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COMPETITION IN FINNISH BANKING – TWO TESTS

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Contents

Abstract

This paper extends Bresnahan's (1982) test of competition to the two-product case. Applying this extension, as well as Bresnahan's original one-product test to the Finnish banking industry before and after the deregulation of financial markets produces some interesting results. With the two product model, a degree of imperfect competition is identified both in deposit and loan markets in the latter half of 1980s. The one product test, on the other hand, indicates that the competition was fairly intense before this. Besides the estimates of the degree of competition, I find evidence of economies of scope in deposit-taking and lending activities of banks. In addition, the paper discusses the concepts of price and output in banking.

1 Introduction

This paper applies Bresnahan's (1982) test of competition to the Finnish banking sector and develops a method of testing competition when firms produce two products whose demand and cost functions are interrelated. In these models the degree of monopoly power exercised can be identified from the reactions of banks to changes in the slopes of the demand curves. The models analyzed in this paper are only special cases of all testable demand and cost functions, but the ideas can easily be extended to more general settings.

In Finland the financial markets are very bank centered. This and the high degree concentration in the banking sector have led numerous economists to doubt the prevalence of competition in Finnish banking.[1] It has also been suggested that competition should now be more intense as a result of several deregulation measures that were effected during later half of the 1980s. So far, however, this view lacks the support of any concrete evidence. In fact, the results obtained in this study suggest quite the opposite.

The last decade was characterized by the liberalization of financial markets all over the world. In Finland the process began in 1980 with the deregulation of forward currency markets. Since then there have been many deregulatory measures, and the extent of explicit cartel agreements has changed.

In the period before August 1986 the interest rates applied by banks were highly regulated. There was an administered ceiling on the average interest rate for loans. Deposits were tax exempt if more than one bank offered the same interest on the same type of account. Effectively this created an interest rate cartel, which kept the interest paid on deposits at a very low level. Banks also had a service price cartel, which broke down a little earlier, in 1985.

In August 1986 the interest rate ceiling on loans was entirely removed, after a period in which it had been gradually relaxed. The formation of interest rates in deposit markets, however, was effectively restricted by taxation until 1991 and banks had to compete for deposits by other means. The competition then was mainly quality competition, i.e. competition in the supply of free or undercharged services. In 1991 the pricing of all banking products

[1] There are five dominant banking groups in Finland. The combined market share of the two largest is approximately 50%.

became essentially unregulated, as the source tax on deposits came in to force.

The two periods analyzed in this paper are prior to 1991: periods before and after the breakdown of the service price cartel and the deregulation of loan markets (1960–1984 and 1986–1990). This recently started deposit price competition may have had an intensifying impact on competition. The data needed to confirm this view is however not yet available.

2 Price and Output in Banking

Banks engage in two main classes of activities: 1) intermediation of funds from depositors to borrowers and 2) transmission of negotiable deposits between depositors.

In the intermediation process banks produce signalling and monitoring services regarding the creditworthiness of debtors. The quantity of the these services can best be approximated by the real value of outstanding loans. This is the output measure most commonly used in banking literature. (see e.g. Hancock (1989), Lawrence (1989)). The price a debtor pays for these services consists mainly of the interest rate differential between his loan and a market instrument of equal risk and maturity. This is the amount of interest lost, as compared with the alternative of issuing an equally risky loan in the market. This price concept corresponds to the revenue of the bank from selling one unit of loans instead of investing the loan capital in existing market instruments.

On the deposit side, the concepts of price and output are far more complicated. Depositors pay for deposits with interest foregone, i.e. by accepting a lower interest rate, but are compensated, for example, with liquidity (access to a ready inventory of cash), deposit bookkeeping, bank cards and access to the deposit transmission system.

Banking literature often takes the view that banks pay depositors both explicit and implicit interest, the latter in the form of free or undercharged services.[2] (e.g. Mitchell (1979) and Walsh (1983)). I have turned this view around. Instead of treating free services as a form of compensation for deposit capital, I treat them as the good purchased in deposit markets. Assuming free access to capital markets, the entire interest margin between deposits and market instruments must be compensation for the free services.[3]

The price at which customers engaging in deposit and money transmission activities can be viewed as buying these services is given by the following formula

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[2] Henceforth I refer to these as free services.

[3] If the bank provides no liquidity and payment services, a deposit is identical to an equally risky market instrument and their price (interest) should be the same.

It follows that if customers accept a lower interest rate on a deposit, it must be because of services received, and this interest differential is then a the payment for them.

$$P_d = \frac{Q_d(R_m - R_d) + s \cdot P_s}{s}, \qquad (2.1)$$

where P_d = price of depositors' services,
Q_d = markka value of deposits,
R_m = market interest rate (equal risk and maturity),
R_d = interest rate on deposits,
P_s = average level of direct charges
s = quantity of depositors' services produced.

2.1. takes into account both the direct charges from the undercharged and fully charged services and the indirect charges from the free services, that come from the interest income lost by the depositor. The main problem in calculating P_d is the quantification of depositors' services produced (s).

In this paper I have measured the quantity of depositors' services by the number of payments intermediated through the interbank clearing-system supervised by the Bank of Finland. This is a good approximation of the number of payments in the economy, as it includes checks, banknotes and giro transfers. This measure of depositors' services probably correlates highly with the other possible volume indicator – the number of cash withdrawals.

For the latter half of 1980's I tested the number of ATMs (Automatic Teller Machines) as a supplementary measure of services, since their amount has nearly quadrupled during this time. The results did not, however, indicate that the number of ATMs had any major impact on the demand.

As explained in the introduction, during the period of regulation the average interest rate of loans was fixed by authorities. This encouraged banks to tie deposits to loans and to offer cheap loans to depositors to increase the demand for deposits, as this enabled the banks to supply more expensive loans to other customers. Because of this and the lack of an orderly functioning money market at that time, we cannot calculate prices of loans and deposits on the basis of the interest rate differential vis-a-vis the market rate.

