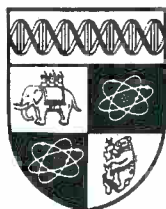SHOULD BANK BRANCHING BE REGULATED? THEORY AND EMPIRICAL
EVIDENCE FROM FOUR EUROPEAN COUNTRIES

Frank A Schmid*

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WARWICK ECONOMIC RESEARCH PAPERS

SHOULD BANK BRANCHING BE REGULATED? THEORY AND EMPIRICAL
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Should Bank Branching Be Regulated? Theory and Empirical Evidence
from Four European Countries

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Abstract:

Along with the liberalisation of bank branching, which was pushed ahead in most OECD
member countries during the past several decades, the fear of 'overbranched' markets has
arisen. In a model of spatial competition, the welfare effects of bank branching regulation
are investigated and empirical results are presented from a pooled cross-section time series
analysis from four European countries. It is shown that for all observations in the sample,
fewer branches would have been socially undesirable. Moreover, the frequently posed
hypothesis that a positive relationship exists between the number of branches and the price
for financial intermediation is rejected.

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Introduction

During the past several decades, bank branching has been widely liberalised in most OECD member countries. At the same time, the fear of 'overbranched' markets has arisen and arguments in favour of branching regulation have gained ground again. Theoretical support for the hypothesis that unregulated markets will be overbranched has been derived from the models of Hotelling (1929) and of Salop (1976). However, empirical evidence is long in coming. In the following, the welfare effects of branching regulation are investigated in a model of spatial competition and empirical results are presented for this model from a pooled cross-section time series analysis from four European countries covering the period 1981-1989. The model also allows us to test the frequently posed hypothesis that the price for financial intermediation increases with the number of branches.[1]

The Model

The following theoretical model is based on Salop (1979). The countries examined are considered to be circular in the sense that all economic activities take place on a circle. As in Salop, a two-stage game is considered in which the number of entrants and their locations are determined in the first stage, which takes place outside the model. In the second stage, the firms compete in prices.[2]

Banks as well as bank customers are assumed to be identical. The banks run networks of identical branches which are, like the customers, distributed equally over the country's circumference. The circumference s is divided into n equal-sized segments, each with a bank

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[1]   See for example Steinherr and Gilibert (1989, pp. 17-18).

[2]   See Tirole (1998, p. 282).

branch at both ends and c/n customers located in between (see figure 1). No pair of neighbouring branches belongs to the same bank.

The customers are price-takers. Each period, each customer chooses the branch that minimizes the sum of the price and transport costs for an arbitrary amount of banking services. No costs are assumed to arise if he switches from the branch he chose in the last period to another one in the present period. The customer's transportation costs associated with one unit of distance between the customer's location and the location of the bank branch are given by m. A customer is indifferent about the two nearest branches i and j that are located at the ends of his segment, if the sum of the transportation costs and the price for banking service equals between them:

$$p_i + m \cdot z = p_j + m \cdot \left(\frac{s}{n} - z \right) \tag{1}$$

where z is the customer's distance to branch i, and p_i and p_j are the prices for banking services of branch i and branch j, respectively. In this case, the customer's distance to branch i is given by

$$z = \frac{p_j - p_i + \dfrac{m \cdot s}{n}}{2 \, m} . \tag{2}$$

Transportation costs are assumed to be sufficiently high to fully compensate for a possible positive price difference between any of the customer's nearest two branches and a branch which is located outside the customer's segment. A bank branch can thus attract only demand that lies within its two adjoining segments (see figure 2).

Individual demand for banking services is assumed to depend negatively on the sum of the price for banking services and transportation costs. Moreover, demand increases with individual economic activity. If the demand function is assumed to be linear in the sum of

the price and transportation costs, individual demand can be represented by the average customer's demand which is given by:

$$x = g(p_i + m \frac{z}{2}, e)$$

$$= g(p_i + \frac{p_j - p_i + \frac{m \cdot s}{n}}{4}, e)$$

(3)

where e stands for the individual's economic activity. If the segments were of unit length, the market share of branch i in a single segment would amount to z, as given by Equation (2). Since its lengths are equal to s/n and because there are c/n customers located in a segment, the demand which branch i faces, reads:

$$X = 2 \frac{z \cdot c \cdot x}{s}$$

(4)

$$= \frac{p_j - p_i + \frac{m \cdot s}{n}}{m \cdot s} \cdot c \cdot g(p_i + \frac{p_j - p_i + \frac{m \cdot s}{n}}{4}, e) \ .$$

Since the spatial environment of a bank branch is considered to be symmetrical, pj represents the price of both neighbouring competitors.

