Bank Size, Specialization and Efficiency in the Netherlands: 1992-1998

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Abstract

In this paper we assess cost and profit efficiency for a sample of banks operating on the Dutch banking market in the period 1992-1998, using stochastic frontier efficiency analysis. Over the entire period, the cost-efficient frontier deteriorates but mean cost efficiency and profit efficiency are relatively stable at the industry level. No evidence is found for trend changes in mean efficiency due to the previous consolidation and deregulation. However, whereas all banks appear to perform rather similarly in terms of cost efficiency, in terms of profit efficiency large general banks and specialized banks clearly outperform small, general banks. Large banks appear to benefit from sheer size and perhaps market power. This is evidence in favor of the large banks behaving collusively and capturing oligopoly rents. Specialized banks operate savely and efficiently in what might be termed a niche market.

1 Introduction

The 1990s have been witness to a series of related yet separately distinguishable global trends in the provision of financial services. These trends include disintermediation, increased competition, internationalization, and deregulation¹. In the European Union, the liberalization of the market for financial institutions [FIs] is assumed to have led to an increase in competition in this period². After the First Banking Coordination Directive of 1977, the EU White Paper of 1985 and the Second Banking Coordination Directive of 1988, the single market for financial services was established on January 1,

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¹For an overview, see Berger (1998).

²In this paper the terms "financial institutions" and "banks" are used interchangeably.

1993. In some EU member countries, this has also led to a considerable consolidation process. As (international) competition increases at a rapid pace, both from banks and non-bank financial institutions, cost efficiency becomes a prerequisite for survival (Allen and Rai (1996) and Berger, Hunter, and Timme (1993)). At the same time, in the battle over increasing market share in these consolidating markets, profitability is the measure of success of individual firms' survival strategies. Clearly, assessing the impact of bank consolidation and deregulation requires an analysis of both cost efficiency and profit efficiency.

Developments in the Dutch banking market have preceded those in other EU countries. The liberalization and consolidation trends currently reshaping many banking markets have already taken place in the Netherlands at the beginning of the 1990s. In the Dutch banking market, concentration in the period 1989-1992 doubled to approximately 80% [C_3 ratio] as a result of a series of mega-mergers. Also, many foreign banks operate in the Netherlands. The Netherlands therefore serve as an excellent example to study the efficiency effects of the liberalization and consolidation trends taking place elsewhere in the EU.

In this paper, we review the evidence for the Netherlands in order to estimate and analyze the effects of liberalization and consolidation on bank efficiency, distinguishing between cost efficiency and profit efficiency. We use stochastic frontier efficiency analysis [SFA]. The SFA methodology allows for an identification and quantification of the sources of inefficiency. It yields a best practice frontier as well as individual firm performance measures benchmarked against this frontier. We apply the analysis to a sample of banks operating on the Dutch banking market in the period 1992-1998. During this period no new major institutional changes occurred in the Dutch banking market. Therefore it provides an appropriate sample to investigate the consequences of the preceding consolidation and deregulation.

First, we analyze whether shifts have occurred in the efficient cost and profit frontiers using a linear and quadratic trend term. In addition, we check for trend changes in average cost efficiency and average profit efficiency between 1992 and 1998. This evidence sheds light on aggregate efficiency developments during this period. We conclude that the cost frontier deteriorates between 1992 and 1996 and then stabilizes, while the profit frontier remains stable over the full sample period. Average cost and profit efficiency relative to the frontier are approximately constant too. Second, we investigate whether the Dutch financial landscape after the consolidation and deregulation wave of the early nineties has is characterized by efficiency differences amongst FIs. To this purpose we test for the equality of cost and profit efficiency between different types of FIs and between FIs of different size. We find that all banks appear to perform rather similarly in terms of cost efficiency. However, in terms of profit efficiency large banks and specialized banks clearly outperform small, general banks.

The remainder of this paper is organized as follows. In section 2, a short review of the literature on measuring efficiency is presented. Next, in section 3 we explain the stochastic frontier models used to estimate and compare cost and profit efficiency. In section 4 the Dutch banking market is introduced, with emphasis on the causes and consequences of consolidation and liberalization trends. Also, we present our data set. Section 5 contains our estimation results. In section 5.1, we estimate and compare different versions of cost and profit functions. We use the preferred models to discuss level shifts in the efficient frontiers and average efficiency scores. In section 5.2, we test for the equality of cost and profit efficiency between different types of FIs. We conclude in section 6.

2 Bank Efficiency

In this section, we introduce and discuss the different types of efficiency currently in use in the literature. We pay specific attention to the problems related to measuring the efficiency of banks. In general, efficiency refers to the difference between observed and optimal values of inputs, outputs and input/output mixes³. Empirical research thereby seeks to measure how efficiently a firm produces outputs with its inputs.

For that, a number of efficiency concepts are widely employed in the literature. Most important are scale efficiency, scope efficiency, economic efficiency and X-efficiency. In cost and profit models, scale efficiency refers to those input/output quantities at which average costs are minimized by moving on the production curve, i.e. the efficient frontier (Berger, Hunter, and Timme (1993)). Scope efficiency measures the extent to which the joint or the single production of an output bundle is optimal.

