MARKET POWER AND PERFORMANCE IN SWEDISH BANKING*

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Abstract

This study analyses the average degree of oligopolistic interaction as well as mark-ups enjoyed in the Swedish banking industry during the period 1996-2002. In the study, a conjectural variation parameter is estimated, using a simultaneous equation model. The supply side was estimated using firm level, balance sheet data, while estimation of the market demand function relied on aggregate (industry level) time-series data. The findings point to some intermediate level of competition, i.e. in the region between perfect competition and Cournot competition. It was further assessed that different types of banks performed with different margins. The perhaps most striking result obtained was that the bank oligopoly did operate with significantly lower margins, considering the whole business mix, than the (much smaller) saving banks. Finally, as a robustness check, several (slightly) different model specifications were considered. All results were consistent with the conclusions stated above.

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1. INTRODUCTION

The aim of the present paper is to empirically assess the level of competition in the banking market in light of all the changes the market recently has been exposed to. (See section 2). For this purpose, I rely on a modification of the conjectural variation approach[1]. The methodology consists basically of an empirical assessment of the comparative statics of a profit-maximizing firm (bank). It is my firm belief that very few similar studies have been undertaken on Swedish conditions.[2] In view of this scarcity, the hope is that the present paper will shed some light on e.g. the impact of the transformation process upon market performance, and if certain groups were more adversely affected than others. The particular form of the conjectural variation approach[3,4] considered consists of a simultaneous equation model comprised by a market demand equation, a cost function and a supply relation derived from profit maximization assumption in a static context.

To ensure identification of the conduct parameter, the demand function was specified as log-linear. The cost function was specified as transcendental logarithmic (translog), for the purpose of flexibility. While supply data was available on firm level, data on variables used to estimate demand were only available in time-series, aggregated form. This precluded simultaneous estimation of supply and demand, which otherwise would be more efficient. Instead, they were estimated separately, and the demand parameters obtained were taken as predetermined in the estimation of the supply system. Both restricted and unrestricted system estimations were carried out. However, the result obtained for the conduct parameter was quite robust to whether the cost constraints were imposed or not.

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[1] That is, a methodology within the New Empirical Industrial Organisation (NEIO) research field. A good reference is Bresnahan (1989) " Handbook of Industrial Organisation", Vol. II.
[2] To my knowledge, Oxenstierna (2000) is the only previous study.
[3] Iwata (1974) is considered as the founder of the conjectural variation approach. An alternative specification, relying on aggregate data, is the approach developed by Bresnahan (1982) and Lau (1982).
[4] The Panzar-Rosse (1987) approach is considered in a companion paper.

2. MARKET EVOLUTION[5]

During the last two decades, the Swedish financial market has witnessed a fundamental transformation process, resulting in a drastic vitalization of its performance. Before the financial crisis, which plagued the country in the beginning of the 90's, the market saw an increase in the number of players, as a response to the important deregulation step, undertaken in 1986, implying the abolition of the prohibition of foreign bank participation[6]. Subsequently, in the trace of the crisis, a substantial decrease in the number of performers was observed. However, after the financial market was restored, i.e. around 1993, the number of actors has again risen sharply. Once again, the market witnessed a substantial increase of foreign banks, a development triggered by the decision to lift the prohibition of opening branches in Sweden[7]. In addition, several new Swedish-owned commercial banks appeared on the scene. Except for banks formed by insurance companies, the market witnessed, at a later stage, the introduction of banks formed by non-financial companies as well. In the most recent years, however, the number of participants has been fairly stable.

Another apparent feature of the transformation process experienced, has been a general tendency of broadening the scope of the business mix. The intensified competition faced in the traditional intermediation business has forced the banks to rethink their strategies. While the vitalized capital markets certainly accounted for part of the increased pressure put on the banking sector, there has also been steps taken, of legislative nature, with the aim of increasing competition in the financial market. Important, international steps, aimed towards harmonization and increased competition, has been taken undertaken. On the global arena, BIS has influenced the

[5] The evolution of the market is more thoroughly described in e.g. Konkurrensverkets rapport 1999:2, ESO: Ds 2002:21, and "Finansmarknad i förändring" (2000).

[6] However, many of these establishments actually failed, since, as it turned out, they had focused on the wrong business segment. (Lybeck, Den svenska finansiella sektorns utveckling i modern tid, SOU 2000:11, appendix 3.)

[7] This step was taken in 1990. The former legislative change, in force from 1986, only allowed foreign banks to open subsidiaries.

way international oriented banks perform, through the Basel Capital Accord (1988). The new more involving Basel Accord, expected to be in force from 2007, is planned to be compulsory through a new EU directive. Today, though, the Second Banking Coordination Directive (1993) is valid. In Sweden it came into force through the EES settlement (1993). Undoubtedly, this directive could be regarded as the cornerstone of the new legislation era. In this directive, the principle of the single market licence allowing banks and other credit institutions to set up branches and offer services throughout the Community is established, and it contains a list of banking services that can be provided in all the Member States on the basis of such a licence[8].
Besides the contribution of deregulation, other important driving forces behind the changed conditions in banking are easy to identify[9]. The implementation of telephone- and internet-based technology has profoundly changed the way banking is conducted, and increased efficiency in certain product segments. The implementation of the new pension system and a changed demographic structure has also contributed to the changed conditions. In addition, banks have experienced widespread disintermediation, losing significant market share in the traditional margin business to large corporate clients and institutional investors in particular. New financial service providers have entered the most profitable segments. To cope with the new conditions, incumbents have been forced to adjust their strategies. The largest commercial banks, in particular, have diversified into new fee- and commission based segments.

3. THE METHODOLOGY

3.1 The Conjectural variation approach

3.1.1 Framework

Assuming *N* banks competing in the industry facing a market demand function of the following stylized form:

[8] http://europa.eu.int/scadplus/leg/en/lvb/l24002.htm
[9] Goddard *et al*, European Banking, Wiley, 2001

$$Q = D(P; \mathbf{Z}; \boldsymbol{\alpha}) + \varepsilon_1 \qquad [1]$$

where Q is quantity, P is the market price, $\mathbf{Z}$ is a vector of exogenous variables affecting demand (often including some variable measuring the general economic activity), and $\boldsymbol{\alpha}$ is the demand parameter vector.

On the supply side, the representative bank *j* is assumed to maximize profits, by solving the following one-shot game in output level:

$$\underset{q_j}{Max}\, P(Q, \mathbf{Z}) q_j - C(q_j, \vec{\omega}_j) \qquad [2]$$

with solution (supply relation):

$$p_j = MC(q_j, \omega_j) - \left(\frac{\partial Q}{\partial q_j} \frac{q_j}{Q} \right) \left(\frac{\partial P}{\partial Q} Q \right) \qquad [3]$$

As evident from [3], an integral part of the solution is the elasticity concept $(\partial Q / \partial q_j \big/ Q / q_j)$, that is, the conjectural variation coefficient. It represents the conjecture that bank *j* has about how the market will react to a change in the output policy of firm *j*. Thus the model involves a kind of pseudo-dynamics pasted on a framework that is essentially static.[10] The (average) conjectural variation coefficient will reveal what kind of oligopolistic behaviour that characterizes the market, and there is no need to impose any *a priori* restriction on it (λ). That is, it is not necessary to assume a certain conduct beforehand, and test for its propriety. Instead, any behavioural model is a priori plausible.[11]

Sometimes it's more appropriate to consider a price game or some kind of dynamic game. In banking, a reasonable dynamic model might involve a capacity game in the first period, followed by a price game in period two. However, from an econometric point of view, such a model is considerably more involving. In a sense, the present one-shot game involves some dynamics (apart from the conjectural variation

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[10] Although derived in a static context, these tests provide a valid empirical test of dynamic equilibrium [Shaffer (1994); Worthington (1990)]

[11] See Cetorelli (1999), p 6.

coefficient) because both the purchase of inputs and the output level decision are endogenized.[12]

The choice of strategic variable depends primarily on the kind of industry examined and to the degree of heterogeneity in output. The price game model is appropriate in conjunction with an assumption of product differentiation, while if, on the other hand, firms produce homogenous products or close substitutes, the price (Bertrand) equilibrium becomes extremely competitive, since a firm recognizes that it can take the entire market from its rivals if it offers a lower price.[13,14]

In general, firms face a more elastic demand curve in the case of pricing competition, implying lower prices, higher output and hence better performance compared to output competition. Tirole (1988) argues that output is the prominent strategic variable choice in industries with sharply rising marginal costs. In the two-stage game model of Singh & Vives (1984), where the choice of strategic variable is endogenized, it is demonstrated that a dominant strategy for each firm is to select a quantity strategy, leading ultimately to the Cournot competition. In contrast, Klemperer & Meyer (1985), who take a similar approach, but instead consider a single stage game, conclude that both the Bertrand and the Cournot outcomes may appear as equilibria.