Marginal costs of financial intermediation amount to mc and are assumed to be constant. Therefore, the profit of bank k which runs n_k banches is given by:

$$\pi_k(p_k, n_k) = n_k \cdot (p_k - mc_k) \frac{p_l - p_k + \frac{m \cdot s}{n}}{m \cdot s} \cdot c \cdot x - f(n_k)$$

(5)

with $f(n_k)$ as the costs of the branch network, including the headquarters. The capital employed in the industry is assumed to be hired for one period only. Thus, no sunk costs exist.

The representative bank k is assumed to choose its profit-maximizing price at the price p_l set by its competitors. The first-order condition of profit-maximization leads to:

$$\left(1 + \eta_k \frac{p_k - mc_k}{p_k}\right) \frac{m \cdot s}{p_k - mc_k} - n = 0 \qquad (6)$$

with

$$\eta_k := \frac{\delta x}{\delta p_k} \cdot \frac{p_k}{x} = \frac{3}{4} \cdot \frac{\delta x}{\delta (p_k + m \frac{z}{2})} \cdot \frac{p_k}{x}$$

as the price elasticity of individual demand which holds for an any branch of bank k. Since the firms are considered to be identical, there is only one market price p. The subscript k now stands for any individual firm.

Although for the individual bank the sum of its customers' transportation costs are endogenous in the price game, the sum of the transportation costs over all customers is constant for a given number of branches. Thus, the Nash-equilibrium of profit-maximization is characterized by:[3]

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[3] A branch attracts customers from neighbouring branches if its lowers its price given the price set by its competitors. Since this increases the distance between its own location and the location of its representative customer, the absolute value of the price elasticity of the representative customer is lower than when the price decrease is followed by all competitors.

$$\left(1 + \frac{3}{4} \eta \frac{p - mc}{p}\right) \frac{m \cdot s}{p - mc} - n = 0 \qquad (7)$$

with

$$\eta := \frac{\delta x}{\delta p} \cdot \frac{p}{x} = \frac{\delta x}{\delta \left(p + \frac{m \cdot s}{4 n}\right)} \cdot \frac{p}{x} \equiv \frac{4}{3} \eta_k$$

as the price elasticity of individual demand which the banking industry as a whole faces.

As long as the banks are allowed to compete in prices, Equation (7) holds in any market situation, regardless of whether or not the number of branches has resulted from regulatory intervention or from entries that have driven the industry profit to a value that keeps potential newcomers out of the market.

Empirical Analysis

The empirical analysis presented here is based on Equation (7). Although no hypothesis on the number of branches has been provided, n has to be considered as endogenous in the econometric model. This holds even for markets where branching is regulated, since in this case as well branching usually follows market development to some extent.

If Equation (7) is rewritten as

$$\left(\frac{1}{p - mc} + \frac{3}{4} \cdot \frac{\delta x}{\delta p} \cdot \frac{1}{x}\right) \cdot m \cdot s - n = 0 \quad , \qquad (7')$$

it can easily be shown that assuming a linear demand, the left-hand side of (7) is strictly decreasing in p. Therefore, a high number of branches and a small circumference go along

with a low price for banking services. Moreover, the price depends positively on the marginal costs of banking services mc and on the translocation costs per distance unit m. Individual economic activity that enters Equation (7) via the demand function is assumed to decrease the price sensitivity of demand. Therefore, greater economic activity results in a steeper demand function and thus a higher price for banking services.

Since the output of banks is considered to be financial intermediation, the sum of gross income and net provision per unit of balance sheet total was chosen as a price variable. Individual economic activity was measured by the gross domestic product per capita (gdppc) and can be regarded as both a proxy for the opportunity costs per time unit and as a yardstick for the state of a country's development. On the one hand, the higher the gross domestic product per capita, the higher the opportunity costs per time unit which one can expect. On the other hand, a high state of development may go along with the emergence of time-saving technologies in banking, such as automated tellers, credit cards, and electronic banking. Thus, for the gdp per capita, the parameter's sign in the regression equation can not be derived unambiguously, although one might expect that its influence as a measure of economic activity will dominate.