The concept of economic efficiency extends this approach to incorporate prices⁴. As explained by Lovell (1993) and Coelli, Prasada Rao, and Battese (1998), the inclusion of input and output prices eliminates the premise that profit maximization or cost minimization are appropriate and equivalent assumptions reflecting a competitive market. As a consequence, profit maximization is no longer automatically the dual of cost minimization and firms may perform significantly different in both aspects.

Finally, the concept of X-efficiency evaluates the implementation of an existing production plan at given prices and technologies and is therefore

³See Lovell (1993), p. 4 and also Coelli, Prasada Rao, and Battese (1998).

⁴Economic efficiency is the sum of technical and allocative efficiency. Technical efficiency is a measure of a firm's distance from the frontier at given prices. Allocative efficiency is the extent to which a firm is able to use inputs and outputs in optimal proportions, given prices and technology (Atkinson and Cornwell (1994) and Berger and Mester (1997)).

also referred to as managerial efficiency. Berger, Hunter, and Timme (1993) note that it comprises the economic efficiency of any single firm minus the scale and scope efficiency effects. Since it allows for sub-optimal (beneath-frontier) operations and incorporates relative prices into the analysis, it is considered superior to the concepts of scale and scope economies. According to Berger, Hunter, and Timme (1993) and Berger and Humphrey (1991) the significance of scale and scope inefficiencies (amounting to 5 percent) is less important in the banking industry than X-inefficiencies (20-25 percent)⁵. We therefore focus on X-efficiency and introduce a stochastic frontier model to measure it.

3 Frontier Models

Stochastic frontier models go back to Färe and Lovell (1978), Greene (1980), Jondrow, Knox Lovell, Materov, and Schmidt (1982), and more recently Battese and Coelli (1988). In this section, we start by briefly discussing the intermediation approach to banking that we employ. Next, we introduce our cost-minimization model and our profit-maximization model. Finally, we present the specification of the models to be estimated.

3.1 Bank production, costs and profits

The specification of inputs to and outputs of bank production is part of an ongoing debate. On the one hand, the production approach distinguishes labor and physical capital as inputs and numbers of processed documents or transactions as output. In the literature, consensus exists that it is mostly appropriate for bank branches with low autonomy in loan policy (see also Ferrier and Lovell (1990)). On the other hand, the intermediation approach starts from the traditional core function of financial institutions and takes deposits as inputs and defines loans and investments as output⁶. Since we are interested in the economic viability and the performance of the entire banking firm, we will use the intermediation approach in the remainder of this analysis. Note that both approaches fail to incorporate the management

⁵See also Berger and Humphrey (1997) and Molyneux, Altunbas, and Gardener (1997). Earlier work by Baker and Bresnahan (1985) and Mester (1987) as well as work by Winton (1996) on the impact of product differentiation already foreboded this statement. In this paper, we concentrate on X-efficiency not only because it appears to be quantitatively more important in the banking industry, but also because the conceptual notion is more appealing.

⁶We refer to Freixas and Rochet (1997), Ferrier and Lovell (1990) and Berger and Humphrey (1997) for an overview of the debate.

of risk, information processing and the solution of agency problems arising due to the differences between loans and deposits and the separation between management and ownership. Potential solutions to these shortcomings may be a different formulation of the constraint under which banks solve their minimization and maximization problems, respectively. An example of the incorporation of risk management is the inclusion of the level of equity in bank production⁷. In funding loans, equity may be used as an alternative instead of deposits. Clearly, this would have an impact on both costs and profits. Furthermore, Mester (1996) argues that the inclusion of equity in the analysis may account for differing risk attitudes of bank managers, since higher levels of equity reduce the risk of default all else being equal. Finally, Berger and Mester (1997) mention the larger dependence of huge banks on debt financing as a reason to include equity. We will therefore include equity as an additional explanatory control variable.

In order to evaluate the efficiency of banks, it is helpful to consider the underlying objectives and constraints banks are facing. We distinguish between cost minimization on the one hand and profit maximization on the other. First, we discuss minimization of a cost function, where cost-inefficiency originates from sub-optimal input quantities given input prices, output quantities and available equity. Thereafter, the case of maximization of a profit function is presented, where profit-inefficiency measures foregone profits due to a suboptimal choice of output quantities given output prices (or suboptimal output prices given quantities). In perfectly competitive markets, the two approaches should yield identical results. However, in the case of imperfect competition market power might lead to a profit efficient bank that is inefficient in terms of costs or vice versa. The combined use of both cost and profit optimization will therefore shed light on the character of inefficiencies.

3.2 Cost minimization

The minimization problem is set up as follows⁸. Let a cost function C consist of the costs incurred due to buying input quantities x at price w . Assuming that banks are price takers in possibly imperfectly competitive input markets, factor prices w are exogenous. In addition it is assumed that output quantities y are chosen subject to exogenously determined product prices as banks are assumed to operate in perfectly competitive output markets. All

⁷See Hughes and Mester (1993), Mester (1991, 1992).