In the present empirical model[15], quantity is considered as the strategic variable, based on the argument that economies of scale/scope presumably influence the input/output decisions banks make. The choice of quantity also makes sense considering the specification of the cost function applied.

3.1.2 The identification problem

The general empirical problem in studies relying on this methodology is how to obtain identification of λ. The following demonstration, intended to show the requirements for identification, is based on Bresnahan (1982).

The industry demand function facing banks may be written: (intentionally stylized)

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[12] See Asogwa (2003)

[13] See e.g. Shapiro (1989)

[14] See Coccorese (2002) for a banking application of the conjectural variation approach that relies on a price game.

[15] See section 3.2.

$$Q = D(P, Y, \boldsymbol{\alpha}) + \varepsilon_1 \qquad [4]$$

where $Y \in \mathbf{Z}$ (see [1])

The supply relation may be stated in a stylized form as:

$$P = MC(Q, \mathbf{W}; \boldsymbol{\beta}) - \lambda * h(Q, \mathbf{Z}; \boldsymbol{\alpha}) + \varepsilon_2 \qquad [5]$$

where $P + h(\bullet)$ is marginal revenue, and $P + \lambda * h(\bullet)$ is perceived marginal revenue. Marginal cost $MC()$, depends on Q and $\mathbf{W}$, where $\mathbf{W}$ is a vector of exogenously given input prices. The vector $\boldsymbol{\beta}$ contains the supply (cost) side parameters. As evident from [4], depending on the size of λ (make take any intermediate value in the region zero to one) a disturbance in the well-known monopolist (cartel) *MR=MC* condition is induced.

As long as firms are not price takers in the output market (λ≠0), it is obvious from [4] that perceived marginal revenue [$P + \lambda * h()$], and not price will equal $MC()$. Since the demand-side parameters and exogenous variables are included in $h(\bullet)$, and P and Q are both endogenously determined, efficient estimation of λ requires simultaneous estimation of [4] and [5]. However, the possibility to identify λ as the coefficient of $h(\bullet)$ in [5] depends on the specification of [4].

It is shown in his paper[16] that the following demand specification is not capable of solving the problem:

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \varepsilon \qquad [6]$$

where Y is an exogenous variable. The marginal cost function is also assumed linear:

$$MC = \beta_0 + \beta_1 Q + \beta_2 W \qquad [7]$$

where W are a vector of exogenously given supply side variables.

[16] In the reminder of this subsection, I refer to Bresnahan (1982)

Hence the supply relation is given by:

$$P = \lambda(-Q / \alpha_1) + \beta_0 + \beta_1 Q + \beta_2 W + \eta \qquad [8]$$

since $h(Q, Z; \alpha) = Q(\partial P / \partial Q) = Q / \alpha_1$ and $Y \in \mathbf{Z}$.

The demand function [1] is identified, since only one endogenous variable is included, i.e. *P*, and there is an excluded exogenous variable, i.e. *W*. The same is true about the supply relation, i.e. *Q* is the only endogenous variable included while the demand exogenous variable *Y* is excluded. But the degree of market power, λ, is not. The problem is evident from [8]. Since the coefficient of *Q* depends on both β_1 and λ, and there is no prior knowledge about β_1, there is no possibility to determine the value of λ.[17] The problem arises because the demand equation is linearly specified, and lacks exogenous variable(s) that enter the equation interactively with *P*. Assume that the demand equation is changed according to the following specification:

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \alpha_3 PZ + \alpha_4 Z + \varepsilon \qquad [9]$$

In [9], a new exogenous variable, *Z*, with the property that it enters interactively with market price *P*, has been imposed. To make the interaction natural, Z might represent the price of a substitute, while Y might be a measure of general economic activity (e.g. income). The supply relation will now be given by:

$$P = -\lambda \frac{Q}{\alpha_1 + \alpha_3 Z} + \beta_0 + \beta_1 Q + \beta_2 W + \eta \qquad [10]$$

since $h(Q, Z; \boldsymbol{\alpha}) = Q(\partial P / \partial Q) = Q / (\alpha_1 + \alpha_3 Z)$

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[17] The coefficient of *Q* also depends on α_1. However α_1 may be treated as known, by first estimating the demand equation.

By treating α_1 and α_3 as predetermined, λ is identified in [10] as the coefficient of $Q/(\alpha_1 + \alpha_3 Z) = Q^*$, since there are now two included endogenous variables, Q and Q^*, while two excluded exogenous variables, *Z* and *PZ* in [10].

The crucial point is (always) that the demand equation contains at least one exogenous variable whose movement will cause the demand curve to rotate. The rotation will trace out the supply relation in a uniquely manner (that is, reveal the degree of market power). In general, such rotation will have no effect on the equilibrium if pricing is competitive, but will have an effect if there is market power. If demand is linearly specified, as above, the inclusion of the variable *PZ* is crucial to achieve such rotation. In Lau (1982), conditions on the demand system in which movements in the exogenous variables are able to cause rotation have been worked out exactly. As a general rule, a necessary and sufficient condition for λ to be identified is that the demand function must *not* be separable in at least one exogenous variable that is included in the demand function but excluded from the marginal cost function.

3.2 The empirical model

In the present study, a log-linear demand function was applied. The explicit form of the market demand function facing the representative firm was given by:

$$\ln Q = \alpha_0 + \alpha_1 \ln P + \alpha_2 \ln Y + \alpha_3 \ln Z + \alpha_4 \ln Z \ln P + \varepsilon_1 \qquad [11]$$

where $Q = \sum_{i=1}^{N} q_i$ is market output; $P = P(Q, \mathbf{Z})$ is market price; *Y* is real *GDP*; and *Z* is the rate on a 3 month Swedish treasury bill. (The data is discussed in section 3.3)

The interactive term $\ln Z \ln P$ was included in [11], even though this is not required for identification purposes due to the log-linear form.
(Since e.g. $\partial^2 Q / \partial Y \partial P = \alpha_1 \alpha_2 Q / PY \neq 0$. Hence the exogenous variable Y does not enter [11] in a separable way and since it is not used as a cost instrument (see below) we know from the Lau condition that identification is possible.)

The specification in [11] implies that $Q(\partial P / \partial Q) = 1/\tilde{\eta} = P/(\alpha_1 + \alpha_4 \ln Z) = P^*$. In the supply system, λ is identified as the coefficient of P^*.