The circumference s equals the number of customers times the distance between an arbitrary customer and his closest neighbour. In order to obtain a measure for the circumference of the circle of a country, the country's expanse was considered to be square and the customers to be equally distributed over this area. When the country's area is divided into squares, each with a single customer in its center, the length of one side of such a square equals the distance between a customer and his closest neighbour. The population of a country was chosen to represent the number of customers in that country. Since headquarters often are sales points as well, they can be regarded as branches in the sense of the underlying model. Therefore, the number of branches in the regression equation includes the number of banking institutions.

The parameters of the regression equation are allowed to be stochastic but are assumed not to vary systematically over time and across countries. The same is assumed to hold for the

marginal costs of financial intermediation (in real terms) which are equal to a parameter of the cost equation, the results of which are presented in table 3 below. Thus, marginal costs are assumed to add to the constant term in the regression equation.

The countries included in the analysis are Finland, Germany, Norway, and Spain.[4] The data are yearly observations from the period 1981-1989. In some of the countries included, this period was still characterized by interest rate regulations. In Norway, interest rates were not deregulated prior to 1985, while in Finland, restrictions on lending rates were in effect until 1986. In Spain, final deregulation took place in 1987.[5] The price competition limitations that had been imposed on the banking sector by regulatory intervention were accounted for by dummy-variables. Since the underlying problem is one of panel data, a generalized two-stage least squares estimator as proposed by Chamberlain (1982) was applied.[6] Table 1 displays the empirical results.

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[4]   These countries as well as Switzerland are the only countries for which a complete data set was available. Since the Suisse banking market can not be considered as mainly determined by domestic factors, it was not included. The data sources are listed in appendix 4.

[5]   For an overview on interest rate deregulation in these countries see Bröker (1989, pp. 156-160) as well as the Organisation for Economic Co-operation and Development (1989, pp. 63-109).

[6]   This estimator does not impose any a priori restrictions on the variance-covariance matrix of the error process and is asymptotically efficient in the class of limited information minimum distance estimators. See Chamberlain (1982, p. 27-28). The two-stage approach is necessary because of the endogeneity of the number of branches. In order to obtain an identified regression equation, an additional instrumental variable had to be included. As the only remaining exogenous variable in the model, the number of customers was chosen as an instrument, again measured in terms of the countries' populations. The regression equation was specified in a linear form.

Table 1: Dependent variable: price for financial intermediation[7]

regressors	expected sign	parameter	t-value
branches	(-)	$- 2.890 \cdot 10^{-6}$	$- 6.16$ *
circumference	(+)	$1.238 \cdot 10^{-3}$	5.30 *
gdp per capita[8]	(+)	$3.552 \cdot 10^{-6}$	3.11 *
dummy-variable (Finland)[9]		$1.093 \cdot 10^{-2}$	2.92 *
dummy-variable (Norway)[10]		$6.877 \cdot 10^{-3}$	2.84 *
dummy-variable (Spain)[11]		$- 3.289 \cdot 10^{-3}$	$- 1.17$
constant		$- 3.601 \cdot 10^{-2}$	$- 1.62$

number of observations: 36

R^2: 0.77; R^2 adjusted: 0.72

*: significant at the 1 percent level (two-tailed test).

Regulation and Welfare

Arguments in favour of banking regulation have been derived from the models of Hotelling (1929) and of Salop (1979). Both models can produce the result that when total demand is perfectly inelastic with respect to price and tranportation costs unregulated markets lead to excessive product differentiation. Applied to a banking market with free entry in which

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[7] Gross income plus provisions (net), divided by the average-year balance sheet total. The gross income equals the sum of the interest income (net) and the non-interest income (net).

[8] Gross domestic product per capita at 1985 prices and exchange rates (US dollars).

[9] The dummy-variable for Finland was set equal to one in the period 1981-1985 and equal to zero otherwise.

[10] Like the dummy-variable for Finland, the dummy-variable for Norway was set equal to one in the period 1981-1985 and equal to zero otherwise.