⁸Estimating cost functions in order to determine the efficiency of financial institutions is the traditional approach in the literature. Applications of this concept to European banking data are Altunbas and Chakravarty (1998), Battese, Heshmati, and Hjalmarsson (1998) and Lang and Welzel (1999).

costs are treated as variable costs. Banks minimize their objective function under the restrictions imposed by the transformation function.

$$\underset{x}{Min} = w'x \text{ s.t. } T(x, y, z) = 0 \quad (1)$$

where w and x are vectors, $T(x, y, z)$ is a so-called transformation function and z denotes equity. The corresponding Lagrangian function can be formulated as:

$$LC = w'x - \lambda T(\bullet) \quad (2)$$

Taking first derivatives and solving yields the conditional factor demand equations, or, in terms of Hughes and Mester (1994), the restricted input requirement set:

$$x_i^* = x_i^*(y, w, z) \quad (3)$$

The minimum cost level is obtained by substituting into the cost function:

$$TC^* = w'x_i^*(y, w, z) = \tilde{c}(y, w, z) \quad (4)$$

The conditional demand for inputs depends on the amount of output sold at prevailing prices, the given factor prices in input markets and the level of equity in the production period.

3.3 Profit maximization

Humphrey and Pulley (1997) introduce a standard profit function, under the assumption that banks operate in perfectly competitive input and output markets. Hence, banks choose optimal input and output quantities, dependent on given input and output prices. However, doubts have been raised in the literature concerning the underlying assumption of perfectly competitive output markets. Humphrey and Pulley (1997) therefore also develop an alternative profit function. Here, banks are still assumed to face perfectly competitive input markets. However, they are active on imperfect output markets, which offer some scope for price differentiation. Hence, banks have little opportunity to influence output quantities but instead can negotiate prices and fees in a more flexible manner. The extent to which they can influence prices depends on the given output quantities at the time of decision, the given input prices and other factors influencing their ability to set prices. In addition, the alternative profit function may account for quality differences in output and for scale biases.

In this model, banks maximize profits subject to both a technology constraint and the so-called pricing opportunity set. The latter reflects a bank's

assessment of its competitive position as well as its assessment of the willingness of customers to pay the prices the bank wishes to charge. The maximization problem then becomes:

$$\underset{p,x}{Max} \pi = p'y - w'x \text{ s.t. } T(x,y) = 0 \text{ and } H(p,y,w,z) = 0 \quad (5)$$

Here, $H(\bullet)$ denotes the pricing opportunity set. The Lagrangian system can be written as:

$$L\pi = p'y - w'x - \lambda T(\bullet) - \theta H(\bullet) \quad (6)$$

Solving simultaneously for p and x gives the optimal output prices and input quantities as:

$$p^* = p^*(y,w,z) \quad (7)$$

$$x^* = x^*(y,w,z) \quad (8)$$

Substitution then yields the optimal profit level:

$$\pi = p^*(y,w,z)'y - w'x^*(y,w,z) = \tilde{\pi}(y,w,z) \quad (9)$$

The appealing feature of this profit function is that it allows for market imperfections on the output side. Additionally, output prices, which are subject to severe measurement problems according to Berger and Mester (1997) and Vander Venet (1998), are not required for the empirical analysis.

3.4 Specification

Now we turn to the implementation of these results for efficiency benchmarks of the banking industry. For the estimation of the cost and alternative profit frontier functions a translog functional form is chosen with three inputs and three outputs. This form has been employed widely and has proven to allow for the necessary flexibility when estimating the frontier function⁹. The cost

⁹Berger and Mester (1997) have compared the translog to the alternative Fourier Flexible Form. Despite the latter's added flexibility, the difference in results between both methods appears to be negligible. Moreover, Swank (1996) finds supportive evidence for stability of the multiproduct translog model for a comparable data set concerning the Dutch banking industry.

frontier function for bank k in period t is then represented by:

$$\begin{aligned}
\ln TC_{kt}(y, w, z) = & a_0 + \sum_{i=1}^3 a_i \ln y_{ikt} + \frac{1}{2} \sum_{i=1}^3 \sum_{j=1}^3 a_{ij} \ln y_{ikt} y_{jkt} + \\
& \sum_{i=1}^3 b_i \ln w_{ikt} + \frac{1}{2} \sum_{i=1}^3 \sum_{j=1}^3 b_{ij} \ln w_{ikt} \ln w_{jkt} + c_0 \ln z_{kt} \\
& + \frac{1}{2} c_1 (\ln z_{kt})^2 + \sum_{i=1}^3 \sum_{j=1}^3 d_{ij} \ln w_{ikt} \ln y_{jkt} + \\
& \sum_{i=1}^3 e_i \ln w_{ikt} \ln z_{kt} + \sum_{i=1}^3 f_i \ln y_{ikt} \ln z_{kt} + v_{kt} + \nu_{kt}
\end{aligned} \tag{10}$$

This 3-input/3-output model will be referred to as model 1a. Here, v and ν are the inefficiency and random error term, respectively. For the profit function, the left-hand side is replaced with net profits and the inefficiency term is $-v$. This formulation will be referred to as model 2a.