To calculate a price for this period we need a different approach. We know the quantity of the two most important banking services: the real markka value of loans and the number of payments transferred (clearing). We also know the total revenue of the banking sector from the National Income statistics. If the volumes of these two services can be combined into a meaningful

index of quantity, we can obtain the price indirectly by dividing the total revenue (P·Q) by the quantity index (Q):

$$P = \frac{(P \cdot Q)}{(Q)} . \qquad (2.2)$$

This price is clearly a less accurate one than the one in 2.1, since the total revenue used includes income from products other than those used in quantity index (approx. 30–40 %) and the weights in the index are necessarily somewhat arbitrary. The total revenue used was that of the whole financial services industry, excluding the Bank of Finland.[4] This can be used since banks have accounted for over 90 % of the industry's total revenue. The revenue data was adjusted by adding the cash reserve system costs to it in order to obtain a price as seen by the consumer.

[4] Keep in mind, that the revenue in the financial services industry consists of two parts: a) net interest income and b) other income. It therefore differs from the ordinary revenue concept.

3 The Models and Estimates

Tests of competition were done with one and two product models. The first test was done with a one product model over the period 1960—1984. The later half of the 1980s was excluded because the deregulation of financial markets[5] as well as the breakdown of the service price cartel in that period have clearly had significant effects on supply and demand, and it seems therefore ill-advised to try to fit the same model to these two periods. Further, the bunding of products (use of a one product model) is necessary when calculating prices for periods marked by interest rate controls on loans, but it is not desirable for periods following the removal of price controls in loan markets and the establishement of money markets.

The other test was done with a two product model. The time period in this test was from August 1986 to December 1989. In this period there was no interest rate ceiling on loans, and the loan price was thereby a decision variable to the banks.

The model and results of this two product case will be presented after first going through the economics of the one product model.

3.1 One product model

From standard microeconomic theory we know that in static equilibrium profit-maximizing firms set marginal revenue perceived equal to marginal cost (MR = MC). The models describing different levels of competition differ however with respect to the amount of marginal revenue perceived. At one extreme we have perfect competition, where the supply relation is

$$MR_p = P = MC. \tag{3.1}$$

At the other extreme, we have the monopolist's supply relation

[5] Deregulation of financial markets has at least potentially increased foreign competition in some markets and led to several liberalizing measures concerning price regulation, such as the removal of interest rate ceilings on loans and permission to grant floating rate loans.

$$MR_p = P + \left(\frac{dP}{dQ}\right)Q = MC, \qquad (3.2)$$

Since the marginal revenue of an oligopolist is price plus some fraction of the other marginal revenue perceived by the monopolist, a more general supply relation can be written

$$P = -\tau \cdot \left(\frac{dP}{dQ}\right)Q + MC, \qquad (3.3)$$

where τ is an index of the degree of competition. τ is 0, when competition is perfect and 1 in the case of a perfect cartel. Intermediate values of τ correspond to other oligopoly solutions. For the Cournot-equilibrium, $\tau = 1/n$, where n is the number of equal size firms in the market, and 1/n is the average market share.

The question then is: under what conditions can we identify τ from industry output and price data and data on exogenous variables alone, without needing to know the exact level of marginal costs in advance.

Bresnahan's model

Bresnahan (1982) presented the following method to measure the degree of competition. If the aggregate demand function can be approximated as

$$Q = a_0 + a_1P + a_2Y + a_3PZ + a_4Z + e, \qquad (3.4)$$

where Q = quantity,
P = price,
Y = exogenous variable such as income,
Z = another exogenous variable such as the price of a substitute,
e = econometric error term,

with Z having the indicated effect on the slope of demand, we can write the perceived marginal revenue as

$$MR_p = P + \tau[1/(a_1 + a_3 Z)]Q. \qquad (3.5)$$

Assume further that MC is linear and can be written

$$MC = b_0 + b_1 Q + b_2 W + e,$$

where W is an exogenous variable of the cost function.

The supply relation (MR = MC) can then be written:

$$P = -\tau[1/(a_1 + a_3 Z)]Q + b_0 + b_1 Q + b_2 W + e, \qquad (3.6)$$

from which the parameter indexing competition (τ) can be identified.[6] In this case τ is the same as the conjectural variations elasticity (for proof, see Shaffer (1983)).

τ is clearly a very simplistic indicator of market power, since it is assumed here to be a constant, although many models indicate that monopoly power varies over time, for example as the level of economic activity varies (Green & Porter, Rotemberg & Saloner). It also measures the market power in industry only on average.

3.2 Test Results from One Product Model

The model estimated is 3.6, where parameters a_1 and a_3 are from the estimation results of equation 3.4.

P is price as in 2.2 and Q is a quantity-index formed from the two most important outputs, real markka value of loans, Q_l, and number of bank-clearings, Q_{cl}, with weights of 15 % and 85 % respectively for 1985. The weights for Q are somewhat arbitrary, but are close to the proportions of total return derived from these products in 1988 (the first year for which market interest rates could be used in the calculations). I also allowed these proportions to vary

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[6] If there is no exogenous variable (Z) affecting the slope of demand, the index of competition (τ) cannot be identified. The supply relation would then be

$$P = \left[-\tau\left(\frac{1}{\alpha_1}\right) + b_1\right]Q + b_0 + b_2 W + e,$$

from which we clearly cannot identify τ, unless we know b_1 in advance.

considerably in several tests, without finding any effect on the estimates of τ. Further, I tested the volume of securities traded as an additional component in the volume index and found no effects on the estimated intensity of competition, but the estimation results were weakened.