[11] The dummy-variable for Spain was set equal to one in the period 1981-1986 and equal to zero otherwise.

branching is not allowed (i.e. each bank has only one sales point), Salop's model predicts that the number of banks in the unregulated market will be twice as high as socially desirable.[12] This result is based on the transportation costs argument only and thus relies heavily on the assumption that there is a constant total demand. However, if total demand is allowed to vary with price and transportation costs, there are additional welfare effects to be taken into consideration.

In the following, the welfare implications of branching regulation will be analysed for a market such as that described in the preceding section in which branching is observed and total demand is endogenous. We will investigate how social welfare is affected if a regulatory agency restricts the number of branches to a level below the current market outcome. This initial number of branches could either be the result of an unregulated market or of existing branching regulations. After several theoretical conclusions have been drawn, they will be compared to the empirical findings.

The real-world case of regulation is usually characterized by restriction on the growth of the number of branches to a level that is lower than desired by the banks, rather than by compulsory reduction in the number of branches below an existing level. Since sunk costs do not exist in this model, the welfare effects of both kinds of regulatory intervention are equal to each other, apart from the customers' income effect. The reason for choosing the hpyothetical case of a reduction in the number of branches for the welfare analysis was that the growth of demand which banks wish to follow by establishing new branches can take many different forms.[13]

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[12] See Tirole (1998, p. 284).

[13] An important consequence of the existence of sunk costs in the real world is the asymmetry between the banks' branching behaviour in a growing market and in a shrinking market. Branches that were established as a result of a growth in demand might not be closed down if demand drops to the old level.

Since the banks are considered to be equal to each other, the regulatory intervention that is to be analysed will cause each of them to close down the same proportion of branches. At a given number of banks, the industry's profit changes by:[14]

$$
\frac{d\pi}{dn} = \frac{c \cdot p \cdot x}{n} \left[\varepsilon \left(1 + \eta \frac{p-mc}{p} \right) \right.
$$

$$
- \frac{1}{4} \eta \left(\frac{p-mc}{p} \right)^2 \cdot \frac{1}{1 + \frac{3}{4}\eta \frac{p-mc}{p}}
$$

$$
\left. - \mu \frac{f(n)}{c \cdot p \cdot x} \right]
$$

(8)

with

$$
\varepsilon := \frac{dp}{dn} \cdot \frac{n}{p} \quad .
$$

The elasticity ε equals the percentage price difference that results from Equation (7) if the number of branches is increased by one percent.

A reduction in the number of branches affects customers negatively both due to a price increase and an increase in transportation costs. The welfare change on the customers' part amounts to:[15]

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[14] For a more detailed treatment see appendix 2.

[15] See appendix 2 for details.

$$\frac{d\,CR}{d\,n} = -c \cdot x \cdot \frac{d\left(p + \dfrac{m \cdot s}{4\,n}\right)}{d\,n}$$

$$= \frac{c \cdot p \cdot x}{n}\left[-\varepsilon + \frac{1}{4} \cdot \frac{p - mc}{p} \cdot \frac{1}{1 + \dfrac{3}{4}\eta\,\dfrac{p - mc}{p}}\right].$$

(9)

If industry profit increases as a result of regulation, new firms might decide to enter the market. Since the number of branches is fixed, they would have to acquire branches from the incumbent banks. According to Equation (7), the industry's revenue does not change with the number of banks at a given number of branches, i.e. the revenue which newcomers can expect equals the revenue which the incumbent banks will have to give up. Therefore, there will only be entries if this leads to a decrease of the total industry costs, which requires a cost elasticity of branching higher than unity. But precisely in this case, marginal costs of branching are lower after the regulatory intervention than before and no entries that were unprofitable in the initial market equilibrium will be profitable now. Thus we can conclude that new entries will not occur. On the other hand, if industry profit decreases at a given number of banks, this decrease can serve as a lower bound for the actual change of industry profit because exits might occur. However, since the corresponding upper bound is zero, a reduction of the number of branches would unambiguously deteriorate social welfare in this case.

In order to obtain values for the price elasticity of demand, a linear demand function for banking services was estimated, the results of which are given in table 2. The regressors included are those which were found to be relevant for the customer's purchase decision as discussed above. Accordingly, the sign for the influence of the gross domestic product per capita is expected to correspond to that given in table 1.