To allow for the impact of consolidation and deregulation on the efficient frontier, we alternatively include a linear and quadratic trend term as well as trend interaction terms. These will be referred to as models 1b and 2b, respectively model 1c and 2c¹⁰. The extended cost frontier referred to as model 1c takes the form¹¹:

$$\begin{aligned}
\ln TC_{kt}(y, w, z) = & [\text{model 1a}] + g_o t + \frac{1}{2} g_1(t)^2 + \sum_{i=1}^3 d_i \ln w_{ikt} t \\
& + \sum_{i=1}^3 h_i \ln y_{ikt} t + c_2 \ln z_{kt} t + v_{kt} + \nu_{kt}
\end{aligned} \tag{11}$$

where $[\text{model 1a}] + g_o t + \frac{1}{2} g_1(t)^2$ is referred to as model 1b. As pointed out by Beattie and Taylor (1985), duality requires a number of restrictions to be imposed a priori in order to estimate indirect cost and profit functions. Following Lang and Welzel (1999), the required symmetry and linear homogeneity in input prices is ensured by imposing the following restrictions, respectively:

$$a_{ij} = a_{ji} \forall i, j, \quad b_{ij} = b_{ji} \forall i, j, \quad \sum_{i=1}^3 b_i = 1, \quad \sum_{j=1}^3 b_{ij} = 0 \forall i,$$

¹⁰Lang (1996) and Altunbas, Goddard, and Molyneux (1999) include such trend terms to measure the rate of technological change. Obviously, these trend terms may capture pure technological change as well as effects of consolidation and deregulation. We only estimate the net effect and are unable to determine the relative contribution of each factor.

¹¹The alternative profit function again is similar except for the before-mentioned adaptations.

$$\sum_{i=1}^3 b_{ij} = 0 \quad \forall j, \quad \sum_{i=1}^3 e_i = 0, \quad \sum_{i=1}^3 d_i = 0$$

In the empirical estimation, linear homogeneity in input prices is imposed by normalizing the dependent variable (TC) and all factor price variables (w) before taking logarithms¹². Each of the variables is included as a ratio relative to one of the factor price variables. Here, the price of labor has been chosen. Note that this imposes homogeneity of degree one in factor prices only. To impose constant returns to scale, normalization of the output variables would be required too.

Empirically, this implies only two coefficients (b_i) for the input factor price variables are obtained while the third one can be inferred from the imposed restriction. The random error term ν_{kt} is assumed i.i.d. with $\nu_{kt} \sim N(0, \sigma_\nu^2)$ and independent of the explanatory variables, see Aigner and Schmidt (1977) and Coelli (1996). The inefficiency term v_{kt} is i.i.d. with $v_k \sim |N(\mu, \sigma_v^2)|$ and it is independent of ν_{kt} . It is drawn from a non-negative distribution truncated at μ instead of zero. For the cost model, let $\varepsilon_{kt} = v_{kt} + \nu_{kt}$. A firm specific cost efficiency estimate of bank k at time t is given by the mean of the conditional distribution of v_{kt} given ε_{kt} and is defined as:

$$\text{Cost EFF}_{kt} = E[\exp(v_{kt})|\varepsilon_{kt}] \quad (12)$$

This measure takes on a value between 1 (fully efficient) and ∞ and indicates how close a bank's costs conditional on its output, input prices and equity level are to the cost a fully efficient bank would incur under the same conditions. For the profit model, $\varepsilon_{kt} = \nu_{kt} - v_{kt}$. Firm specific profit efficiency estimate is again given by the mean of the conditional distribution of v_{kt} given ε_{kt} and is defined as:

$$\text{Profit EFF}_{kt} = E[\exp(-v_{kt})|\varepsilon_{kt}] \quad (13)$$

which takes on a value between 0 and 1, where 1 indicates a fully efficient bank.

The frontier functions are estimated through maximum likelihood methods. For this purpose the computer program FRONTIER 4.1 by Coelli (1996), is used. Following the parameterization outlined in Coelli (1996), the terms σ_v^2 and σ_ν^2 are replaced by $\sigma^2 = \sigma_v^2 + \sigma_\nu^2$ and $\gamma = \sigma_v^2 / (\sigma_v^2 + \sigma_\nu^2)$. The parameter γ represents the share of inefficiency in the overall residual variance and ranges between 0 and 1. A value of 1 suggests the existence of a deterministic frontier¹³, whereas a value of 0 can be seen as evidence in favor of a standard OLS estimation. In the latter case, no structural inefficiency exists.

¹²See Coelli, Prasada Rao, and Battese (1998).

¹³We note that this is not the same as a DEA model, because of restrictions on the shape of the frontier and the distribution of the inefficiency term.