The cost function was specified as transcendental logarithmic (translog). The translog cost function is a second order Taylor expansion[18] of any cost function. This property makes it a truly flexible choice and recommendable in situations where it is desirable to avoid strong assumptions about (the real) functional form. It was further assumed that banks were operating with three inputs: funds, labour and physical capital, with corresponding factor prices $\{\omega_1; \omega_2; \omega_3\}$. Consistent with the intermediation approach[19], deposits were treated as an input, used in conjunction with labour to originate loans. Hence the cost function is given by:

$$\ln C_j = c_0 + s_0 \ln q_j + \frac{s_1}{2}(\ln q_j)^2 + \sum_{m=1}^{3} c_m \ln \omega_{mj} + \ln q_j \sum_{m=1}^{3} s_{m+1} \ln \omega_{mj} + \\ + c_4 \ln \omega_{1j} \ln \omega_{2j} + c_5 \ln \omega_{1j} \ln \omega_{3j} + c_6 \ln \omega_{2j} \ln \omega_{3j} + \sum_{m=1}^{3} c_{m+6} (\ln \omega_{mj})^2 \qquad [12]$$

Implying the marginal cost function:

$$MC_j = \frac{\partial C_j}{\partial q_j} = \frac{C_j}{q_j}\left(s_0 + s_1 \ln q_j + \sum_{m=1}^{3} s_{m+1} \ln \omega_{mj} \right) \qquad [13]$$

The usual properties of a cost function pose some restrictions on [13]. Due to the translog form, we should in general need to be concerned with the properties of symmetry and linear homogeneity in the coefficients of input prices. However, the specific formulation of [12] makes it possible to avoid the test of symmetry. Test of symmetry with respect to input prices would have been necessary if different coefficients were estimated for e.g. $\ln \omega_{1i} \ln \omega_{2i}$ and $\ln \omega_{2i} \ln \omega_{1i}$, but this is not the case in [12]. In addition, since the bank is treated as a supplier of a composite product, the symmetry in the coefficients of produced goods will not be an issue of concern

[18] It is also a generalization of the Cobb-Douglas functional form.
[19] See Klein (1971) and Sealey & Lindley (1977) for details about the intermediation model.

either. The property of linear homogeneity (degree one) implies the following restrictions:

$$\sum_{m=1}^{3} c_m = 1 \qquad \text{[R1]}$$

$$\sum_{m=1}^{3} s_{m+1} = 0 \qquad \text{[R2]}$$

$$\sum_{m=1}^{6} c_{m+3} = 0 \qquad \text{[R3]}$$

These conditions, as well as the evident cross-equation restrictions, were imposed on the system estimated below.

By substituting [11] and [13] into the supply relation, the latter will be given by:

$$p_j = \frac{C_j}{q_j}\left(s_0 + s_1 \ln q_j + \sum_{m=1}^{3} s_{m+1} \ln \omega_{mj}\right) - \lambda_j \left[P/(\alpha_1 + \alpha_4 \ln Z)\right] \qquad \text{[14]}$$

For λ to be correctly specified in [14], it is necessary to treat the input prices as exogenously given. This assumption seems reasonable at least as far as the markets for labour and physical capital are concerned because banks face intense competition for these inputs from other banks as well as non-bank firms. The market for funds will also be treated as competitive based on the argument that depositors today have many other tempting saving options such as government bonds, the fund (stock) market etc - alternatives which exert a competitive pressure upon banks deposit rate policy. To the extent that this is not true, i.e. banks have some limited degree of market power in the deposit market, it can be shown[20] that this will be misattributed to the asset side, and consequently λ will be biased upwards. This implies that a finding of competitive behaviour becomes even more striking.

[20] See Shaffer (1999), p 191.

As evident from [14], the dependent variable is price measured at firm level (p_j) while the market price (*P*) is used on the RHS. While not truly consistent with the way the supply relation was derived, (since a quantity game was considered, not a price game) it allows for some heterogeneity in the price setting policy, and, in addition, is good for identification purposes.[21]

As a proxy for the whole range of services offered, total assets were used.[22] By considering the whole business mix, the effects of potential strategic actions among business segments will be incorporated. Concurrently with the diversification into new business segments, increased cross selling has become an important strategy. This in turn implies that behaviour at different sub-markets has become more interrelated. If such interrelation is neglected, by focusing on e.g. the intermediation margin business only, it is quite likely that the estimation of market power will be biased.
The price proxy will (consequently) include interest income as well as provision-based income. As pointed out by DeYoung (1994), if income from services is not taken into account, a bias in estimated marginal cost may be generated, and more so if large banks (in terms of on-balance sheet items) also are large providers of off-balance sheet activities (as seems likely).

3.3 Data

To obtain consistent (and efficient) estimates of the supply side parameters, [12] and [14] were estimated using firm level, balance sheet data. This information were delivered by Sveriges Riksbank. The overall pool included a total of 631 observations, covering the time span 1996-2002. The average number of commercial banks included amounted to 11 while the corresponding number for the saving banks is 79. To qualify for inclusion in the study, the bank should have been a participator in the market for the whole period or almost the whole period. In addition, sufficient firm level data must be available. While the quite high coverage rate, i.e. 92 % in terms of

[21] See Tsutsui & Uchida (2002)
[22] Total assets were used also by e.g. Shaffer (1993), Shaffer & DiSalvo (1994), Berg & Kim (1994) and Angelini & Cetorelli (2000)

total assets on average, do seem to indicate that most banks did pass these requirements, the complete exclusion of foreign subsidiaries/branches, due to lack of data, could induce some selection bias. However, because of their smallness it was not considered as a problem of overwhelming magnitude. In addition, to the extent that they really enjoy some market power (reflected in their ability to influence the behaviour of e.g. the larger commercial banks), this should be incorporated in the latter firms' perceived demand functions, and therefore contribute to the overall degree of market power, the level of which is indicated by the average interaction parameter.

Firm balance sheet data were exploited to create the operational variables shown below (time subscripts omitted). Based on the argument in section 3.2, I use total assets as a proxy for bank production level.[23] In the absence of direct observations on prices, it has become standard, in banking cost studies as well as studies of bank competition, to impute output and factor prices from such ratios as calculated below.[24]

The operational supply-side variables were:

q_j = total assets of bank *j*

p_j = proxy for output price (interest revenue + provision based income)/total assets for bank *j*

ω_{1j} = proxy for the unit price for funds, i.e. interest expenses/ (saving deposits + certificates and bonds issued), measured at firm level

ω_{2j} = proxy for the unit price of personal costs, i.e. total labour costs / number of employees, at firm level

ω_{3j} = proxy for the unit price of physical capital, i.e. net operating costs minus interest and personal costs divided by total assets (measured at firm level)

C_j = total costs for firm *j*, that is, total operating costs plus interest paid on deposits

[23] See Shaffer (1993), Angelini & Cetorelli (2000) and Asogwa (2993) for applications relying on total assets as proxy for the output level.
[24] Shaffer & DiSalvo (1994)

The estimation of the market demand function relied on aggregate time-series data. Industry output and information used to calculate the market price (same proxy as above) were obtained from the Swedish Bankers Association (website). Macro data such as GDP, inflation rate, unemployment rate and market interest rates [that is, rates on the 3 month Treasury bill and Government bonds (10 years to maturity)] were obtained from Sveriges Riksbank (website).

The operational variables used in the estimation of [11] (time subscripts omitted) are shown below. It is hypothesized that Y will affect the level of aggregate demand positively. If Z is a good measure (up to a monotone transformation) of the price of a substitute for bank loans, then this variable should take a positive coefficient.[25]

Q= industry output (total assets)
P= market price (the same proxy as above)
Y= gross domestic product in real terms
Z= proxy for a substitute to bank loans (real rate on a 3 month Swedish Treasury bill)

3.4 Estimation method

The identification of λ from the mark-up captured by $\lambda / \tilde{\eta}$ requires knowledge of $1/\tilde{\eta}$, that is, the inverse of the market demand semi-elasticity to price. This information was obtained by estimating the market demand function:

$$\ln Q = \alpha_0 + \alpha_1 \ln P + \alpha_2 \ln Y + \alpha_3 \ln Z + \alpha_4 \ln Z \ln P + \varepsilon_1 \qquad [11]$$

Equation [11] was estimated with both OLS and 2SLS. OLS has better small sample properties, while 2sls is able to account for potential correlation between the market price P and the error term. I refrained from imposing a time trend, in order not to generate multicollinearity with the income variable. Subsequently, the demand parameter estimates were used to create the variable representing the inverse of the

[25] See Shaffer (1993) and Shaffer & DiSalvo (1994).

semi-elasticity of market demand to price. The parameter λ is identified as the coefficient of this variable, based on estimation of equation [14]. To achieve parameter consistency, and to ensure that the requirements of a proper cost function are fulfilled, the supply system was estimated imposing cross-equation restrictions as well as the constraints [R1]-[R3]. The system was estimated by the 3SLS method, using instruments for the endogenous variables C_j and q_j.