Table 2: Dependent variable: financial intermediation per capita[16]

regressors	expected sign	parameter	t-value
price	(-)	$- 1.158 \cdot 10^{2}$	$- 1.74$ *
average distance[17]	(-)	$- 7.117 \cdot 10^{2}$	$- 2.61$ **
gdp per capita	(+)	$9.647 \cdot 10^{-4}$	5.73 **
constant		$1.018 \cdot 10$	2.93 **

number of observations: 36
R^2: 0.81; R^2 adjusted: 0.79
*: significant at the 5 percent level (one-tailed test)
**: significant at the 1 percent level (two-tailed test).

Moreover, a cost equation was estimated in accordance with the hypothesis that branching involves constant marginal costs, the results of which are given in table 3. The estimated parameters allow calculation of the price-cost margins as well as of the values of the cost elasticity of branching μ.[18]

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[16] Again, a minimum-distance estimator as proposed by Chamberlain (1982) was applied. According to the price definition used, the amount of financial intermediation was measured by the average-year balance sheet total. The figures had been deflated by the CPI (1985=100) and converted into US dollars at the 1985 exchange rates.

[17] Average distance between a bank branch and a customer. The values are arrived at by dividing the calculated circumferences (as used in the first regression equation) by the countries' populations.

[18] As can be shown, the estimated values for the price elasticity of demand and for the price-cost margin meet the sufficient condition for a positive number of branches as required by Equation (7).

Table 3: Dependent variable: total costs[19]

regressors	expected sign	parameter	t-value
financial intermediation	(+)	$9.178 \cdot 10^{-3}$	6.75 **
branches[20]	(+)	$1.514 \cdot 10^{-1}$	17.21 **
banks	(+)	$5.992 \cdot 10^{-1}$	2.31 **

number of observations: 36
R^2: 0.99; R^2 adjusted: 0.99
* : significant at the 1 percent level (one-tailed test).

When the estimated values are inserted into Equation (8),[21] it turns out that for all observations of Finland (except for the year 1981) and Germany, a lower number of branches would have meant higher industry profit given the number of banks in the market.[22] Finland and Germany are countries which have pursued a liberal branching policy for decades.[23] Since for both countries the loss of customers' surplus is greater than the increase in industry profit, social welfare would have been higher with a lower number of branches. However, an interpretation of these results in terms of policy recommendations is only relevant for the periods during which the countries in question are characterized by unregulated price

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[19] Again, a minimum-distance estimator as proposed by Chamberlain (1982) was applied. Total costs were measured by the operating expenses, deflated by the CPI (1985=100) and converted into US dollars at the 1985 exchange rates.

[20] The number of branches does not include the number of banking institutions.

[21] According to the price definition used, the customers' expenses for financial intermediation were measured by the sum of the industry's gross income and the provisions (net). The values had again been deflated by the CPI (1985=100) and converted into US dollars at the 1985 exchange rates.

[22] The figures are given in appendix 2.

[23] See Bröker (1989, p. 194). In Germany, bank branching was fully liberalised in 1958.

competition. While this holds for Germany over the whole sample period, interest rates in Finland have been deregulated during the year 1986.[24]

For Norway, which liberalised branching in 1983 and deregulated interest rates in 1985, industry profit would have been higher with fewer branches in all the periods covered by the sample, except for the years 1981, 1983, and 1984. In Spain, branching was deregulated in 1985 while interest rates were not fully liberalised prior to 1987. For the period 1981-1984, the empirical results for Spain show that for a given number of banks, industry profit would have been lower with fewer branches while the opposite result holds for the period 1985-1989. However, it turns out that also for Norway and Spain, the customers' loss of surplus dominates the total welfare effect for the whole period examined.

Conclusions

In a model of spatial competition, the welfare effects of branch banking regulation were investigated and empirical results were presented from the period 1981-1989 for four European countries. It was shown that for all observations in the sample, fewer branches would have been socially undesirable. Moreover, the frequently claimed hypothesis that a positive relationship between the number of branches and the price for financial intermediation exists, was rejected.

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[24] See Bröker (1989, p. 194) as well as Organisation for Economic Co-operation and Development (1989, pp. 108-109).

