vartheta_{it}^m \tag{11}$$

where TC_{jt} corresponds to total costs, Q_{jt}^n is the n^{th} $(n = 1, 2)$ output, P_{jt}^m is the m^{th} $(m = 1, 2)$ input price of bank j in time t, λ is a common constant and S is the cost share, i.e. expenditures on input m divided by total cost. To ensure symmetry and linear homogeneity the following parameter restrictions are imposed:

$$\phi_{np} = \phi_{pn}, \varphi_{mp} = \varphi_{pm}, \sum_m \upsilon_j^m = 1, \sum_r \varphi_{mr} = 0, \sum_m \chi_{nm} = 0.$$

I allow the correlation of error terms on the cost function and share equations, but assume the correlation is zero across banks. Unlike in Kim(1985), I treat output as a potentially endogenous variable and apply iterative three-stage least squares using the lagged values of ouputs and characteristics of rival banks as instruments.

Then the marginal cost function, c_{jt}^s (where s stands for the specific product which is always product 1 in the cost function) can be calculated by taking the first order condition of the translog cost function with respect to first output on the sub-market s in the following manner:

$$c_{jt}^1 = \frac{TC_{jt}}{Q_{jt}^1}(\tau^1 + \phi_{11} \ln Q_{jt}^1 + \frac{1}{2}\phi_{12} \ln Q_{jt}^2 + \chi_{11} \ln P_{jt}^1 + \chi_{12} \ln P_{jt}^2). \tag{12}$$

All banks are assumed to be X-efficient.

3 Merger Simulation

One of the advantages of structural models over reduced forms is that the estimated parameters are immune to changes in policy or in the environment. Thus these models can be used for stress testing or merger simulations. In this paper, I consider some hypothetical mergers and calculate their potential effect on the average price-cost margins in the banking industry. The general findings in the empirical literature is that banking mergers generate adverse price effect and harm consumers. For example Prager and Hannah (1998) finds that bank mergers, which increases the Herfindahl index by more than 200 points or to a level greater than 1800, are substantially reduce deposit rates paid by the bank. Using the structural model described in the previous section I assess the unilateral effects of hypothetical mergers of each pair out of the 3 biggest banks.

The approach typical in the merger simulation literature (Berry and Pakes (1993), Werden and Froeb (1994)) changes the ownership structure in each market, while holding the set of products, all of their characteristics, and the equilibrium assumptions constant. In this application, I assume that after the merger the merged bank behaves as a single-product Bertrand competitor in each submarket. The number of branches reflects the sum of the individual banks' branches that are involved in the merger and I recompute the number of employees per branch as well. Moreover, I assume that there are no synergies or at least none of the cost savings are passed on to consumers. Under these assumptions I provide estimates of post-merger price-cost margins using the pre-merger estimates of the parameters of the demand and cost functions.

4 Data

The model is applied to a panel of Finnish banks' data from 2003-2006. There are quarterly data from balance sheet and income statements of commercial banks collected by the Finnish Financial Supervisory Authority and the Bank of Finland. Interest rates and quantities (stock and new loans and deposits as well) are collected monthly based on regulations and guidelines of the European System of Central Banks (ESCB)[6]. Only bank level data is available without branch-level details so the market is defined as the whole country. I use the new loans and deposits in the 2003-2006 period because there were some changes in the definition of different accounting aggregates in 2003. Sectorial breakdown of loans and deposits are available but in this paper I use only the aggregate household loans and deposit data. Aggregation could cause problems if there are some significant changes in the share of some very different products but in this time period the Finnish market was quite stable and no big structural change happened. The service fees are imputed from the accounting data. Finnish banks report service fee income by activities such as loans, deposits, payment transactions, standing order charges, securities brokerage, issues of securities and asset management. To compute service fees I divided the accounting data on fee revenues with the stocks of the loans and deposits. For the cost function estimates I also used the accounting data. The administrative cost was used as total cost. Labor cost was approximated by the ratio of personnel expenses to the number of employees, while the price of physical capital is proxied by the difference between all non-interest and personnel expenses to fixed assets.