In the spirit of e.g. Angelini & Cetorelli (2000), I also considered estimation of the supply side only. This method is appropriate when it's difficult to get a sufficient data set on the exogenous variables affecting market demand. This method will produce consistent marginal cost parameters, while it's no longer possible to identify the conduct parameter. However, we will achieve knowledge about the overall degree of market power ($\lambda / \tilde{\eta}$) as the difference between the applied price proxy and estimated marginal cost (mark-up).[26] Because banks differ considerably in size, and also belong to different ownership types (e.g. commercial or saving) it is of potential interest to investigate if mark-ups varies accordingly. Thus, prior to the investigation, banks were coded as large commercial (whole-sale); small commercial (niche banks); large saving banks (using the medium bank as reference); and small saving banks. Subsequently, the following supply system was estimated[27]:

$$p_j = \frac{C_j}{q_j}\left(s_0 + s_1 \ln q_j + \sum_{m=1}^{3} s_{m+1} \ln \omega_{mj} \right) + \sum_{k=1}^{4} \theta_k D_k + s_5 t + s_6 t^2 \qquad [15]$$

$$\ln C_j = c_0 + s_0 \ln q_j + \frac{s_1}{2}(\ln q_j)^2 + \sum_{m=1}^{3} c_m \ln \omega_{mj} + \ln q_j \sum_{m=1}^{3} s_{m+1} \ln \omega_{mj} +$$
$$+ c_4 \ln \omega_{1j} \ln \omega_{2j} + c_5 \ln \omega_{1j} \ln \omega_{3j} + c_6 \ln \omega_{2j} \ln \omega_{3j} + \sum_{m=1}^{3} c_{m+6} (\ln \omega_{mj})^2 + \qquad [16]$$
$$+ \sum_{k=1}^{4} c_{k+9} D_k + c_{14} t + c_{15} t^2$$

where D_k takes a value of one for banks belonging to group *k* and zero otherwise. The estimated mark-up for category *k* is captured by the parameter θ_k. To capture

[26] See Appelbaum (1982)
[27] The methodology is adopted from Angelini & Cetorelli (2000) with some modifications.

potential time effects, the model was also estimated with a quadratic time trend imposed. Complete results from all different model specifications considered are reported in table 2.

The specification of [15] implies that the same cost structure is estimated for the whole panel while differences among groups are entirely captured in the dummy variables. The results from this estimation procedure are reported in table 2. While the imposition of the same cost structure for all groups obviously implies a large gain in terms of degrees of freedom, it might be a too strong restriction, and could therefore introduce a bias in the estimation of the Lerner indexes. Because of this potential problem, the regressions were also run for the separate groups. The results from this procedure are reported in table 2a-2d. As evident form the tables, the two procedures give consistent results, indicating that the bias introduced by the homogenous cost structure assumption was in fact small.

The approach proposed by Angelini & Cetorelli is more "robust" in the sense that it will simply yield information about the average mark-up enjoyed, without imposing the requirement that λ_j in fact measures firms' conjectures. As pointed out by Bresnahan (1989), any oligopolistic model will fit a relationship like [3], that is, a supply relation derived based on the profit maximization assumption.

3.5 Empirical Results

3.5.1 Estimation of market demand

To achieve prior knowledge about market demand parameters, as necessary to be able to identify λ based on estimation of [12]:[14], the market demand function [11] was estimated using time-series data. Autocorrelation in the error term was corrected for, and the fit of the model, in terms of adjusted R^2, was 0.89. Both OLS and 2SLS estimation were considered. The OLS method is preferable on the ground that the sample is this small, but it fails to account for the fact that the market price, treated as an independent variable, is in fact endogenously determined, and might be correlated with the error term. The 2SLS, on the other hand, has questionable small-sample properties. The implied value of the market demand elasticity to price, based on OLS estimation, is -0.311. The 2SLS produced a similar value, -0.332. Apparently, these values are fairly low in absolute terms, indicating that the elasticity of demand for banking products were inelastic during the exam period. However, they do seem reasonable, as they conform to results obtained from other investigations, albeit undertaken on different markets. With knowledge of the market elasticity to price, the corresponding value of the inverse of the semi-elasticity of demand to price is easily derived. These values were calculated to –0.184 and –0.172, respectively.

3.5.2 Estimation of the supply system

With knowledge of demand parameters achieved, λ is now identified as the coefficient of the semi-elasticity of demand variable. (See equation [14].) The value obtained for λ, based on estimation of [12]:[14] amounted to around 0.09 (in absolute terms) and was highly significant[28]. Hence, the hypothesis of perfect competition, implying a value of λ equal to zero, was clearly rejected. Nor is there, quite evidently, any support for the cartel solution (implying λ=1). Cournot conduct implies a value of λ equal to the Herfindahl-Hirschman index (HHI). The average HHI (with respect to total assets) turned out to be considerably higher (0.19). Hence, the actual performance did fall in the region between perfect competition and Cournot. The value of λ obtained corresponds to a Lerner index of 22%[29]. While most other industries operate with considerably lower margins, this result seems reasonable for the banking industry. For the period 1974-1996, profitability in terms of ROE, averaged 22% for the commercial banking industry in Sweden, while profitability in the manufacturing industry was only 12%[30]. However, according to both table 2, (which report estimation results with the homogenous cost structure assumption imposed) and tables 2A-D (the homogenous cost structure assumption relaxed), there is a large difference among certain groups, in particular between the largest commercial banks (wholesale) and the saving banks. Based on the results reproduced

[28] This value is obtained using demand parameter estimates produced by the 2SLS procedure. Complete results are found in Table 4.

[29] This number was obtained by first multiply λ with the inverse of the semi-elasticity of market demand to price. Subsequently, this product was divided by the market price. (See table 1)
[30] Excluding the years most severely affected by the crisis, 1991-93. If these years are included, profitability drops to 13 and 11%, respectively. Konkurrensverkets rapportserie 1999:2.

in table 2, it was verified[31] that banks belonging to either of the two commercial bank groups enjoyed margins significantly lower (at the 99% level) than the group of small saving banks. The comparison between the group of large and small saving institutions is in favour of the group of large ones, although the difference is insignificant at the 95% level of significance. As shown in table 2A, the saving bank sector enjoyed margins around 25%, while the corresponding value for the commercial sector was only 10%. From table 2B it's evident that within the commercial sector, the niche banks seem to have performed reasonable (17-22%), while margins for the wholesale banks were substantially depressed (3-6%). Presumably, there was an unfortunate combination of transitory and lasting effects, which affected the largest banks most severely. For example, as a reaction to the increased competitive pressure in some retail banking segments, the largest banks have focused increasingly on achieving growth from other business segments, based on fee and commission revenues. While the broadening of the business mix probably entails diversification benefits and, in addition, these new segments involve less credit risk and are more cash flow certain, they involve lower margins compared to the intermediation margin business. What really harmed the largest banks, however, was the fall in the stock market in the trace of the IT crash, implying a drop in provision revenues. This should have impacted on the results for the years 2001 and 2002. In 1997, profits were depressed by the costs associated with acquisitions that all four were engaged in.