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Appendix 1:   Second-Order Condition

The second-order derivative of the profit function of bank k reads:

$$\frac{\delta^2 \pi_k}{\delta p_k^2} = n_k \cdot c \left[-2 \frac{1}{m \cdot s} x \left(1 + \eta_k \frac{p_k - mc_k}{p_k} \right) \right.$$

$$\left. + 2 \frac{1}{n} \frac{\delta x}{\delta p_k} + \frac{1}{n} (p_k - mc_k) \frac{\delta^2 x)}{\delta p_k^2} \right] . \qquad (a1\text{-}1)$$

Since the sum of the price and tranport costs, $p_k + 0.25(p_j - p_k + ms/n)$, is linear in the price p_k, this holds for individual demand as well. Consequently, the second-order derivative $\delta^2 x / \delta p_k^2$ vanishes. Since the first-order condition demands that the term $1 + \eta_k (p_k - mc_k)/p_k$ is positive, the second-order condition holds.

Appendix 2:   Regulation, Industry Profit, and Customers' Surplus

The industry profit reads:

$$\pi = (p - mc) \cdot c \cdot x(p,e) - f(n) \qquad (a2\text{-}1)$$

with $f(n) \equiv n_k f(n_k)$. The reaction of an exogenous change in the number of branches amounts to:

$$\frac{d\pi}{dn} = \frac{dp}{dn} c \cdot x + (p - mc) \cdot c \; \frac{dx}{d\left(p + \dfrac{m \cdot s}{4n}\right)} \cdot \frac{\delta\left(p + \dfrac{m \cdot s}{4n}\right)}{\delta n}$$

$$-\frac{df(n)}{\delta n}$$

(a2-2)

$$= \frac{dp}{dn} c \cdot x + (p - mc) \cdot c \; \frac{dx}{dp} \cdot \left(\frac{dp}{dn} - \frac{m \cdot s}{4n^2}\right) - \frac{df(n)}{\delta n} \quad .$$

When Equation (7) is solved for $ms/4n^2$ and inserted into (a2-2), Equation (8) follows after some transformations.

The change of an individual customer's surplus as a result of a change in the sum of the price and transport costs is given by -x. Thus, for a change in the number of branches, it amounts to:

$$-x \cdot \frac{\delta\left(p + \dfrac{m \cdot s}{4n}\right)}{\delta n} \quad .$$

(a2-3)

After multiplying (a2-3) by the number of customers and transforming it along the lines of Equation (a2-2), Equation (9) results.

The following four tables display change in the industry profit, customers' surplus, social welfare, and social welfare per capita if the number of branches had been lower by one unit in the sample period.

Table a2-1: Difference in Social Welfare if the Number of Branches in Finland had been lower by One Unit (US Dollars at 1985)

Year	Industry profit	Customers' surplus	Social welfare	Social welfare per capita
1981	$-1.93 \cdot 10^4$	$-3.31 \cdot 10^5$	$-2.97 \cdot 10^5$	$-7.31 \cdot 10^{-2}$
1982	$1.70 \cdot 10^4$	$-3.25 \cdot 10^5$	$-2.57 \cdot 10^5$	$-6.38 \cdot 10^{-2}$
1983	$1.04 \cdot 10^5$	$-2.85 \cdot 10^5$	$-1.47 \cdot 10^5$	$-3.73 \cdot 10^{-2}$
1984	$1.39 \cdot 10^5$	$-2.94 \cdot 10^5$	$-1.31 \cdot 10^5$	$-3.17 \cdot 10^{-2}$
1985	$1.33 \cdot 10^5$	$-3.47 \cdot 10^5$	$-1.73 \cdot 10^5$	$-4.37 \cdot 10^{-2}$
1986	$2.14 \cdot 10^5$	$-3.34 \cdot 10^5$	$-9.86 \cdot 10^5$	$-2.45 \cdot 10^{-2}$
1987	$2.25 \cdot 10^5$	$-3.96 \cdot 10^5$	$-1.36 \cdot 10^5$	$-3.46 \cdot 10^{-2}$
1988	$2.39 \cdot 10^5$	$-4.92 \cdot 10^5$	$-2.04 \cdot 10^5$	$-5.13 \cdot 10^{-2}$
1989	$3.43 \cdot 10^5$	$-4.45 \cdot 10^5$	$-8.38 \cdot 10^5$	$-2.06 \cdot 10^{-2}$

Table a2-2: Difference in Social Welfare if the Number of Branches in Germany had been lower by One Unit (US Dollars at 1985 Prices)