Z, the critical variable affecting the slope of demand is the market interest rate on tax-exempt government bonds. This Z is likely have the desired effect on demand, since tax-exempt government bonds have been the closest substitute for demand deposits as an investment, as interest income from both has been tax-exempt in practice. A dummy-variable was included because the indexation of time deposits was prohibited in Finland in 1968. This may have had effects on both demand and supply. The dummy is zero through 1968 and one thereafter.

Estimations were done using the OLS and instrumental variables methods. In this case we don't expect serious simultaneity problems in estimating demand functions, since the changes in supply conditions have been vastly greater than those in demand conditions, because of technological development. As expected, the two methods produced similar results for demand (and supply). The results on demand are given in table 1.

Table 1.

TEST RESULTS: DEMAND ESTIMATES				
Test period	1960-1984		1960-1984	
	OLS		IV-Method	
	estimate	t-value	estimate	t-value
Constant	-21.49	-4.30	-32.25	-4.24
Price (P)	0.95	3.52	1.54	3.73
GNP (Y)	5.18	12.26	4.46	7.45
Z (Government Bond Interest Rate)	2.75	5.15	3.98	4.78
P*Z	-0.13	-4.84	-0.20	-4.58
R**2	0.98		0.98	
Durbin Watson	1.72		1.90	

INSTRUMENTAL VARIABLES: constant W (= wage rate), trend, Z, Y, dummy.

The fit of demand is good, as indicated by the high R^2 values, and no strong evidence of autocorrelation was found. Of prime importance is the fact that high t-values are obtained for the coefficients of PZ (t-values -4.8 and -4.6).

The supply relation estimates are presented in table 2.

Table 2.

TEST RESULTS: SUPPLY ESTIMATES				
Test period	1960-1984		1960-1984	
	OLS		IV-Method	
	estimate	t-value	estimate	t-value
Constant	13.08	8.41	11.88	4.19
Quantity (Q)	-1.32	-7.07	-1.15	-3.21
τ	0.00066	1.20	0.0025	0.07
W	3.49	5.14	4.01	3.36
Trend	-0.29	-1.88	-0.42	-1.50
Dummy for 1968	-3.07	-6.52	-3.20	-3.28
R**2	0.95		0.94	
Durbin Watson	1.99		1.98	

INSTRUMENTAL VARIABLES: constant, W (= wage rate), trend, Z, Y, dummy.
τ = index of competition; τ is 0 if competition is perfect and 1 in the case of perfect cartel.

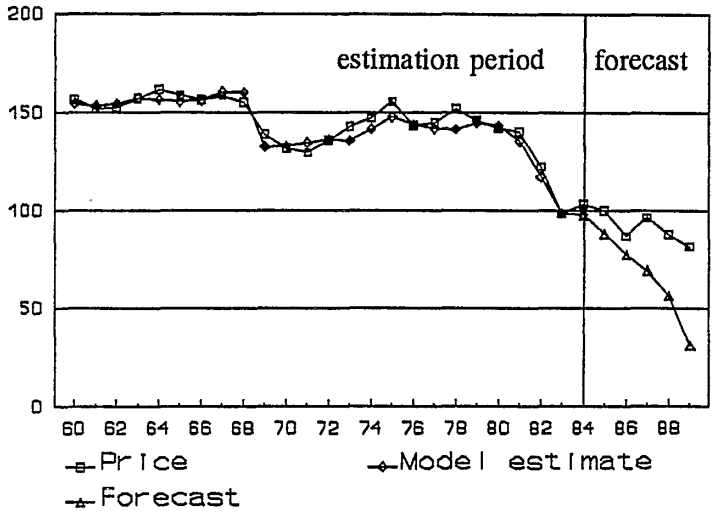
W is the wage and social security costs per working hour. Further, since there has been considerable technical development, which certainly has affected marginal costs, a trend variable that could capture this effect was included. The reserve requirement was tried as a variable affecting the level of marginal costs, but it achieved no statistical significance and is therefore left out of final estimations.

Note, that the results are competitive, i.e. the τ's are almost zero. The nearly zero τ's indicate that competition in Finnish banking has been nearly perfect in 1960s, 1970s and early 1980s. This means that the banks have competed away the regulated interest margin by supplying free services and/or cheap loans to depositors.

The good fit for supply shows up in Figure 1, where both the estimated price and actual price are plotted. I have also projected the graph (actual prices and model estimates) beyond the estimation period in order to see whether the pricing has changed (on the assumption that the marginal cost function has remained same). This

test suggests that competition has more likely eased than intensified in the latter half of the 1980s.

Figure 1. **Price, model estimate and forecast**



3.3 Two Product Model

Banks do not produce just one product, but many products and for several markets. The most important bank outputs in Finland are markka loans and deposit services produced for domestic markets.

We can in some cases construct indices of quantity and price, but in the process we may lose information. Therefore, it is interesting to see whether we can test the degree of competition using direct, product-specific data also in the case of two products (loans and deposit services).

Consider banks (i = 1...I), each of which produce for two markets (k = 1,2). Each bank chooses quantities q_{ki}, k = 1,2 so as to maximize its profits, π_i. That is

$$\max_{q_{1i},q_{2i}} \Pi_i = P_1 q_{1i} + P_2 q_{2i} - C_i(q_{1i},q_{2i}), \qquad (3.7)$$

subject to: $P_k = P_k(Q_1,Q_2,Z)$, k = 1,2

$P_k(\cdot)$ is the inverse demand function for product k, Q_k is the total supply of product k, so that $Q_k = \sum_{i=} q_{ki}$. $C_i(\cdot)$ is the multi-product firm's cost function and Z the exogenous demand variables.