The transitory effects of e.g. the fall in the stock market and the costs associated with acquisitions have certainly influenced the estimation results, but they do not explain why substantial lower margins for commercials were obtained for *all* years in the sample. Hence, there is support for the prediction that e.g. the implementation of new technology and the deregulation process have intensified competition in the Swedish market, and that the big four were the most affected. In addition, the implementation of the second banking directive, by reducing cross-border entry barriers, has most likely implied that the "national" market became more exposed to potential

[31] This was achieved by re-specifying the model slightly. That is, the small saving dummy parameter still measures the estimated mark-up (reference parameter) while the other group dummies measure differential effects relative to the reference parameter. The results from this estimation procedure is not reported but is of course available on request.

competition, that is, increased contestability[32]. Also this effect has hurt the largest commercial banks the most, since they are, to a considerable degree, engaged in such business segments that are exposed to international competition. Finally, it was obtained that the largest commercial banks operated in a region where the average cost was lower than marginal cost, that is, in a region of *dis*economies of scale, while for the other categories, e.g. commercial niche banks, large and small saving banks, the opposite was true. Also this finding might contribute to the lower performance of the largest commercial banks.

4. CONCLUSION

In this paper, a methodology within the NEIO research field was applied to determine the average degree of oligopolistic interaction as well as the average mark-up enjoyed in the Swedish banking market during the time span 1996 –2002. The methodology relied on a simultaneous equation model, comprising information about market demand, as well as supply relations derived from the profit maximization assumption on a firm level. One motive for undertaking the study was to challenge the prediction by the structure-conduct-performance paradigm. This paradigm predicts bad performance (from a customer point of view) since the Swedish banking market is comparatively highly concentrated. However, the findings obtained do not support the SCP paradigm, as it was obtained that the market performed in a considerably more competitive manner than the Cournot outcome (SCP). These findings are in line with the results obtained from other recent studies undertaken within this field.

Another motive for undertaking the investigation was to study the impact of e.g. the deregulation process, EU harmonization and the implementation of new technology upon market performance, and to identify if the changed conditions have implied worse condition for certain groups. It was obtained that while the saving bank sector has continued to enjoy margins around 25 %, that is, in line with traditional profitability levels in the banking sector, the commercial bank sector, and the largest

[32] High degree of contestability for large banks was established by e.g. Bikker & Haaf (2001) for several countries, including Sweden. Other recent contestability tests, albeit not concerned with the Swedish market, include DeBandt & Davis (2000); Yildirim & Philippatos (2003); and Claessens & Laeven (2003).

banks in particular, seem to have experienced a period of considerable lower margins. In part, transitory effects might be responsible for this. However, margins for the largest commercial banks were systematically lower for all years, a circumstance that gives support for the prediction that the changed conditions have affected this category the most.

REFERENCE LIST:

Angelini, P & Cetorelli, N. (1999) ”Bank competition and regulatory reform: The case of the Italian banking industry” Working Paper Series, Federal Reserve Bank of Chicago, WP 99-32

Appelbaum, E (1982) “The estimation of the degree of oligopoly”, *Journal of Econometrics*, vol. 19, pp. 287-299

Asogwa, R.C. (2003) “Liberalization, consolidation and market structure in Nigerian banking”, Department of Economics, University of Nigeria, Nsukka, Nigeria.

Berg, S.A. & Kim, M. (1994) ”Oligopolistic interdependence and the structure of production in banking: an empirical evaluation”, *Journal of Money, Credit, and Banking*, vol. 26, pp 309-322.

Bikker, J.A. & Haaf, K. (2001) ”Competition, concentration and their relationship: an empirical analysis of the banking industry”, Financial Structure, *Bank Behaviour and Monetary Policy in the EMU Conference*, October 5-6, 2000, Groningen

Bresnahan, T.F. (1982) “The oligopoly solution concept is identified”, *Economic Letters*, vol.10, pp. 87-92

Bresnahan, T.F. (1989) “Empirical studies of industries with market power”, in Schmalensee, R. and Willig, R.D. (eds.), *Handbook of Industrial Organisation*, vol. II, North-Holland, Amsterdam

Cetorelli, N. (1999), “Competition analysis in banking: appraisal of the methodologies”, *Federal Reserve Bank of Chicago Economic Perspectives*, n. 1, pp 2-15.

Coccorese, P. (2002) “Competition among dominant firms in concentrated markets: Evidence from the Italian Banking Industry”, *Center for Studies in Economic and Finance, Italy,* Working paper no. 89

DeBandt, O. & Davis, E.P. (2000) “Competition, contestability and market structure in European banking sectors on the eve of EMU”, *Journal of Banking and Finance*, vol.24, pp. 1045-1066

DeYoung, R. (1994) “Fee-based Services and Cost Efficiency in Commercial Banks”, Proceedings from a Conference on Bank Structure and Competition, *Federal Reserve Bank of Chicago*, pp. 501-519

ESO, Bergman, M.A. (2002) “Lärobok för regelnissar – en ESO-rapport om regelhantering vid avregleringar”, Ds 2002:21

Goddard, J.A. & Molyneux, P. & Wilson, J.O.S. (2001) “European Banking – Efficiency, Technology and Growth”, *John Wiley & Sons, Ltd*, England

Iwata, G. (1974) ”Measurement of conjectural variations in oligopoly”, *Econometrica*, vol. 42, pp 947-966

Klein, M. (1971) “A theory of banking firm”, *Journal of Money, Credit, and Banking*, vol. 7, pp. 205-218

Klemperer, P. & Meyer, M. (1985) ”Price competition vs. quantity competition: The role of uncertainty”, Rand Journal of Economics, vol. 17, pp. 618-638.

Konkurrensverkets rapport 1999:2, Konkurrensen på bankmarknaden – betalningsförmedling och villkor för nya aktörer.

Lau, L. (1982) “On identifying the degree of competitiveness from industry price and output data”, *Economic Letters*, vol. 10, pp 93-99

Marquardt, R. (2000) “Finansmarknad i förändring”, *Svenska Bankföreningen*

Oxenstierna, G. (2000) ”Testing for Market Power in the Swedish Banking Oligopoly”, working paper 2/2000, Södertörns högskola

Panzar, J.C. & Rosse, J.N. (1987) ”Testing for monopoly equilibrium”, *Journal of Industrial Economics*, vol. 25, pp. 443-456

Sealey C.W.Jr., Lindley, J.T. (1977), “Inputs, outputs, and a theory of production and cost at depositary financial institutions”, *Journal of Finance*, vol.32, pp. 1251-1266

Shapiro, C. (1989) “Theories of oligopoly power”, in Schmalensee, R. and Willig, R.D. (eds.), *Handbook of Industrial Organisation*, vol. I, North-Holland, Amsterdam

Shaffer, S. (1993) “A Test of Competition in Canadian Banking”, *Journal of Money, Credit, and Banking*, vol.25, pp.49-61.

Shaffer, S. and DiSalvo, J. (1994) “Conduct in a Banking Duopoly”, *Journal of Banking and Finance*, vol. 18, pp. 1063-1082.

Shaffer, S. (1999), “Ownership Structure and Market Conduct Among Swiss Banks”, mimeo.

Singh, N. & Vives, X. (1984) “Price and quantity competition in a differentiated duopoly”, *Rand Journal of Economics*, vol. 15, pp 546-554.