4 Dutch Banking Market

The Dutch banking market has long been a forerunner in the EU with respect to both liberalization and consolidation¹⁴. De Leeuw (1996) argues that the new 'Wet Toezicht Kredietwezen'¹⁵ of 1978 already led to significant changes in the Dutch banking market. The new law spurred desegregation and increased competition between banks, non-bank financial institutions and insurance companies, which could now more easily apply for a full banking license. Entry into the market traditionally reserved for banks increased and a merger wave followed. Overall, market concentration increased. The next revision of the Wet Toezicht Kredietwezen in 1992 continued this liberalization trend and brought Dutch legislation in line with EU directives. This ongoing deregulation and liberalization of the Dutch market for financial services was expected to increase competition, not only internally but also from abroad. The presence of an increasing number of foreign banks (notably Japanese and German) in the Dutch banking market is witness of this development. Nevertheless, competition in the Dutch banking market is in many ways still limited by the Dutch borders, making it a market in its own right [see Huizinga (1998)]. An example is given by Fase (1997), who finds that cross-border substitutability between domestic and foreign deposits is almost non-existent¹⁶. The Netherlands is thus faced with a banking market that is open and relatively deregulated, but at the same time still limited in terms of geographic scope of competition¹⁷.

In anticipation of increasing European competition, two mergers around 1990 created Dutch financial giants ABN AMRO and ING¹⁸. The merger leading to ING Group was the first case of so-called 'Bancassurance': the combination of a universal bank and an insurance company [Nationale Nederlanden]. In 1990, the Fortis conglomerate was set up in the Netherlands and Belgium as a much looser form of the same principle. As a consequence

¹⁴For comparative European efficiency studies, see Bikker (1997), Molyneux, Altunbas, and Gardener (1997), Altunbas, Molyneux, and Thornton (1997) and Allen and Rai (1996). Altunbas, Goddard, and Molyneux (1999) try to separate scale and scope economies as well as X-efficiency from what is called 'pure technical change'. The latter is defined as the efficiency change that is solely attributable to technological progress.

¹⁵= Law on the Supervision of Credit Institutions. See, De Leeuw (1996), ch. 4.

¹⁶Fase (1997) finds a substitution elasticity of 0.22 (SD = 0.07) for the period 1984-1994 (with M2 as a denominator for the share of cross-border deposits).

¹⁷Moverover, both the new firms entering the market and the competition from non-bank financial institutions that follow the liberalization trend focus on the supply of specialized financial products. The traditional intermediary function that still makes up the bulk of the general banks (commercial banks and cooperative banks) does not face the same competitive threat.

¹⁸The ABN AMRO merger took place in 1990. ING Group was formed in 1989 through a merger of NMB and Postbank with Dutch insurance company Internationale Nederlanden. In addition, in 1991 Bank Mees en Hope and Pierson merged to form MeesPierson (effective in 1992).

of these developments, the market concentration rate [C_3 ratio] jumped from slightly above 40% to more than 80% in a period of three years and is currently the highest in the European Union. The number of banks is relatively stable, although the big players in the market have all indicated their desire to further expand. The reason behind a new merger trend would be the wish to become a European and/or global player. Consequently, future merger candidates might have to be found across the border.

Type	Frequency	%
General		
Commercial Bank	32	69.6
Cooperative Bank	2	4.3
Specialized		
Investment Bank/Securities House	5	10.9
Real Estate / Mortgage Bank	4	8.7
Credit Institutions	3	6.5
Total	46	100

Table 1: Typology

Another noteworthy feature of the Dutch banking market is the rapid decrease in the number of branches held by the merged banks in the years immediately following their mergers. The large banks used the good economic climate to eliminate most of the overlap in branch networks and to restructure operations in a period of three years¹⁹. At the same time, other banks in the market reacted to the new market situation. They were forced to reconsider their strategic options and possibly restructure as well. The literature on bank mergers finds these effects of mergers take a period of approximately four years to fully materialize²⁰.

Our sample period runs from 1992 to 1998, starting directly after the consolidation phase in the Netherlands and ending before a new consolidation wave announced itself. During that period, the market for FIs in the Netherlands is more or less stable and consists of approximately 80 firms with a full banking license.

We use the IBCA data provided through BankScope. Taking care of overlap due to holding companies and eliminating non-bank FIs²¹, we are

¹⁹The total number of branches went from 5718 (end of 1987) to 7518 (end of 1993) and back to 6635 (end of 1996 [Sources: Molyneux, Altunbas, and Gardener (1997), p. 66 and Liso, Balaguer, and Soler (1999), p. 114].

²⁰See Akhavein, Berger, and Humphrey (1997), Shaffer (1993) and Altunbas, Molyneux, and Thornton (1997) for analyses of big bank mergers. The effects of bank mergers for consumers are studied by Avkiran (1999) and Berger and Humphrey (1992). Vander Venet (1998) tries to predict mergers.

²¹A good example is ABN AMRO Lease Holding: although it has a banking license, we do not consider it a real 'bank' and hence it is removed from our sample data set.

left with approximately 60 firms. For each year, we include only those firms for which all variables are available. This leaves us with a non-balanced panel with 46 banks, 7 periods and 210 observations (112 missing), with sizes ranging from 432 billion Euros for ABN AMRO Holding to 22 million Euros for Finansbank Holland²². Of those 46 FIs, 13 are owned by foreign companies. Three large conglomerates form a distinct group in terms of size: ABN AMRO Holding, ING Group and Rabobank Group. In table 1, the typology of the 46 banks is presented; 34 are general banks, two of which are cooperative banks. Twelve institutions have a specialized nature.