The Finnish market is dominated by 3 banks: OP Bank Group (which is the commercial bank of some of the cooperative banks, Nordea and Sampo. These 3 banks cover about 70% of both loan and deposit market. There are numerous smaller banks and local cooperatives that have typically only a few branches. I restrict the sample to those banks that have at least 0.1% of market share at a given time. Because of this the number of banks changes from quarter to quarter. Altogether there are 12 banks that are in the whole sample. The remaining other banks, local cooperatives and other monetary institutions are considered as the outside good of the model. Unfortunately because of the small number of banks and quarterly data the number of observations is quite limited and this has put some constrains on the estimation approach as well.

For bank characteristics I have used the number of branches, number of employees

[6] For a detailed definition of the variables see: http://www.ecb.int/ecb/legal/pdf/l_1020020112en00240046.pdf

per branch and consumer satisfaction data. The first two were available from the balance sheets of the banks. The consumer satisfaction data are from the EPSI Finland dataset. Consumer satisfaction numbers were available for the 4 biggest banks and a summary number for the rest. The levels were not significant but the changes in the numbers proved to have explanatory power.

5 Estimation

I estimate the demand and the cost function separately. Estimating the demand and cost jointly could be more efficient but if either one of those are misspecified the biases would contaminate the estimates of the other. The equation-by-equation estimation is consistent but has the usual problem that in the demand function prices are correlated with the unobserved demand factors (such as style or service quality) and in the cost function the quantities depend on the equilibrium assumption. This endogeneity problem could result in biased parameter estimates. It has been documented in the literature that ignoring these correlations may even lead to upward sloping demand curves (Berry (1994), Berry et al. (1995)). The obvious remedy for this endogeneity problem is to use instrumental variables. In a discrete choice setting, prices and the unobserved product characteristics enter the demand equations in a nonlinear way that makes the application of instrumental variables method cumbersome. Berry (1994) proposes an estimation procedure, which avoids this problem by transforming the equation so that the parameters enter the objective function linearly. The standard logit demand equation will have the following form for deposit supply (normalizing the mean utility of the 0th outside good to zero):

$$ln\left(S_{jt}^{d}\right) - ln\left(S_{0t}^{d}\right) = \delta_{jt}^{d} = r_{jt}^{d}\alpha^{d} - r_{jt}^{sd}\alpha^{sd} + x_{jt}\beta^{d} + \xi_{jt}^{d}, \tag{13}$$

and for loan demand:

$$ln\left(S_{jt}^{l}\right) - ln\left(S_{0t}^{l}\right) = \delta_{jt}^{l} = r_{jt}^{l}\alpha^{l} + r_{jt}^{sl}\alpha^{sl} + x_{jt}\beta^{l} + \xi_{jt}^{l}. \tag{14}$$

One can estimate these equations by a simple ordinary least square regressions. The interest rates and fees are potentially endogenous but a standard linear instrumental variable (IV) method can be used to avoid this problem. In this application, I used a general method of moments (GMM) estimator. The standard IV and two-stage least square (2SLS) estimators are special cases of the GMM estimator. I use the feasible efficient two-step GMM estimator implemented in the *ivreg2* Stata command when the *gmm* option is used. The 2SLS can be considered as a GMM estimator with a suboptimal weighting matrix when errors are not i.i.d. This GMM estimation also generates heteroscedasticity-robust standard errors.

An important issue is choosing the instruments. As instruments I used the standard lagged values, cost variables and rival-bank characteristics (suggested by Berry et al (1995)) in the demand function and lagged values and rival-bank characteristics in the cost function. In the demand function, the interest rates and fees are instrumented with administrative cost per total asset, lagged values of fees, interbank interest rates (Euribor) and characteristics of other banks (salaries per employee, number of branches and number of employees.) In the cost function, the outputs are instrumented with lagged values of outputs, interbank interest rates and rival bank characteristics.

I have tested overidentifying restrictions and the relevance of the instruments with the Shea partial R^2 measure, first stage F and Anderson statistics and the Hansen J-test. These tests are part of the standard output of ivreg2 command in Stata and their detailed description can be found for example in Baum (2006.)