Tirole, J. (1988) “The Theory of Industrial Organisation”, *The MIT Press, Cambridge, Massachusetts*

Tsutsui, Y. & Uchida, H. (2002) ”Has competition in the Japanese Banking Sector Improved?” Graduate School of Economics, Osaka University; Wakayama University

Yildirim, H. Semih & Philippatos, George C. (2003) “Competition and contestability in Central and Eastern European banking markets”, *EFMA Meeting in London, England and 2003 FMA International Meeting in Dublin, Ireland*

Table 1. Selected features of the dataset

	Mean	Std.Dev.	Max	Min
All banks				
(631 obs)				
Output(composite)	25060	113081	945545	10.4
Price (composite)	0.071	0.125	0.111	0.038
Interest Rev/assets	0.061	0.012	0.098	0.032
Interest Margin	0.038	0.011	0.073	0.005
Unit cost of funds	0.032	0.017	0.192	0.011
Unit cost of labour	0.428	0.095	1.042	0.032
Unit cost of capital	0.174	0.008	0.704	0.001
Total costs	1288	5662	47020	0.483
Total deposits	13037	56731	475624	9.53
Employees	422	1730	12930	1.00
Branches	22.8	95.5	1077	1.00
Universal comm.				
(41 obs)				
Output(composite)	360693	275338	945545	1453
Price (composite)	0.055	0.010	0.075	0.038
Interest Rev/assets	0.047	0.008	0.068	0.031
Interest Margin	0.014	0.005	0.029	0.006
Unit cost of funds	0.058	0.020	0.102	0.029
Unit cost of labour	0.546	0.116	0.832	0.215
Unit cost of capital	0.016	0.013	0.052	0.003
Total costs	18345	13436	47020	106
Total deposits	183105	135814	475624	1120
Employees	5707	3996	12930	40.0
Branches	292	250	1077	1.00

	Mean	Std.Dev.	Max	Min
Niche banks				
(36 obs)				
Output(composite)	6751	6745	31224	2044
Price (composite)	0.076	0.020	0.111	0.044
Interest Rev/assets	0.061	0.018	0.098	0.034
Interest Margin	0.029	0.021	0.073	0.005
Unit cost of funds	0.050	0.039	0.192	0.016
Unit cost of labour	0.480	0.129	0.948	0.239
Unit cost of capital	0.021	0.018	0.070	0.001
Total costs	433	463	2622	132
Total deposits	4404	2728	13056	1011
Employees	142	67.0	287	63.6
Branches	4.56	5.80	17.0	1.00
Saving banks				
(548 obs)				
Output(composite)	1152	1579	11289	10.4
Price (composite)	0.072	0.011	0.105	0.044
Interest Rev/assets	0.062	0.011	0.096	0.043
Interest Margin	0.040	0.007	0.060	0.019
Unit cost of funds	0.028	0.010	0.065	0.011
Unit cost of labour	0.416	0.083	1.04	0.032
Unit cost of capital	0.017	0.006	0.040	0.005
Total costs	68.5	100	722	0.483
Total deposits	880	1138	7377	9.534
Employees	45.0	59.5	399	1.00
Branches	3.85	4.00	29.0	1.00

All numbers in Mkr, converted into 1995 values. (except ratios)

Table 2. Supply system estimation results - Whole sample 1996-2002. The same cost structure imposed on all banks. Cost constraints imposed.

	Average conduct	Group dummies	Time trend	Dummies+time trend
Supply rel				
s_0	96.26*** (30.15)	90.71*** (29.59)	85.30*** (29.23)	71.17*** (21.31)
s_1	-2.54*** (-10.94)	-1.179*** (-3.443)	-1.567*** (-7.190)	1.793*** (4.783)
s_2	1.563* (1.722)	2.729*** (3.142)	-1.906** (-2.154)	-3.561*** (-3.409)
s_3	5.397*** (5.166)	3.084*** (3.083)	7.499*** (8.162)	4.125*** (3.853)
s_4	-6.961*** (-9.316)	-5.813*** (-7.539)	-5.593*** (-8.423)	-0.5636 (-0.684)
$theta_{average}$	**1.615*** (38.15)**	**-**	**2.167*** (25.59)**	**-**
$theta_{small\_sav}$	**-**	**1.855*** (27.94)**	**-**	**3.935*** (18.54)**
$theta_{large\_sav}$	**-**	**2.019*** (31.66)**	**-**	**3.694*** (18.88)**
$theta_{niche\_com}$	**-**	**1.340*** (9.130)**	**-**	**3.040*** (12.11)**
$theta_{univ\_com}$	**-**	**0.154 (1.006)**	**-**	**1.436*** (5.919)**
$s_{5(time)}$	-	-	-0.1453*** (-7.447)	-0.947*** (-8.131)
$s_{6(time\ sqr)}$	-	-	-	0.0964*** (6.915)
Cost fcn				
$c_{0\ (int)}$	80.2* (1.797)	-	168.4*** (4.415)	-
$c_{1(W1J)}$	-48.81* (-1.809)	-58.49** (-2.289)	10.78 (0.433)	39.93 (1.408)
$c_{2(W2J)}$	29.22 (1.094)	52.78** (2.089)	-14.82 (-0.652)	21.02 (0.827)
$c_{3(W3J)}$	119.6*** (6.451)	105.7*** (5.776)	104.0*** (6.521)	39.04** (2.166)
$c_{4(W12J)}$	-22.51*** (-4.499)	-19.90*** (-4.154)	-23.07*** (-5.636)	-8.032* (-1.692)
$c_{5(W13J)}$	-8.27*** (-4.153)	-8.534*** (-4.549)	-8.509*** (-5.287)	-14.28*** (-8.002)
$c_{6(W23J)}$	35.89*** (8.234)	33.61*** (8.008)	27.85*** (7.221)	12.11*** (2.758)
$c_{7(W11J)}$	-4.12 (-1.415)	-4.588* (-1.659)	2.091 (0.797)	6.829** (2.295)
$c_{8(W22J)}$	-9.41*** (-3.711)	-6.582*** (-2.757)	-11.32*** (-5.321)	-3.053 (-1.269)
$c_{9(W33J)}$	3.43** (2.328)	2.882** (1.984)	3.583*** (2.900)	3.104** (2.158)
$c_{10(Large\ sav)}$	-	80.83* (1.943)	-	185.8*** (4.454)
$c_{11(Small\ sav)}$	-	71.75* (1.727)	-	176.3*** (4.229)
$c_{12(Univ\ comm)}$	-	78.05* (1.856)	-	173.2*** (4.107)
$c_{13(Niche\ comm)}$	-	82.89** (2.001)	-	190.9*** (4.594)
$c_{14(Time)}$	-	-	-1.830*** (-8.670)	-10.94*** (-5.885)
$c_{15(Time\ square)}$	-	-	-	1.003*** (4.708)
Adj R^2	0.998	0.998	0.998	0.999
Obs	631	631	631	631
d.f.	615	613	615	611

Coefficients are multiplied by 100, with t-ratios in parentheses. The system was estimated with 3SLS. Software: Limdep.
Instrumental varibles used were: Constant, group dummies, time dummies, levels and logs of: constant; lagged output, price and cost; current and lagged unit prices of input, and all their cross-produ

Table 2A. Supply system estimation results - RESTRICTED (pooled sample - ownership/time partitions) 1996-2002

	Whole panel	Early period	Late period	Comm. b.	Saving b.
Supply rel					
s_0	96.26***	91.60***	106.9***	116.4***	48.96***
	(30.15)	(23.93)	(16.42)	(9.958)	(7.882)
s_1	-2.54***	-1.753***	-1.503***	-1.871	1.960***
	(-10.94)	(-6.514)	(-5.194)	(-1.634)	(4.745)
s_2	1.563*	-0.754	2.122	7.139***	7.524***
	(1.722)	(-0.675)	(1.469)	(3.031)	(7.027)
s_3	5.397***	5.763***	-0.123	-3.468	9.971***
	(5.166)	(4.391)	(-0.066)	(-1.161)	(5.827)
s_4	-6.961***	-5.009***	-1.999**	-3.671**	-17.50***
	(-9.316)	(-4.975)	(-2.027)	(-2.416)	(-11.35)
L	**1.615*** **	**1.71*** **	**1.470*** **	**0.646*** **	**1.798*** **
	(38.15)	(29.39)	(30.89)	(4.472)	(34.16)
price	7.101	7.353	6.755	6.510	7.183
Lerner (L/p)	0.227	0.233	0.218	0.099	0.250
Cost fcn					
$c_{0\ (int)}$	80.2*	112.3**	-216.9**	-125.7	368.2***
	(1.797)	(2.518)	(-2.515)	(-1.540)	(3.154)
$c_{1(W1J)}$	-48.81*	6.63	-155.0***	-106.2**	-152.7***
	(-1.809)	(0.222)	(-3.592)	(-2.230)	(-3.487)
$c_{2(W2J)}$	29.22	8.90	195.2***	105.8**	-43.68
	(1.094)	(0.291)	(4.083)	(2.216)	(-0.618)
$c_{3(W3J)}$	119.6***	84.5***	59.88**	100.4***	296.4***
	(6.451)	(3.567)	(2.318)	(3.843)	(5.080)
$c_{4(W12J)}$	-22.51***	-18.3***	8.813	-6.893	3.722
	(-4.499)	(-3.388)	(0.925)	(-0.594)	(0.291)
$c_{5(W13J)}$	-8.27***	-6.54***	-32.73***	-5.327	-43.69***
	(-4.153)	(-2.662)	(-8.295)	(-1.278)	(-5.884)
$c_{6(W23J)}$	35.89***	24.3***	42.74***	20.84**	0.132
	(8.234)	(5.215)	(4.598)	(2.248)	(0.013)
$c_{7(W11J)}$	-4.12	-0.036	-69.13	-7.852	3.880
	(-1.415)	(-0.011)	(-1.441)	(-1.311)	(0.713)
$c_{8(W22J)}$	-9.41***	-5.73**	-19.38	0.258	-6.390
	(-3.711)	(-2.203)	(-1.166)	(0.018)	(-1.526)
$c_{9(W33J)}$	3.43**	1.45	10.15***	4.516	36.25***
	(2.328)	(0.877)	(5.122)	(1.572)	(6.250)
AC	5.642	5.762	5.478	6.265	5.556
Adj R^2	0.998	0.998	0.999	0.997	
Obs	631	365	266	77	554
d.f.	616	350	251	62	539