As was the case in the one product model, profit maximizing conduct depends on the degree of monopoly power of banks. In the Nash-equilibrium where firms choose quantities, assuming that revenues and costs are continuous and twice differentiable, the following first order conditions must hold:

$$\frac{d\Pi_i}{dq_{1i}} = P_1 + \tau_1 \left[\frac{dR}{dQ_1} - P_1 \right] - \frac{dC_i}{dq_{1i}} = 0$$

$$\frac{d\Pi_i}{dq_{2i}} = P_2 + \tau_2 \left[\frac{dR}{dQ_2} - P_2 \right] - \frac{dC_i}{dq_{2i}} = 0, \qquad (i = 1...I). \tag{3.8}$$

R is the total revenue for the industry and C_i the costs of company i. 3.8 includes all possible oligopoly solutions, where marginal revenue is partly perceived ($0 < \tau < 1$). If the τ's are both one, 3.8 is the perfect cartel's profit maximizing solution; if τ's are zero, it is the solution for the firm in perfect competition.

Let us look next at the precise profit maximizing solutions in three cases: perfect cartel, Cournot-competition and perfect competition. This inspection reveals that the middle term in 3.8 [$\tau(\cdot)$] consists of two distinct terms, from which the perceived monopoly power can vary.

In a perfect cartel profit is maximized when

$$\frac{d\Pi_i}{dq_{ki}} = P_k + Q_1 \left(\frac{dP_1}{dQ_k} \right) + Q_2 \left(\frac{dP_2}{dQ_k} \right) - c_{ik} = 0, \tag{3.9}$$

$$k = 1,2, \quad i = 1,2...I,$$

where c_{ik} is firm i's marginal cost of producing product k.

In one period quantity competition (2-product Cournot-Nash) each bank maximizes it's profit by setting

$$\frac{d\Pi_i}{dq_{ki}} = P_k + q_{1i}\left(\frac{dP_1}{dQ_k}\right) + q_{2i}\left(\frac{dP_2}{dQ_k}\right) - c_{ik} = 0. \qquad (3.10)$$

$k = 1,2,\ i = 1,2...I.$

This profit maximizing solution is similar to 3.9, except that Q_k is replaced here by q_{ki}. The smaller q_{ki} is as compared with Q_k, i.e. the smaller firm c market share is, the smaller the marginal revenue perceived. In perfect competition the number of firms is unlimited, or at least firms behave as if this were the case (i.e. they are price takers); hence profit maximation becomes

$$\frac{d\Pi_i}{dq_{ki}} = P_k - c_{ik} = 0. \qquad (3.11)$$

$k = 1,2,\ i = 1,2...I.$

(3.11) is also the outcome in two product Bertrand-competition.[7]

The use of monopoly power in these three different models (Cartel, Cournot and perfect competition/Bertrand) varies only according to the perceived marginal revenue in markets k and m of a change in quantity in market k, m≠k. (That is, according to the degree to which firms take into account the two price effects perceived by the monopolist: $Q_1 \cdot dP_1/dQ_k$ and $Q_2 \cdot dP_2/dQ_k$, k = 1,2). The models do not, however, imply that these effects should be perceived in equal proportion, i.e. that the τ's should be of equal size (see Cournot model).

This suggests that we could write a more general supply relation in the following form:

$$P_k = c_k - \tau_{1k} \cdot (Q_1 \cdot (dP_1/dQ_k)) - \tau_{2k} \cdot (Q_2 \cdot (dP_2/dQ_k)). \qquad (3.12)$$

$k = 1,2$

Again, τ_{mk} tells us the degree to which firms take into account the price effect in market m when deciding on production in market k, and c_k is the marginal cost of producing k. In a cartel both τ's are

[7] Bertrand-competition is one period price competition and yields the same outcome as perfect competition (for a proof in the one product case see e.g. Tirole (1989); the extension to the two product case is trivial).

equal to one; in perfect competition they are zero. In one period Cournot competition they are:

$$\tau_{1k} = 1/n_1 \text{ and}$$
$$\tau_{2k} = 1/n_2,$$

where n_k is in the number of equal-size firms in market k and $1/n_k$ the market share of the representative firm.[8]

Specification of the two product model

Let the demand in two markets (deposit-and loan markets) be

$$\begin{aligned} Q_1 &= \alpha_0 + \alpha_1 P_1 + \alpha_2 P_2 + \alpha_3 Y + \alpha_4 Z_1 P_1 + \alpha_5 Z_1 + e_1 \\ Q_2 &= \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 Y + \beta_4 Z_2 P_2 + \beta_5 Z_2 + e_2 \end{aligned} \qquad (3.13)$$

Let the marginal cost function be linear and of the following specific form:

$$MC_k = \delta_{k0} + \delta_{k1} Q_1 + \delta_{k2} Q_2 + \delta_{k3} W \qquad (3.14)$$

$(k = 1,2)$.

Q_k is the quantify of product k, P_k its price, Y and Z exogenous variables affecting demand and W a variable vertically shifting marginal costs (e.g. wage rate).

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[8] In a Nash equilibrium, which prevails in supergame (Cartel) and Cournot and Bertrand competition, the decision variables of competitors are assumed to be given, and companies do not make any nontrivial assumptions about competitors' reactions as they do in the conjectural variations approach. In 3.12 we assume a Nash equilibrium. Otherwise the supply relation should include two more terms: $\tau_{1m}(Q_1 \cdot (dP_1/dQ_m))$ and $\tau_{2m}(Q_2 \cdot (dP_2/dQ_m)$; m, k, = 1, 2, m#k.