Year	Industry profit	Customers' surplus	Social welfare	Social welfare per capita
1981	$1.91 \cdot 10^6$	$-2.24 \cdot 10^6$	$-3.36 \cdot 10^5$	$-5.45 \cdot 10^{-3}$
1982	$1.85 \cdot 10^6$	$-2.30 \cdot 10^6$	$-4.55 \cdot 10^5$	$-7.38 \cdot 10^{-3}$
1983	$1.86 \cdot 10^6$	$-2.39 \cdot 10^6$	$-5.22 \cdot 10^5$	$-8.49 \cdot 10^{-3}$
1984	$2.00 \cdot 10^6$	$-2.45 \cdot 10^6$	$-4.50 \cdot 10^5$	$-7.35 \cdot 10^{-3}$
1985	$2.14 \cdot 10^6$	$-2.59 \cdot 10^6$	$-4.44 \cdot 10^5$	$-7.27 \cdot 10^{-3}$
1986	$2.38 \cdot 10^6$	$-2.80 \cdot 10^6$	$-4.25 \cdot 10^5$	$-6.96 \cdot 10^{-3}$
1987	$2.64 \cdot 10^6$	$-2.99 \cdot 10^6$	$-3.42 \cdot 10^5$	$-5.60 \cdot 10^{-3}$
1988	$2.87 \cdot 10^6$	$-3.13 \cdot 10^6$	$-2.61 \cdot 10^5$	$-4.26 \cdot 10^{-3}$
1989	$2.93 \cdot 10^6$	$-3.28 \cdot 10^6$	$-3.58 \cdot 10^5$	$-4.26 \cdot 10^{-3}$

Table a2-3: Difference in Social Welfare if the Number of Branches in Norway had been lower by One Unit (US Dollars at 1985 Prices)

Year	Industry profit	Customers' surplus	Social welfare	Social welfare per capita
1981	$-6.83 \cdot 10^{4}$	$-4.21 \cdot 10^{5}$	$-4.89 \cdot 10^{5}$	$-1.19 \cdot 10^{-1}$
1982	$1.08 \cdot 10^{4}$	$-3.82 \cdot 10^{5}$	$-3.71 \cdot 10^{5}$	$-9.02 \cdot 10^{-2}$
1983	$-4.32 \cdot 10^{4}$	$-4.56 \cdot 10^{5}$	$-4.99 \cdot 10^{5}$	$-1.21 \cdot 10^{-1}$
1984	$-5.93 \cdot 10^{3}$	$-4.70 \cdot 10^{5}$	$-4.76 \cdot 10^{5}$	$-1.15 \cdot 10^{-1}$
1985	$8.98 \cdot 10^{4}$	$-4.52 \cdot 10^{5}$	$-3.62 \cdot 10^{5}$	$-8.71 \cdot 10^{-2}$
1986	$1.11 \cdot 10^{5}$	$-5.25 \cdot 10^{5}$	$-4.14 \cdot 10^{5}$	$-9.93 \cdot 10^{-2}$
1987	$1.98 \cdot 10^{5}$	$-4.54 \cdot 10^{5}$	$-2.56 \cdot 10^{5}$	$-6.11 \cdot 10^{-2}$
1988	$1.42 \cdot 10^{5}$	$-5.86 \cdot 10^{5}$	$-4.44 \cdot 10^{5}$	$-1.05 \cdot 10^{-1}$
1989	$7.71 \cdot 10^{3}$	$-7.40 \cdot 10^{5}$	$-7.32 \cdot 10^{5}$	$-1.73 \cdot 10^{-1}$

Table a2-4: Difference in Social Welfare if the Number of Branches in Spain had been lower by One Unit (US Dollars at 1985 Prices)