Coefficients are multiplied by 100, with t-ratios in parentheses. The system was estimated with 3SLS. Software: Limdep.
Instrumental varibles used were: Levels and logs of: constant; lagged output, price and cost; current and lagged unit prices of input, and all their cross-products and squares.

Table 2B. Supply system estimation results - RESTRICTED (pooled sample - ownership/size partitions)

	Whole panel	Wholesale com.	Niche com.	Large sav.	Small sav.
Supply rel					
s_0	96.26***	82.81***	384.3***	104.9***	23.42***
	(30.15)	(7.437)	(4.206)	(8.925)	(3.991)
s_1	-2.54***	1.627**	-43.67***	-3.984***	11.51***
	(-10.94)	(1.956)	(-3.376)	(-4.803)	(14.02)
s_2	1.563*	10.73***	1.005	8.312***	14.27***
	(1.722)	(4.295)	(0.226)	(5.901)	(12.02)
s_3	5.397***	-5.764*	21.84***	5.620**	0.879
	(5.166)	(-1.954)	(2.825)	(2.033)	(0.538)
s_4	-6.961***	-4.966***	-22.84***	-13.93***	-15.15***
	(-9.316)	(-2.933)	(-2.860)	(-6.805)	(-9.280)
L	**1.615*** **	**0.146**	**1.784*** **	**1.830*** **	**1.882*** **
	(38.15)	(1.600)	(3.650)	(23.15)	(35.76)
price	7.101	5.514	7.644	7.421	6.945
Lerner (L/p)	0.227	0.026	0.233	0.247	0.271
Cost fcn					
$c_{0\ (int)}$	80.2*	-153.3	-962.5***	72.30	336.9***
	(1.797)	(-1.245)	(-2.836)	(0.418)	(4.775)
$c_{1(W1J)}$	-48.81*	-379.6***	69.30	-138.1**	-69.49***
	(-1.809)	(-5.103)	(1.101)	(-2.428)	(-2.662)
$c_{2(W2J)}$	29.22	315.9***	-83.43	16.71	-3.198
	(1.094)	(4.427)	(-1.073)	(0.159)	(-0.079)
$c_{3(W3J)}$	119.6***	163.7***	114.1*	221.4***	172.7***
	(6.451)	(7.442)	(1.786)	(2.910)	(4.440)
$c_{4(W12J)}$	-22.51***	4.226	7.667	-11.46	-18.91**
	(-4.499)	(0.331)	(0.488)	(-0.650)	(-2.487)
$c_{5(W13J)}$	-8.27***	-0.522	-6.000	-27.36***	-27.48***
	(-4.153)	(-0.120)	(-1.429)	(-2.927)	(-5.832)
$c_{6(W23J)}$	35.89***	49.62***	3.406	-6.585	12.44***
	(8.234)	(5.767)	(0.242)	(-0.336)	(2.583)
$c_{7(W11J)}$	-4.12	-51.87***	8.443	0.360	12.80***
	(-1.415)	(-4.876)	(1.261)	(0.061)	(3.780)
$c_{8(W22J)}$	-9.41***	19.16*	17.07	70.92***	-2.552
	(-3.711)	(1.710)	(0.673)	(4.111)	(-1.035)
$c_{9(W33J)}$	3.43**	6.230**	-11.60**	22.12**	16.19***
	(2.328)	(2.415)	(-2.179)	(2.487)	(4.515)
AC	5.642	5.086	6.762	5.843	5.268
Adj R^2	0.998	0.996	0.979	0.990	0.994
Obs	631	47	36	277	277
d.f.	616	32	21	262	262

Coefficients are multiplied by 100, with t-ratios in parentheses. The system was estimated with 3SLS. Software: Limdep.
Instrumental varibles used were: Levels and logs of: constant; lagged output, price and cost; current and lagged unit prices of input, and all their cross-products and squares.

Table 2C. Supply system estimation results - UNRESTRICTED (pooled sample - ownership/time partitions) 1996-2002

Supply rel	Whole panel	Early period	Late period	Comm. b.	Saving b.
s_0	-7.033	36.99***	-25.11*	-1.994	-67.63***
	(-0.706)	(2.842)	(-1.905)	(-0.102)	(-4.516)
s_1	-0.285	-0.641	2.402***	-2.416**	4.472***
	(-0.840)	(-1.601)	(5.142)	(-2.106)	(8.824)
s_2	-10.51***	-7.077***	-16.41***	-12.19***	-3.992**
	(-7.369)	(-3.884)	(-7.547)	(-3.453)	(-2.310)
s_3	-10.59***	-1.390	-23.00***	-26.46***	-0.450
	(-5.436)	(-0.625)	(-6.833)	(-5.697)	(-0.213)
s_4	-14.54***	-9.469***	-6.659***	-15.10***	-29.82***
	(-14.035)	(-6.673)	(-5.489)	(-7.024)	(-14.05)
L	**1.636*** **	**1.719*** **	**1.471*** **	**0.757*** **	**1.767*** **
	(38.60)	(29.54)	(30.86)	(5.209)	(33.50)
price	7.101	7.353	6.755	6.510	7.183
Lerner (L/p)	0.230	0.234	0.218	0.116	0.246
Cost fcn					
$c_{0\ (int)}$	1734.9***	953.9***	1764.3***	1579.9***	2096.1***
	(10.52)	(4.805)	(8.131)	(4.841)	(6.349)
$c_{1(W1J)}$	314.7***	183.4***	404.4***	454.5***	108.6
	(6.761)	(3.558)	(5.587)	(3.925)	(1.345)
$c_{2(W2J)}$	557.1***	240.3***	881.8***	546.9***	185.6**
	(10.12)	(3.975)	(11.54)	(5.719)	(2.235)
$c_{3(W3J)}$	333.8***	206.1***	177.7***	141.6***	681.1***
	(11.59)	(5.575)	(5.086)	(3.033)	(7.611)
$c_{4(W12J)}$	33.79***	6.132	106.9***	51.39***	14.76
	(4.655)	(0.786)	(8.354)	(2.720)	(1.075)
$c_{5(W13J)}$	11.62***	4.367	-17.73***	9.310	-14.37
	(3.530)	(1.136)	(-3.512)	(1.266)	(-1.383)
$c_{6(W23J)}$	80.30***	44.60***	69.62***	21.00	26.11**
	(12.87)	(6.548)	(6.029)	(1.476)	(2.319)
$c_{7(W11J)}$	17.41***	9.712**	33.14***	34.69***	11.90*
	(4.558)	(2.417)	(5.149)	(3.482)	(1.748)
$c_{8(W22J)}$	14.73***	4.113	23.11	13.58	4.440
	(4.157)	(1.164)	(1.090)	(0.874)	(1.015)
$c_{9(W33J)}$	10.12***	5.837***	11.51***	-9.153**	57.93***
	(6.332)	(3.031)	(5.745)	(-2.477)	(8.442)
AC	5.642	5.762	5.478	6.265	5.556
Adj R^2	0.997	0.998	0.999	0.994	0.995
Obs	631	365	266	77	554
d.f.	616	350	251	62	539

Coefficients are multiplied by 100, with t-ratios in parentheses. The system was estimated with 3SLS. Software: Limdep.
Instrumental varibles used were: Levels and logs of: constant; lagged output, price and cost; current and lagged unit prices of input, and all their cross-products and squares.