Year	1992	1993	1994	1995	1996	1997	1998	Total
Frequency	21	23	33	34	35	30	34	210
Percentage	10	11	16	16	17	14	16	100

Table 2: Frequency per Year

As can be seen in table 2, the total number of banks included per year in our data set varies from 21 to 35. In table 3, we give an overview of all banks and the number of years they have been included. We note that this is mostly the result of data availability.

In table 4, we present a few summary statistics for the variables involved. All quantity variables are in thousands of Euros and corrected for inflation. The explanatory variables are profit before tax (PBT) and total cost (TC). The former is recorded in the banks profit and loss account, whereas the latter is the sum of interest expenses, personnel expenses and other operating expenses. We identify three outputs. Loans (Y1) is the total stock of all loans supplied by a bank. Investments (Y2) is the sum of total securities, equity investments and other investments. The third output is deposits held with other banks (Y3). As explained in section 2 and in line with Hughes and Mester (1993), we include equity (Z1) as a control variable.

²² ABNAMRO figures for 1998, Finansbank Holland figures for 1994. Inflation adjusted.

N	F	NAME	N	F	NAME
1	7	ABN Amro Holding	24	5	GWK Bank
2	5	Achmea Hypotheekbank	25	4	Hollandse Koopmans Bank
3	4	Asahi Bank (Nederland)	26	6	Indonesische Overzeese Bank
4	3	Bank Labouchere NV	27	6	ING Group
5	6	Bank NL Gemeenten	28	6	Kas-Associatie
6	7	Bank of Tokyo - Mitsubishi	29	1	KBC Bank Nederland
7	7	Banque Artesia Nederland	30	7	Kempen en Co
8	4	Banque de Suez Nederland	31	5	MeesPierson
9	7	CenE Bankiers	32	1	Bank v/d Bouwnijverheid
10	3	CITCO Bank	33	7	Nationale Investeringsbank
11	3	Commerzbank	34	1	Waterschapsbank
12	4	Cooperatieve Voorschotbank	35	3	Nedship Bank
13	7	Dai-Ichi Kangyo Bank	36	5	Nomura Bank
14	7	Delta Lloyd Bank	37	4	Rabobank Group
15	6	Demir-Halk Bank	38	3	Robeco Effectenbank
16	6	Deutsche Bank de Bary	39	3	SNS Reaal Groep
17	2	Effectenbank Stroeve	40	2	Spaar en Voorschotbank
18	4	F. van Lanschot Bankiers	41	1	Staal Bank
19	7	FGH Bank NV	42	5	Tokai Bank Nederland
20	4	Finansbank (Holland)	43	1	Triodos Bank
21	7	Fortis Bank Nederland	44	5	United Garanti Bank Int.
22	7	Friesland Bank	45	2	Van der Hoop Effektenbank
23	6	Generale Bank Nederland	46	4	Westland/Utrecht Hyp. bank

N = Number, F = Frequency

Table 3: Banks Included

Finally, we identify three input prices. The price of financial capital, expressed in annual percentages is constructed as: $[\text{Interest Expense}/(\text{Customer \& Short Term Funding} + \text{Other Funding})]*100$. Next, we compute the price of labor. Unfortunately, information about the number of people employed by banks is fragmentary. Therefore, we approximate the number of employees as follows. We assume a constant relationship between number of employees and fixed assets. For all banks in the Netherlands for which we have information about the number of employees, we regress the logarithm of the number of employees on the logarithm of fixed assets²³. This result is used to estimate the number of employees for all banks. Our proxy for the price of labor is then composed as follows: $\text{Personnel Expenses}/\text{Estimated number of Employees}$.

²³The result is: $\ln \text{Employees} = 3.215 (0.104) + 0.899 (0.031) * \ln \text{Fixed Assets}$, with an R^2 of 0.885. Standard errors are in parentheses.

	N	Minimum	Maximum	Mean	SD	Skew	Kurt
PBT	210	108	3504100	160591	540438	4.24	18.02
TC	210	4889	33659600	1586822	5110147	4.02	16.03
Y1	210	21443	221401700	11781323	35907411	3.95	15.30
Y2	210	520	141876600	5100788	19388943	4.93	25.71
Y3	210	3300	64700986	3466024	11850548	4.47	19.11
Z1	210	7893	29077300	1099080	3706414	4.68	24.25
W1	210	0	11.97	5.45	2.05	0.39	1.17
W2	210	0.02	337351	5164	34085	9.05	85.49
W3	210	18	1542	182	245	3.20	12.16

SKEW = Skewness, KURT = Kurtosis, SD = Standard Deviation

PBT	Profit Before Tax	Z1	Equity
TC	Total Cost	W1	Price of Financial Capital
Y1	Loans	W2	Price of Labor
Y2	Investments	W3	Price of Physical Capital
Y3	Deposits with Banks		

Table 4: Summary Statistics

The price of physical capital (W3) is: [Other Operating Expense/Fixed Assets]*100. Before estimation PBT, TC, W1 and W2 are divided by W3, the price of physical capital to impose linear homogeneity in input prices, as explained in section 3.