We can now write the supply relation 3.12 for product 1 as:[9]

$$P_1 = \delta_0 + \delta_1 Q_1 + \delta_2 Q_2 + \delta_4 W_1$$
$$- \tau_{11} \cdot Q_1/[(\alpha_1+\alpha_4 Z_1) - \alpha_2\beta_1/(\beta_2+\beta_4 Z_2)] \qquad (3.15)$$
$$- \tau_{21} \cdot -\beta_1 Q_2/[(\alpha_1+\alpha_4 Z_1)(\beta_2+\beta_4 Z_2) - \beta_1\alpha_2].$$

The competition indices (τ's) are identified in 3.15, since the derivatives of P_1 and P_2 with respect to Q_k are known functions of Z_1 and Z_2, which implies that they separate in the estimation process from the parameters of Q_k, which come from the marginal cost function.

The supply relation for product two can be derived similarly. As before, the indices of competition (τ) are simplifications, since they

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[9] In order to solve for P_{11} and P_{21} (from 3.12, P_{11} is the derivative of P_1 with respect to Q_1 and P_{21} is the derivative of P_2 with respect to Q_1), we write first the inverse demand functions:

$$P_1 = \frac{Q_1/(\alpha_1+\alpha_4 Z_1) - \alpha_2 \cdot Q_2/[(\alpha_1+\alpha_4 Z_1)\cdot(\beta_2+\beta_4 Z_2)]}{1-\alpha_2\beta_1/[(\alpha_1+\alpha_4 Z_1)\cdot(\beta_2+\beta_4 Z_2)]} +$$

$$\frac{(\alpha_0+\alpha_5 Z_1 - \alpha_3 Y)/(\alpha_1+\alpha_4 Z_1) + \alpha_2\cdot(\beta_0 - \beta_5 Z_2 - \beta_3 Y)/[(\alpha_1+\alpha_4 Z_1)(\beta_2+\beta_4 Z_2)]}{1-\alpha_2\beta_1/[(\alpha_1+\alpha_4 Z_1)\cdot(\beta_2+\beta_4 Z_2)]}$$

$$P_2 = \frac{Q_2/(\beta_2+\beta_4 Z_2) - \beta_1 \cdot Q_1/[(\beta_2+\beta_4 Z_2)\cdot(\alpha_1+\alpha_4 Z_1)]}{1-\beta_1\alpha_2/[(\alpha_1+\alpha_4 Z_1)\cdot(\beta_2+\beta_4 Z_2)]} +$$

$$\frac{\beta_0+\beta_5 Z_1 - \beta_3 Y)/(\beta_2+\beta_4 Z_2) + \beta_1\cdot(\alpha_0 - \alpha_5 Z_1 - \alpha_3 Y)/[(\beta_2+\beta_4 Z_2)(\alpha_1+\alpha_4 Z_1)]}{1-\beta_1\alpha_2/[(\alpha_1+\alpha_4 Z_1)\cdot(\beta_2+\beta_4 Z_2)]}$$

From these we see that the desired derivatives are:

$$P_{11} = \frac{1}{(\alpha_1+\alpha_4 Z_1) - \alpha_2\beta_1/(\beta_2+\beta_4 Z_2)}$$

$$P_{21} = \frac{-\beta_1}{(\alpha_1+\alpha_4 Z_1)\cdot(\beta_2+\beta_4 Z_2) - \beta_1\alpha_2},$$

are assumed constant and only reflect the use of market power on average.[10]

3.4 Test Results from Two Product Model

The model tested was 3.15, where the parameters α and ß are estimates from 3.13. Q_1 is the real markka value of loans, P_1 the interest rate margin of new loans over the 3-month money market rate. The rationale for choosing such a short term maturity for the calculation of the loan price is that in Finland the long term capital markets are quite undeveloped. The reason for using new loans instead of loan stock is that the price of new loans is a decision variable to banks and a price to which consumers can react, whereas the price as calculated from loan stock is not.[11,12]

Q_2 is the number of clearing transactions. The rationale for this was given in section 2. Since it is impossible to separate the free services from priced services, I have put these two types of services together and calculated the price P_2 to match the quantity of clearing transactions as:

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[10] If the demands are separable, the supply relation can be written

$$P_1 = -\tau_1 \cdot Q_1/(\alpha_1 + \alpha_4 \cdot Z_1) + MC_1(Q_1,Q_2) \quad \text{and}$$

$$P_2 = -\tau_2 \cdot Q_2/(\beta_2 + \beta_4 \cdot Z_2) + MC_2(Q_1,Q_2),$$

and we are back in the original Bresnahan model, with the exception that we now have the quantity of the other product in the marginal cost function (if costs are not also separable).

[11] The price (interest rate differential) of loan stock is not a decision variable, since banks carry interest rate risks, which if materialized (as the level of interest rates changes) affect the final interest rate margin.

[12] Another possibility would be to use the value of new loans as the quantity. In this approach, however, several problems would arise: The series of new loan volume contains much random fluctuation, and to make these loans comparable we would have to discount them over their entire maturities, of which we however have no knowledge. In addition, this approach would not correctly reflect the production that takes place in the banking industry, since banks surely produce in loan markets even at times when the amount of outstanding loans remains unchanged.

$$P_2 = \frac{Q_d(R_m - R_d) + s \cdot P_s}{s} \qquad (3.16)$$

where P_2 = price of deposits and payment transmission
Q_d = real markka value of deposits,
R_m = market interest rate (3-month),
R_d = average interest rate of deposits,
s = quantity of services produced (clearing),
P_s = average level of service charges (in real terms).

P_s is the index of bank service charges from the Central Statistical Office's cost of living index, scaled so that the proportion of income from service charges accords with the bank's income statements. The proportion of service charges income from total deposit and money transmission income was 21 %.[13,14]

After specifying prices and quantities we still have to determine what the exogenous variables affecting the slope of demand (Z) might be. It turns out that in deposit markets the interest rate on government bonds (tax exempt) has such an effect. This was the case in the former one product model as well. One could conjecture that in loan markets the level of the money market interest rate might have such an effect on demand. This in fact turns out to be the case. A dummy variable is set for December 1988, so that the exceptional growth in loan stock as well as deposits following a change in tax laws could not have an effect on the estimates. The time period for the tests was from August 1986 to December 1989.