From the estimated demand parameters I computed the elasticities. The corresponding own price elasticities of bank j in period t can be calculated according to the following formula that is derived from equations (1 and 2). The deposit rate elasticity is

$$\eta_{jkt}^{d} = \frac{\partial s_{jt}^{d}}{\partial r_{kt}^{d}} \frac{r_{kt}^{d}}{s_{jt}^{d}} = \begin{cases} \alpha^{d} r_{jt}^{d} \left(1 - s_{jt}^{d}\right) & \text{if } j = k \\ -\alpha^{d} r_{kt}^{d} s_{kt}^{d} & \text{if } j \neq k \end{cases}, \tag{15}$$

and the service fee elasticity can be calculated as:

$$\eta_{jkt}^{ds} = -\frac{\partial s_{jt}^{d}}{\partial r_{kt}^{sd}} \frac{r_{kt}^{sd}}{s_{jt}^{d}} = \begin{cases} \alpha^{sd} r_{kt}^{sd} \left(1 - s_{jt}^{d}\right) & \text{if } j = k \\ -\alpha^{sd} r_{kt}^{sd} s_{kt}^{sd} & \text{if } j \neq k \end{cases} . \tag{16}$$

Loan rate elasticities are calculated correspondingly. Estimates of the price-cost margins can be obtained by a simple calculation from the estimated deposit service and loan demand parameters and observed market shares.

6 Results

Table 3 reports the estimated logit demand functions with instruments. Both the interest rate and fee parameters are significant and have the expected sign. The number of branches are significant too. It seems that even in Finland where internet banking is very widespread branches still have an important role. According to the estimates branches are particularly important for the loan demand. The number of employees also has significant positive effect on loan demand. Taking out loans are generally more time consuming than deposit services so any measure that saves time has a higher marginal benefit. A better staffed branch can serve consumers faster and it is more important in cases of time consuming transactions (such as loans) so it can increase demand more. The level of consumer satisfaction was not significant but the change in consumer satisfaction is highly significant and has the expected positive sign. The Shea partial R^2 measure, the first stage F and Anderson statistics indicate that the instruments are relevant. The Hansen J-test indicates that the null hypothesis of correct model specification and valid overidentificating restrictions cannot be rejected.

Table 4 reports parameter estimates for the cost function. Based on the t-statistics and the value of the adjusted R^2 the overall fit of the cost equations can be considered good for both market segments. Unfortunately not every output and input price parameters are significant but they have the correct signs. The last line of Table 4 reports the imputed average marginal costs. There are a few cases (about 6 in both markets) where the estimated marginal costs were negative. Since marginal cost cannot be negative theoretically these cases were dropped. The marginal cost estimations could be affected by bundling but our data does not have any information on this issue.

Table 5 reports the "observed" price-cost margins with the true interest rates, imputed fees and zero and estimated marginal costs in the first two lines. The third and fourth lines contain the implied price cost margins based on the Bertrand and cartel models. The upper numbers are the simple averages, the lower number are the market share weighted averages. It is interesting to observe that even the margins with zero cost are quite close to the margins predicted by the competitive Bertrand model. The average margins adjusted with the estimated marginal cost are below or very close to Bertrand margins. These results indicate that even though the concentration is fairly high in the Finnish banking sector, it can be described as a competitive product-differentiated Bertrand oligopoly at least on the loan and deposit markets.

Table 6 reports the bank-by-bank comparison of "observed" margins to the competitive and collusive benchmarks. Not surprisingly I have found that even at the individual level most of the banks' price-cost margins are close to the theoretical competitive level. On the deposit side the market share-weighted numbers are even lower meaning that big banks have lower price-cost margins than small banks. On the loan side the opposite is true but even there the margins are much below the collusive ones.

To further extend the analysis I have calculated the standard errors of the estimated average price-cost margins by bootstrapping. I draw with replacement 2000 samples from the observed data and on each boostrapped sample I estimate the elasticities and insert them into the price-cost margin formula. I use the standard deviation of the 2000 bootstrapped price-cost margins as the standard errors of the corresponding predicted PCM. The results are the same. On both markets, I can reject the collusive model.

Given the previous results, I consider the Bertrand model as an adequate model of the industry and I use it as a base model of the merger simulations. I simulate 3 hypothetical mergers of pairs of the biggest three banks in Finland. Under the assumption that no cost savings are passed on to the consumers the average unilateral effect of the mergers would be an approximately 39% increase in the loan margin and a 37% increase in the deposit margins. This would be equivalent of a 70 basis point increase in the loan and a 10 basis point decrease in the deposit interest rates. The price-cost margin on the loan side would be 0.76 and 0.19 on the deposit side. The top three banks have about 70% of market share on both market but it still seems that the small banks provide enough competitive pressure that would to keep interest rates close to the competitive one at least on the deposit side.