5 Estimation Results

We now turn to the empirical analysis. In section 5.1 we first estimate the different model versions and compare the results. We choose one model as the preferred model and interpret it. We investigate whether the consolidation and liberalization wave in the early 1990s leads to trendlike changes in both the efficient frontier and estimated mean cost and profit efficiency relative to the frontier. In section 5.2, we use the preferred models to compute individual efficiency scores. We use the efficiency scores for individual FI's to analyze differences in efficiency between large and small banks and between general and specialized banks.

5.1 Estimated Cost and Profit Frontiers

The detailed estimation results for versions a, b and c of the cost and profit models respectively are presented in table 5 and table 6²⁴. In table 5 and

²⁴We start by estimating model a. The resulting maximum likelihood estimators are used as starting values for the grid search in the estimation of model b. For the additional

table 6 we also present 1-sided Log Likelihood Ratio tests of the standard response function [OLS] versus the full frontier model²⁵. The LLR test results show that we can reject the restrictions imposed by OLS. Consequently, we use the specification including a stochastic inefficiency term for all models.

MODEL	1a		1b		1c	
	B	t	B	t	B	t
Constant	3.61	3.80	4.49	5.63	5.10	6.44
LNy1	0.53	1.25	0.39	1.14	0.10	0.28
LNy2	0.72	4.02	1.01	7.44	0.70	4.49
LNy3	0.28	1.55	-0.05	-0.30	0.65	3.50
LNz1	-1.57	-2.77	-1.47	-3.18	-1.73	-3.40
LNw13	1.70	11.76	2.01	17.73	2.08	14.14
LNw23	-0.33	-4.68	-0.37	-5.49	-0.31	-4.50
T			0.12	3.86	0.37	4.64
Tsquared			-0.01	-3.60	-0.01	-1.79
TlnY1					-0.03	-2.01
TlnY2					0.01	1.30
TlnY3					-0.01	-0.98
TlnW13					-0.01	-0.88
TlnW23					0.00	0.31
TlnZ1					0.00	0.12
σ^2	0.60	5.17	0.54	10.01	0.27	8.99
γ	1.00	763	1.00	3615108	1.00	81267
μ	-1.54	-5.82	-1.47	-7.71	-0.66	-5.45
LL Function	49.87		63.59		71.20	
LLR 1-sided	103.40**		127.72**		124.97**	
Iterations	47		50		57	

** = significant at 1%

Table 5: Estimation Results under Cost Minimization (Model 1)

With respect to the estimated cost function in table 5, we note that γ , the share of inefficiency in the overall residual variance, is insignificantly different from 1, which indicates a deterministic frontier. Also, for our cost model μ is significantly negative with a value of -0.66 in model 1c. This

variables of model b we use starting values 0. For σ^2 , γ and μ we use the grid values of model a. The same procedure is used when we estimate model c (with the values from model b). This procedure ensures that we have a smooth grid search and run less risk of the grid stopping at a local maximum. The maximum number of iterations for the grid has been set at 10,000. To save space, the coefficient estimates for the interaction terms (except those including the time trend) have been left out. They are available from the authors upon request.

²⁵See Kodde and Palm (1986). The null hypothesis in this test is $\gamma = 0$ versus the alternative that $\gamma > 0$.

means that the top of the half normal distribution of our inefficiency term v lies close to 1, as is evident from figure 1. Hence most of our FIs are relatively cost efficient and average cost efficiency is high.

MODEL	2a		2b		2c	
	B	t	B	t	B	t
Constant	5.42	4.96	5.42	4.96	6.25	5.87
LNy1	-2.04	-2.77	-2.04	-2.77	-0.71	-1.00
LNy2	-0.16	-0.27	-0.16	-0.27	0.40	0.67
LNy3	-1.63	-2.35	-1.63	-2.35	-0.33	-0.44
LNz1	3.93	3.78	3.93	3.78	0.14	0.15
LNw13	0.83	2.38	0.83	2.38	1.17	2.30
LNw23	0.24	1.14	0.24	1.14	-0.14	-0.47
T			0.01	0.08	0.50	1.51
Tsquared			0.01	0.45	0.00	0.23
TlnY1					0.00	-0.07
TlnY2					0.01	0.47
TlnY3					0.02	0.76
TlnW13					0.00	-0.09
TlnW23					0.02	1.49
TlnZ1					-0.07	-0.80
σ^2	5.15	4.18	4.95	4.05	4.32	3.96
γ	1.00	332	1.00	245	0.99	219
μ	-4.53	-3.63	-4.44	-3.79	-4.14	-3.08
LL Function	-197.24		-194.49		-190.90	
LLR 1-sided	65.17**		63.28**		56.25**	
Iterations	42		44		46	

** = significant at 1%

Table 6: Estimation Results under Profit Maximization (Model 2)

The profit efficiency results in table 6 show that again γ is insignificantly different from 1 so that the efficient frontier is deterministic. The estimated value of μ is significantly negative but with a reported value of approximately -4.5 . This is a much larger value than was the case for the cost efficiency estimate. The impact of a different value of μ can be easily seen from a comparison of figures 1 and 2. These figures display the distribution of cost and profit efficiency scores respectively. In the case of cost efficiency, the relatively small value of μ indicates that the peak of the density function of inefficiency terms (v) is close to zero. As a result, most individual efficiency scores are close to the full efficiency value of 1. In figure 1, this is reflected by the very flat path of the efficiency scores on the left side. The large negative μ for profit efficiency on the other hand implies that the peak of the density function of inefficiency terms is far away from zero.