Year	Industry profit	Customers' surplus	Social welfare	Social welfare per capita
1981	$-5.72 \cdot 10^5$	$-1.11 \cdot 10^6$	$-1.68 \cdot 10^6$	$-4.45 \cdot 10^{-2}$
1982	$-3.59 \cdot 10^5$	$-9.94 \cdot 10^5$	$-1.35 \cdot 10^6$	$-3.59 \cdot 10^{-2}$
1983	$-6.39 \cdot 10^5$	$-1.22 \cdot 10^6$	$-1.86 \cdot 10^6$	$-4.86 \cdot 10^{-2}$
1984	$-1.70 \cdot 10^5$	$-9.60 \cdot 10^5$	$-1.13 \cdot 10^6$	$-2.95 \cdot 10^{-2}$
1985	$4.32 \cdot 10^4$	$-8.98 \cdot 10^5$	$-8.55 \cdot 10^5$	$-2.22 \cdot 10^{-2}$
1986	$2.14 \cdot 10^4$	$-9.18 \cdot 10^5$	$-8.97 \cdot 10^5$	$-2.32 \cdot 10^{-2}$
1987	$1.75 \cdot 10^5$	$-8.92 \cdot 10^5$	$-7.17 \cdot 10^5$	$-1.85 \cdot 10^{-2}$
1988	$3.37 \cdot 10^4$	$-1.02 \cdot 10^6$	$-9.90 \cdot 10^5$	$-2.55 \cdot 10^{-2}$
1989	$2.13 \cdot 10^5$	$-1.01 \cdot 10^6$	$-7.93 \cdot 10^5$	$-2.04 \cdot 10^{-2}$

Appendix 3: Price-Cost Margin, Price Elasticity of Demand (η), and the Sensitivity of the Price towards Branching (ε)

The price-cost margins presented in table a3-1 were calculated on the basis of the estimated parameter for the marginal costs of financial intermediation as given in table 3 in the text.

Table a3-1:   Price-Cost Margins of Financial Intermediation

	Mean	Max	Min	last period (1989)	standard deviation
Finland	0.80	0.83	0.75	0.75	0.02
Germany	0.72	0.76	0.68	0.71	0.02
Norway	0.83	0.85	0.81	0.85	0.01
Spain	0.84	0.85	0.83	0.84	0.00

The following two tables display the estimated values of the price-elasticity of demand (η) and the percentage price difference that results from a one-percent difference in the number of branches (ε).

**Table a3-2:**   Price Elasticity of Demand for Financial Intermediation (η)

	Mean	Max	Min	Last period (1989)	Standard deviation
Finland	-0.59	-0.25	-0.97	-0.25	0.24
Germany	-0.28	-0.20	-0.35	-0.21	0.06
Norway	-0.66	-0.43	-0.93	-0.56	0.18
Spain	-1.16	-0.93	-1.39	-0.93	0.17

Table a3-3:   Percentage Price-Difference as a Result of a One-Percent Difference in the Number of Branches (ε)

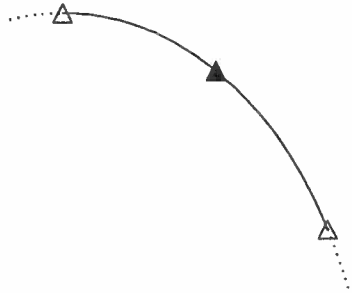|	Mean	Max	Min	Last period (1989)	Standard deviation
Finland	-0.22	-0.19	-0.27	-0.27	0.03
Germany	-3.61	-2.97	-4.45	-3.99	0.49
Norway	-0.12	-0.09	-0.14	-0.09	0.01
Spain	-1.64	-1.43	-1.83	-1.79	0.14

Appendix 4: Data Sources

- Consumer Price Index: Statistisches Bundesamt (1990a)
- Country size: Statistisches Bundesamt (1990b)
- Data on national banking industries: Organisation for Economic Co-operation and Development (1991a)
- Gross domestic product per capita at the 1985 price levels and exchange rates (US dollars): Organisation for Economic Co-operation and Development (1991d)
- Population: Organisation for Economic Co-operation and Development (1991c)
- 1985 exchange rates (units per US dollar): Organisation for Economic Co-operation and Development (1991b)

Figures

Figure 1: The Circular Country
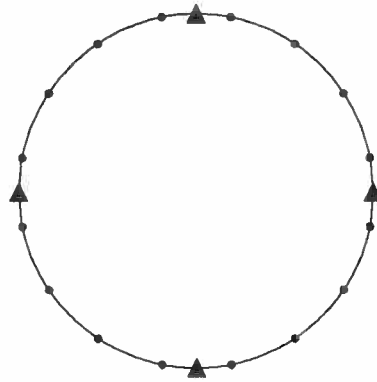
▲ : Branch

● : Customer

Figure 2: Relevant Market of a Single Firm

▲ : Bank branch

△ : Competitors