7 Discussion

The Finnish banking sector is highly concentrated with the top three banks having 70% of both the loan and deposit markets. In spite of this high concentration level I find that the Finnish retail loan and deposit markets are fairly competitive. The observed margins are rather low and it seems that the profit of the banks stems from other activities such as asset management, payments, trading, etc. rather than from household lending and deposits. We can compare the results of this paper directly with the estimates of Molnar et al. (2007) for Hungary. The Hungarian banking market is less concentrated but they have found that it is much less competitive than the Finnish. They did not have data on consumer satisfaction but their other parameters estimates are on a similar scale as in this paper. The interest rate elasticities are higher in Hungary on total deposits and at the same magnitude on loans. So the implied, theoretically predicted margins are lower than or similar to the Finnish case. However the "observed" margins especially on the loan side are much higher than in Finland[7]. These findings provide another evidence that concentration measures (such as Herfindahl index etc.), still often used in reduced form estimations, are rather poor proxies of market power.

One non-competition related explanation of these observations could be that the emerging Hungarian loan markets are more risky. However even after adjusting for risks,

[7] They studied the loans maket at a less aggregated product-level so the comparison are not perfect.

the PCMs found by Molnar et al. (2007) are still almost double of the Finnish one. So it seems that there is difference in the competitive conduct as well. This could be due to the fact the in Hungary the barriers to entry are much higher than in Finland. As the EU Competition Commission's Retail Banking Sector inquiry reports, based on countries' regulations across the four sets of barriers, the OECD has constructed a composite index of regulatory barriers to banking competition, where one denotes the highest possible barriers and zero denotes no regulatory barriers. According to this index, the EU Member States with the highest barriers are Slovakia (0,46), Ireland (0,43), Hungary (0,42) and Portugal (0,38). The lowest barriers to competition are reported in the UK, Luxembourg and Finland (all on 0,28).

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Appendix

Table 1: **Macroeconomic and banking sector-related indicators** This table reports basic macroeconomic and financial indicators. Credit and deposit aggregates include corporate and household sectors. Observations are from year-end. Source is the Bank of Finland.

	2001	2002	2003	2004	2005
Real GDP growth (%)	2.6	1.62	1.75	3.66	2.87
Growth of households' net financial wealth (%)	-10.06	-7.66	7.33	3.99	10.32
Consumer inflation (%)	2.63	1.99	1.29	0.13	0.76
Number of banks	369	369	366	363	363
Loans/GDP (%)	61.53	64.7	72.41	76.71	83.25
Deposits/GDP (%)	52.168	54.26	56.98	57.55	59.63

Table 2: **Descriptive statistics** This table reports summary statistics of the variables.

Variables	Min.	Max.	Mean	Median	St. dev.
New household loans (1000 euros)	4421.71	2185576	424192.3	108627.8	552274.8
New household deposits (1000 euros)	1439.15	2186800	282114.4	140086.5	450253.9
New household loan interest rates (%)	2.971	8.746	4.408	4.032	1.311
New household deposit interest rates (%)	1.774	3.277	2.208	2.047	0.38
Deposit service fees/total deposits (%)	0.001	0.6471	0.364	0.03	.1118
Loan service fees/total loans (%)	0.087	1.42	0.254	0.188	0.245
Number of branch	1	677	200.495	116	220.93
Employees per branch	1	47	16.063	11	11.273
Change in consumer satisfaction	-.7561	.7057	-.0811	-.0252	.3753
Operational cost/total asset (%)	0.14	8.19	1.13	0.78	1.28
Total loans/total assets (%)	0.1	83.11	29.56	24.33	24.60
Personal expenses/employees (1000 euros)	8.223	181.50	31.89	27.01	26.06

Table 3: **Results of demand estimations using logit specification and IV estimation with cost shifters and BLP instruments:** This table reports the GMM estimates of bank level demand functions of loans and deposit services in a logit specification. The dependent variables are the logarithms of market shares of each banks minus the outside good defined as smaller banks and other monetary institutions. The explanatory variables are the interests rates, service fee, bank characteristics (such as number of existing branches, employes per branches) and change in reported consumer satisfaction. Standard errors are reported in parenthesis.