Table 2D. Supply system estimation results - UNRESTRICTED (pooled sample - ownership/size partitions)

Supply rel	Whole panel	Wholesale com.	Niche com.	Large sav.	Small sav.
s_0	-7.033	-12.52	-41.89	-85.71***	-42.75**
	(-0.706)	(-0.676)	(-0.303)	(-4.837)	(-2.543)
s_1	-0.285	3.590***	-0.0125	-0.719	13.67***
	(-0.840)	(4.597)	(-0.001)	(-0.836)	(13.88)
s_2	-10.51***	-4.294	-23.78***	-10.03***	8.100***
	(-7.369)	(-1.144)	(-3.159)	(-5.254)	(4.291)
s_3	-10.59***	-22.65***	-34.80**	-24.58***	-4.941**
	(-5.436)	(-5.738)	(-2.205)	(-7.144)	(-2.223)
s_4	-14.54***	-8.105***	-8.600	-33.81***	-21.61***
	(-14.035)	(-6.303)	(-0.988)	(-13.67)	(-9.614)
L	**1.636*** **	**0.336*** **	**1.281** **	**1.579*** **	**1.874*** **
	(38.60)	(3.818)	(2.534)	(19.48)	(35.53)
price	7.101	5.514	7.644	7.421	6.945
Lerner (L/p)	0.230	0.061	0.168	0.213	0.270
Cost fcn					
$c_{0\ (int)}$	1734.9***	553.2	1211.9*	1840.9***	1018.4***
	(10.52)	(1.476)	(1.845)	(5.902)	(4.052)
$c_{1(W1J)}$	314.7***	-310.1*	350.5***	168.5**	20.96
	(6.761)	(-1.940)	(2.985)	(2.209)	(0.362)
$c_{2(W2J)}$	557.1***	826.0***	421.5**	71.47	119.3**
	(10.12)	(6.671)	(2.389)	(0.530)	(2.281)
$c_{3(W3J)}$	333.8***	94.50*	-4.277	476.7***	308.9***
	(11.59)	(1.790)	(-0.054)	(5.153)	(4.694)
$c_{4(W12J)}$	33.79***	55.54**	27.23	-27.23	-9.239
	(4.655)	(2.443)	(0.979)	(-1.419)	(-1.108)
$c_{5(W13J)}$	11.62***	-15.38	-11.36	-4.712	-18.87***
	(3.530)	(-1.485)	(-1.403)	(-0.440)	(-2.604)
$c_{6(W23J)}$	80.30***	63.93***	-13.65	-24.31	24.13***
	(12.87)	(5.519)	(-0.762)	(-0.997)	(4.041)
$c_{7(W11J)}$	17.41***	-67.09***	20.98**	13.52**	14.49***
	(4.558)	(-3.701)	(2.371)	(2.090)	(3.082)
$c_{8(W22J)}$	14.73***	80.91***	38.37	46.05***	2.380
	(4.157)	(6.248)	(1.483)	(2.653)	(0.872)
$c_{9(W33J)}$	10.12***	-1.112	-8.109	27.63***	23.30***
	(6.332)	(-0.362)	(-1.481)	(3.022)	(5.023)
AC	5.642	5.086	6.762	5.843	5.268
Adj R^2	0.997	0.994	0.979	0.988	0.994
Obs	631	46	36	277	277
d.f.	616	31	21	262	262

Coefficients are multiplied by 100, with t-ratios in parentheses. The system was estimated with 3SLS. Software: Limdep.
Instrumental varibles used were: Levels and logs of: constant; lagged output, price and cost; current and lagged unit prices of input, and all their cross-products and squares.

Table 3. Market demand estimation results - aggregate time series 1991-2002

	LS	2SLS
$a_{0(int)}$	-22.43***	-19.82**
	(-2.583)	(-2.230)
$a_{1(m\text{-}price)}$	-0.624	-0.517
	(-1.292)	(0.303)
$a_{2(r\text{-}gdp)}$	2.431***	2.269***
	(4.312)	(3.896)
$a_{3(subst.)}$	-0.280	-0.186
	(-0.826)	(-0.537)
$a_{4(m\text{-}pr*sub)}$	-0.090	-0.053
	(-0.678)	(-0.388)
Adj R^2	0.889	0.888
Obs	12	12
n	-0.311	-0.332
1/ñ	-0.184	-0.172

Table 4. System estimation of the interaction parameter - Whole panel

Supply rel	Restricted (Dem:LS)	Unrestricted (Dem:LS)	Restricted (Dem:2SLS)	Unrestricted (Dem:2SLS)
s_0	96.04***	-15.63	92.88***	-11.51
	(30.47)	(-1.576)	(30.09)	(-1.199)
s_1	-2.508***	-0.0416	-2.153***	0.0669
	(-10.88)	(-0.123)	(-9.583)	(0.205)
s_2	1.318	-11.80***	0.6560	-11.71***
	(1.474)	(-8.309)	(0.759)	(-8.507)
s_3	5.484***	-11.66***	5.707***	-9.800***
	(5.310)	(-6.083)	(5.610)	(-5.260)
s_4	-6.802***	-14.91***	-6.363***	-14.16***
	(-9.146)	(-14.45)	(-8.741)	(-14.19)
CV param.	**-7.944*** **	**-8.105*** **	**-9.142*** **	**-9.241*** **
	(-38.11)	(-38.80)	(-40.53)	(-40.94)
Cost fcn				
$c_{0\,(int)}$	82.39*	1854.4***	103.2**	1804.0***
	(1.862)	(11.27)	(2.391)	(11.44)
$c_{1(W1J)}$	-42.46	347.4***	-33.97	349.5***
	(-1.590)	(7.489)	(-1.317)	(7.772)
$c_{2(W2J)}$	26.30	588.7***	23.09	556.3***
	(0.992)	(10.81)	(0.890)	(10.58)
$c_{3(W3J)}$	116.2***	343.5***	110.9***	330.2***
	(6.292)	(11.99)	(6.145)	(12.02)
$c_{4(W12J)}$	-21.86***	38.23***	-21.83***	36.00***
	(-4.387)	(5.296)	(-4.416)	(5.089)
$c_{5(W13J)}$	-8.177***	12.87***	-9.514***	11.72***
	(-4.127)	(3.921)	(-4.841)	(3.665)
$c_{6(W23J)}$	34.84***	81.78***	33.21***	78.99***
	(8.044)	(13.20)	(7.804)	(13.14)
$c_{7(W11J)}$	-3.557	19.55***	-2.348	20.94***
	(-1.231)	(5.143)	(-0.835)	(5.631)
$c_{8(W22J)}$	-9.479***	16.36***	-8.773***	14.58***
	(-3.767)	(4.681)	(-3.517)	(4.267)
$c_{9(W33J)}$	3.254**	10.33***	35.11**	10.05***
	(2.218)	(6.507)	(2.408)	(6.430)
Adj R^2	0.998	0.997	0.998	0.997
Obs	631	631	631	631
d.f.	616	616	616	616

Coefficients are multiplied by 100, with t-ratios in parentheses. The system was estimated with 3SLS. Software: Limdep.
Instrumental varibles used were: Levels and logs of: constant; lagged output, price and cost; price of substitute; current and lagged unit prices of input, and all their cross-products and squares.