The test results of demand estimation (using OLS and IV methods) are given in table 3.

[13] 3.16 is the same as 2.1 on page 10.

[14] I have come to that figure in the following way. Assuming that loans create 15 % of income (as in the one product case), we can get the income from these two types of services from bank income statistics. In bank income statistics service charges are included under the heading 'charges and fees'. This figure, however, includes unknown proportions of income from loans and possibly other products as well. The 21 % figure is attained by attributing 90 % of 'charges and fees' to payment transfers.

Table 3.

TEST RESULTS FROM THE TWO PRODUCT MODEL - DEMAND IN LOAN AND DEPOSIT MARKETS								
	Loan Markets (Q1 =)		Deposit Markets (Q2 =)		Loan Markets (Q1 =)		Deposit Markets (Q2 =)	
	OLS		OLS		IV-Method		IV-Method	
	estim.	t-value	estim.	t-value	estim.	t-value	estim.	t-value
Constant	-370.44	-8.92	73.99	0.29	-126.74	-0.47	-1.53	0.00
Y	4.86	12.75	4.21	6.17	1.72	0.43	4.65	4.39
P1	-8.68	-2.19	-21.74	-5.07	-40.34	-0.61	-14.15	-1.47
P2	-6.00	-4.35	-59.59	-2.35	-18.17	-1.67	-53.18	-0.95
Z	3.03	1.56	-31.83	-1.30	27.17	0.72	-36.45	-0.74
P * Z	0.38	1.01	4.88	1.66	4.24	0.49	4.98	0.81
Dummy 12/1988	10.11	3.63	11.16	1.62	6.15	0.36	9.52	1.17
R**2	0.99		0.93		0.92		0.92	
Durbin Watson	1.03		1.69		1.63		1.90	

Y = monthly GNP-indicator
P1 = price of loans
P2 = price of deposits and payment transmission
Z = market interest rate or the interest rate of tax exempt government bonds
Instrumental variables used: constant, government bond (tax exempt) interest rate, money market interest rate, Y, W and variables W*Z.

In both markets the other products price seems to have noticeable effects on demand. The effect on the slope of demand (PZ) does not come out very strong, particularly in loan markets, but even there the effect remains positive (making the slope of demand steeper as interest rates rise), even though the standard error is reduced from the OLS-estimate.

The fit was good, as indicated by the high R^2 values. Autocorrelation is a problem in the loan markets. This was somewhat expected because of the variable choice (the loan stock adjusts slowly). Autocorrelation does not diminish, even when the equations are re-estimated by the Hildreth-Lu method.

The supply relation estimates are presented in tables 4 and 5. W, the exogenous variable of the marginal cost function, is the wage rate index for the financial sector.

Table 4.

TEST RESULTS FROM TWO PRODUCT MODEL: SUPPLY IN LOAN AND DEPOSIT MARKETS												
	Deposit Markets (P2 =)								Loan Markets (P1 =)			
	OLS		OLS **		HILDRETH-LU		HILDRETH-LU **		OLS		HILDRETH-LU	
	estim.	t-value	estim.	t-value	estim.	t-value	estim.	t-value	estim.	t-value	estim.	t-value
Constant	28.079	2.44	10.412	7.62	23.962	1.68	5.155	1.66	-18.345	-1.96	-16.269	1.44
Q1	-0.281	-1.00	-0.060	-3.08	0.109	0.46	-0.009	-0.48	0.023	1.00	0.001	-0.04
Q2	0.035	1.94	0.044	2.51	0.010	0.80	0.010	0.86	-0.053	-3.23	-0.037	-2.86
τ 11, τ 22	0.370	4.92	0.452	6.32	0.270	4.66	0.292	4.85	0.052	4.50	0.041	4.14
τ 21, τ 12	0.243	4.54	0.281	5.79	0.181	4.44	0.189	4.61	0.079	4.79	0.063	4.28
W	-0.630	-1.35	0.093	-	-0.627	-1.17	0.093	-	0.646	1.70	0.657	1.49
Rho					0.741	4.54	0.740	4.84			0.502	2.94
R**2	0.70		0.68		0.81		0.80		0.69		0.76	
Durbin Watson	0.71		0.77		1.51		1.46		0.95		1.54	

Q1 = real markka value of loans
Q2 = number of clearing-transactions
t = index of competition
W = real wage rate in Financial sector

In the OLS and Hildreth-Lu estimates both τ's have the expected sign, are statistically significant and get values that suggest the use of monopoly power between 4 and 45 per cent. The statistical significance of the supply relation tests is fairly good, especially when estimated by the Hildreth-Lu method.

In loan markets the use of monopoly power appears to be smaller, ranging from 4 to 8 per cent, whereas in deposit markets the use of monopoly power is higher: 18 to 45 per cent. The variations in the use of monopoly power come from the fact that banks perceive differently their market power in markets one and two when deciding on their production in market one.

In the deposit market estimates wage costs get the wrong sign. The estimates of competition (τ) do not, however, change significantly if we constrain the coefficient of wages to a positive number reflecting the share of wages in bank factor costs. The test results where the coefficient of wages is constrained positive (share = approx. 1/3 of total income) is marked with two stars (**).

With the instrumental variables method, the other estimate on the use of market power in loan markets gets a negative sign (table 5). One might be tempted to connect this negative sign to the credit rationing theory, but the statistical significance of the coefficient is so low that it is more reasonable to conclude that the instrumental variable test does not tell us anything about the use of monopoly power in loan markets, although it does so with respect to deposit

markets. (Even in loan markets, the adverse effects of the supply of loans on the demand for deposits are probably taken into account).