	Loans	Deposits
Interest rate	-78.12^{***} (25.182)	624.00^{***} (139.85)
Fees	-2.78^{***} (.50)	-10.04^{***} (1.19)
Number of branches	$.0058^{***}$ (.0004)	$.0022^{***}$ (.0004)
Employees per branch	$.042^{***}$ (.009)	$-.0016$ (.003)
Change in consumer satisfaction	$.893^{***}$ (.226)	$.558^{***}$ (.171)
Instrumented variables: Interest rates and fees		
Excluded instruments: lagged fees, cost per asset, 1 month euribor, other banks' characteristics		
First stage F stat./ Interest rate	51.21^{***}	1455.26^{***}
First stage F stat./ Fee	21717.04^{***}	236.01^{***}
Second stage F stat.	159.18^{***}	131.04^{***}
Number of obs	92	90
Anderson canon. corr. LR statistic ()P-value)	0.00	0.00
Hansen J statistic (P-value)	0.80	0.266
Interest rate elasticity	-3.15	9.39
Service fee elasticity	$-.19$	$-.83$

Table 4: **Results for cost functions** This table reports the 3SLS estimates of a system of a translog cost function and cost share equations. The dependent variable are the logarithms of total cost of each banks. The explanatory variables include the outputs and input prices. t-statistics are reported in parenthesis. See the text for description of variables and instrument sets. Below are the marginal cost estimates with standard errors in parenthesis.

	Loans	Deposits
lnQ1(output in sub-market)	.221*** (.04)	.03 (.10)
lnQ2 (rest of total assets)	.796*** (.02)	.93*** (.10)
lnQ1lnQ1	.006 (.007)	.026*** (.007)
lnQ1lnQ2	−.021** (.01)	−.045*** (.01)
lnQ2lnQ2	.012*** (.003)	.010 (.006)
lnP1 (wage)	.001 (.0006)	.107* (.06)
lnP2 (rent)	.99*** (.00)	.891*** (.06)
lnP1lnP1	−.0001 (.00008)	−.05*** (.001)
lnP2lnP2	.00003*** (.0)	−.051*** (.001)
lnP1lnP2	.0 (.0)	.05*** (.001)
lnQ1lnP1	−.0 (.0)	.007 (.013)
lnQ1lnP2	−.0 (.0)	−.021 (.013)
lnQ2lnP1	.0023*** (.0003)	.027*** (.009)
lnQ2lnP2	−.002*** .0003	−.027*** (.009)
Intercept	.31** (.15)	.27 (.26)
Adjusted R^2	0.861	0.987
Excluded Instruments:		
lagged output values, 9-month euribor, rival banks' characteristics		
Average Estimated Marginal Cost		
	.018 (.014)	.016 (.061)

Table 5: **Average and market share weighted average relative price-cost margins for household loan and deposit markets:** This table reports the means and market share weighted means of "observed" and implied relative price-cost margins. The "observed" PCMs are calculated with the observed interest rates and estimated or zero marginal cost. The implied PCMs are calculated with the estimated demand elascticities. The upper numbers are the simple averages, the lower numbers are weighted with the maret shares of the banks.

	Loans	Deposits
"Observed" Average and Market Share Weighted Average Relative Price-Cost Margins		
Observed, ($c_{jt} = 0$)	.46 .54	1.66 .39
Observed, (c_{jt} estimated)	.01 .27	.26 $-.218$
Implied Average and Market Share Weighted Average Relative Price-Cost Margins		
Bertrand	.34 .36	.10 .16
Cartel	1.16 1.07	1.03 1.32

Table 6: **Comparision of "observed" (with estimated marginal costs) and implied relative price-cost margins bank by bank and weighted by the market share.** This table reports the results of market power test. Banks are sorted in three intervals according to their "observed" PCMs: lower than the implied Bertrand value, between Bertrand and cartel value or above cartel value. The degree of competition is defined to be low if the majority of observed values are higher than the implied values of Bertrand model. The lower number are the market share weighted values.

	Household Loans	Household deposits
"Observed" PCMs lower than Bertrand	0.78 0.62	0.75 0.85
"Observed" PCMs between Bertrand and cartel	0.22 0.38	0.03 0.03
"Observed" PCMs higher than cartel	0 0	0.22 0.12