In regard to deposit markets, the use of monopoly power is greater according to all the tests. This might result from the fact that in the loan markets banks face competition from outside the banking industry, especially from insurance companies. It may also be, as credit rationing theory suggests, that the level of interest rates affects credit losses, and thus marginal revenue, in a way that is not reflected in 3.15. This may also have accounted for the discovery that the use of market power seems to be smaller in loan markets.

Table 5.

TEST RESULTS FROM THE TWO PRODUCT MODEL: SUPPLY IN LOAN AND DEPOSIT MARKETS				
IV-Method	Loan Markets (P1 =)		Deposit Markets (P2 =)	
	estim.	t-value	estim.	t-value
Constant	2.60	0.13	31.26	1.12
Q1	-0.03	-0.18	-0.05	-0.19
Q2	0.03	0.15	0.05	0.17
τ 11, τ 22	-0.11	-0.71	0.37	0.98
τ 21, τ 12	0.51	1.61	-0.15	-0.29
W	-0.20	-0.34	-0.61	-0.51
Dummy 12/1988	-	-	-0.35	-0.22
R**2	0.58		0.55	
Durbin Watson	1.63		2.29	

Q1 = quantity of loans
Q2 = quantity of deposit services = (clearing)
τ = index of competition
W = wage rate in financial sector
Instrumental variables: constant, government bond interest rate, market interest rate, Y, W and variables W*Z.

Estimated price, actual price and competitive price[15] are shown in figures 2 and 3. The model does produce a somewhat peculiar result in that the interest rates for loans should be below the market interest rate under perfect competition. This can, however, be explained at least in three different ways: 1) part of the revenue

[15] Price that equals marginal costs. This is, however, not the price that would prevail in true perfect competition since the volume produced and therefore marginal costs would be different. I will nevertheless use this expression hereafter.

from loans comes in the form of charges and fees, 2) the market interest rate used is not for the same maturity as in the case of loans, 3) there are considerable economies of scope.

The figures are drawn from OLS estimates. Regarding deposits, I used the estimates where the coefficient of wages was constrained.

Figure 2. **Price, model estimate and estimate of perfect competition price in loan markets**

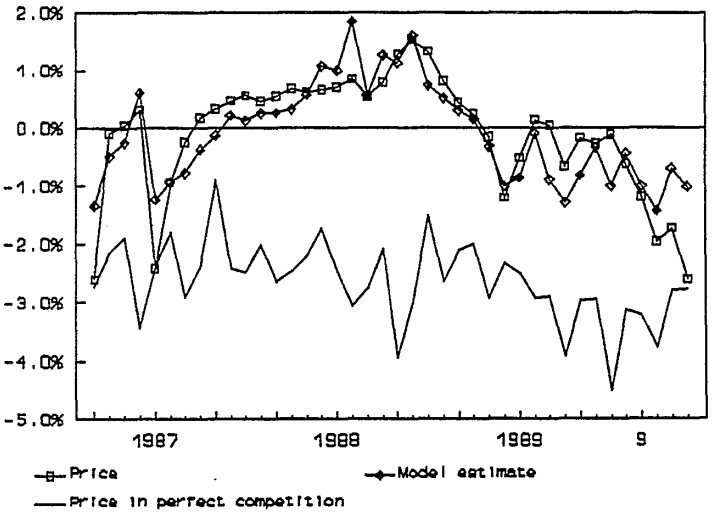
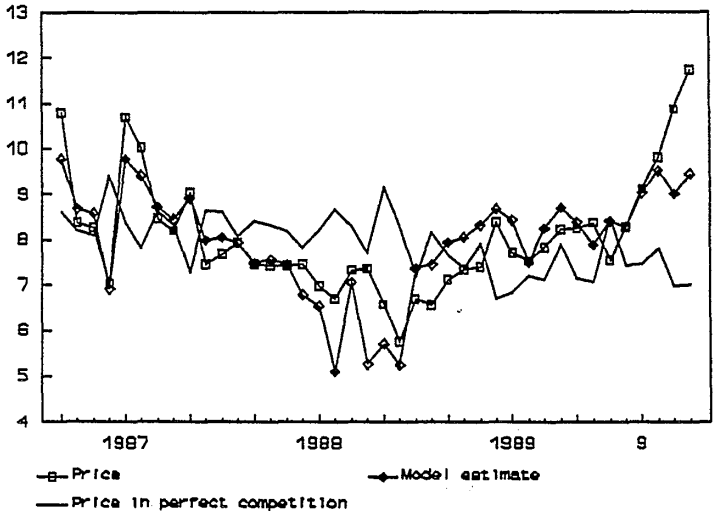


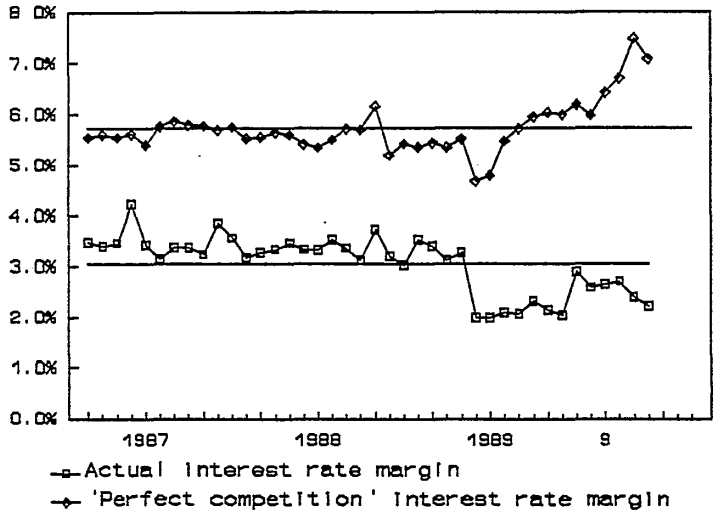
Figure 3. **Price, model estimate and estimate of perfect competition price in deposit markets**



At this point we should note that there is more uncertainty involved in the supply relation estimates than is reflected in the t-values. This arises from the fact that there was considerable uncertainty in the demand estimates, especially of the coefficients for PZ. In estimating the supply relation we have however treated these parameters as constants. This uncertainty is not so significant if we look only at the perfect competition estimates, since the uncertainty mainly concerns the value of the marginal revenue of a monopoly firm and thereby the proportion of market power being used.

In Figure 4 we have the actual interest rate margin and a hypothetical interest rate margin, which could have been attained in perfect competition with the prevailing supply and prices of services.

Figure 4. **Interest rate margin and model estimate of perfect competition interest rate margin on the prevailing supply of free services and service prices**



As Figure 4 shows, the model suggests that the same banking services, at their prevailing prices (P_s) could have been produced under more intense competition at half the interest rate margin. Again, this is not the interest rate margin that would prevail in actual perfect competition, since in perfect competition it might be optimal for banks to change the supply of free services as well as to alter service prices. It is probably nevertheless a fairly good approximation of the true perfect competition price.

4. Conclusions

The purpose of this study was to evaluate the degree of competition in Finnish banking. This was approached by estimating two different models from which the monopoly power used can be identified. The monopoly power perceived is identified in these models from the reactions of banks to changes in the slopes of the demand curves. The first test was with a one product model using annual data in the time period 1960 to 1984 (the regulated period). The second test was with the two product model using monthly data in the period after the deregulation of loan markets (08.1986–12.1990).

The results of the tests suggest that the conventional story about the weakness of competition in the Finnish banking industry, and the assertion that competition has now (in late 80s) become more intense are possibly false. In fact, the results here indicate exactly the opposite.

According to the tests it seems that competition in Finnish banking was quite intense until the latter half of 80's. At that time, possibly because of enormous growth in demand for banking products, competition seems to have become less keen.[16] The use of monopoly power appears to have been present then especially in deposit taking activities, where 20–40 % of the monopoly power was perceived, but was also present in loan markets, where 4–8 % of the monopoly power was taken into account. The observed eagerness of foreign banks to open branches in Finland during recent years could be seen as evidence of this imperfect competition.

The method applied produces at least two interesting byproducts. First, it gives estimates of economies of scope and, second, it makes the calculation of dead-weight loss possible. I have not, however, pursued the latter possibility in this paper.

[16] This vast growth in demand could have caused banks to be constrained by capacity, which might have had a negative effect on competition.

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Appendix

DATA ON VARIABLES USED IN TESTS IN THE ONE PRODUCT CASE, 1960—1984					
	Mean	Min	Max	s	Source
Q = 0.15·Ql+0.85·Qcl (1985-weights, 1985=1)	2.255	0.38	7.27	1.84	BOF
P = (P·Q)/Q/consumer price index	28.94	15.00	41.09	7.115	
Z = interest on taxexempt government bonds	9.98	6.30	15.68	2.23	BOF
P·Z	294.88	157.54	626.70	126.34	
W1 = (wages + social security costs)/working hours	4.38	2.39	6.15	1.28	NI
Y = real GNP	0.89	0.52	1.31	0.24	BOF
P·Q 1)	28.05	2.20	109.08	30.44	NI+BOF
Consumer Price index (1985=1)	0.39	0.14	0.94	0.25	BOF

BOF = Bank of Finland database
NI = national Income Statistics
Ql = real markka value of loans
Qcl = number of clearing transactions: cheques, bills and bank giros

1) Total income of financial sector - Bank of Finland's + the costs of reserve requirement

DATA ON VARIABLES USED IN TESTS IN THE MULTIPRODUCT CASE, 1986/8—1989/12					
	Mean	Min	Max	s	Source
Q_1 = real markka amount of loans	237.11	193.40	278.87	31.05	BOF
Q_2 = number of clearing transactions; cheques, bills and bank giro	197.41	137.87	260.52	31.38	BOF
P_1 = interest rate on new loans 1) - Z1	-0.28	-3.01	1.53	1.21	BOF
P_2 = 0.79 ·[Q_d·(R_m-R_d)] + 0.21·[P_2]2)	8.36	5.76	12.42	1.60	
Z1 = short-term market interest rate (3-month)	11.17	9.06	16.08	2.01	BOF
Z2 = interest rate on tax-exempt government bonds	8.07	7.27	9.07	0.43	BOF
P_1·Z1	-5.41	-48.19	13.85	16.34	
P_2·Z2	67.75	45.62	106.77	15.28	
Y = monthly indicator of total output (1980=100)	127.63	118.60	135.60	5.03	MI
W = real level of earnings of financial sector	32.41	30.65	33.75	0.93	BOF
[Q_d · (R_m - R_d)] = outstanding deposits · (3-month HELIBOR - deposit rate)					
[P_2] = bank service charge component of the consumer price index (1985=100)	60.77	35.41	94.19	15.04	BOF
	114.44	97.51	146.14	10.37	CPI

1) the interest rate on new loans has been adjusted to correspond to the actual share of different debt instruments in lending each year.
2) the weights 0.79 and 0.21 are the average weights of the components in the price P_2.

Note: the order of magnitude of the variables P_2 and Q_2 has been set so that the income from them is in the correct proportion to the income from the loan market.

BOF = Bank of Finland database
CPI = component of consumer price index depicting bank service charges, obtained from the Central Statistical Office of Finland.
MI = monthly indicator of total output; Central Statistical Office in Finland publications.

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