Consequently, most individual FIs are in the tail of the density, leading to wider dispersion of profit efficiency than of cost efficiency.

Figure 1: Distribution Cost Efficiency [CE] Scores (Model 1c)

Table 7 reports likelihood ratio tests for all models. On the cost side, all restrictions are rejected. Therefore, model 1c becomes the preferred model. For profit efficiency on the other hand, no restrictions can be rejected. As a result, we will use the most simple model (2a) from now on.

Interpretation of the regression coefficients requires much caution, due to the presence of a large number of nonlinear interaction terms. The marginal effect of an increase in the loan variable ($\ln(Y1)$) on the respective dependent variables total costs (TC) or before tax profits (BTP) for instance, is not measured by the magnitude of the coefficient on $\ln(Y1)$ alone, but by the combination of all coefficients on explanatory variables that include $\ln(Y1)$. Also note that coefficients are not elasticities as the left hand variables are in absolute numbers not logarithms. With these caveats in mind, the following holds for the direct effects, excluding interaction terms.

For cost model 1c, all coefficients on the output variables carry a positive sign, although it is insignificant for $\ln(Y1)$, the loans variable. High equity holdings are significantly negatively correlated with total costs. The direct effect of input prices is diverse; it is high and significantly positive (2.08) for the price of financial capital (W1), low and significantly negative (-0.31) for the price of labor (W2), and positive ($-2.08+0.31+1 = 0.77$) for the price of physical capital (W3). The negative coefficient on W2 suggests that total costs decrease with higher wages.

The positive coefficient on the linear trend term T suggests a shifting cost curve with higher costs (on the frontier) through time. The negative squared trend coefficient offsets the linear trend effect when time goes on.

Figure 2: Distribution Profit Efficiency [PE] Scores (Model 2a)

From the point estimates on the linear and quadratic trend term we derive a deterioration of the cost frontier between 1992 and 1996. From 1996 onwards the cost frontier remains in the same position. This evidence is consistent with the literature which tends to find approximately a four year adjustment period after a major consolidation²⁶. Note that for profit efficiency model 2a was the preferred one. It implies that no significant trend effects of consolidation and deregulation are found for the efficient profit frontier²⁷.

Model 1	Restrictions	Test Statistic	Model 2	Restrictions	Test Statistic
LRTa,c	8	42.68**	LRTa,c	8	12.67
LRTb,c	6	15.23*	LRTb,c	6	7.17
LRTa,b	2	27.44**	LRTa,b	2	5.51

** = significant at 1%, * = significant at 5%

Table 7: Likelihood Ratio Test (LRT)

For the profit model 2a, the coefficients on both total loans (Y1) and deposits with banks (Y3) are negative and significant. The coefficient on Y2 on the other hand is not significantly different from zero. Overall, increasing the size of production leads to lower or at best equal profits, implying diseconomies of scale (again excluding the interaction effects). The coefficient on equity is positive and significant. Remember that the effect of equity in the cost estimation was significantly negative. The coefficient on the price

²⁶See footnote 20.

²⁷As noted before, we only estimate a net trend effect. It is possible that the consolidation and deregulation caused a deterioration of the efficient profit frontier which was offset by gains through pure technological progress.

of financial capital (W1) is significantly positive (0.83). The coefficients on the prices of personnel (W2) and physical capital (W3) are small, viz. 0.24 and -0.07 (-0.83-0.24+1) and insignificant.

Next, we turn to the mean efficiency scores that result from model 1c and model 2a. Remember that profit efficiency scores are in a range from 0 to 1, where 1 indicates a bank is efficient and operates on the frontier. For cost efficiency, scores lie range from 1 to ∞ , where an efficient bank again has a score of 1. In table 8, we report a few summary statistics on cost and profit efficiency scores.

	N	Min.	Max.	Mean	SD	Skewness
CE	210	1.003	5.658	1.35	0.60	3.92
PE	210	0.012	0.958	0.56	0.26	-0.44

Table 8: Summary Statistics CE and PE

Table 8 shows that individual cost efficiencies vary from a high of 1.003 to a low of 5.658. Moreover, the mean cost efficiency of 1.35 suggests that most FIs have an efficiency score close to 1. This is consistent with the graphical evidence in figure 2. The distribution of individual profit efficiency scores is more uniform. This follows from the fact that mean profit efficiency is almost halfway the lowest efficiency score of 0.012 and the highest efficiency score of 0.958. In addition, figure 3 provides graphical evidence on the relation between cost and profit efficiency scores for individual FIs. The scatter plot suggests a weak correlation between both scores. This is confirmed by the bilateral correlation coefficient between these two scores, which equals -0.121 . It provides evidence in support of our claim that both cost and profit efficiency need to be investigated.

Figure 4 reports the time path of mean cost efficiency for the years 1992-1998, both unweighted and weighted by total assets. Figure 5 does the same for mean profit efficiency.

From figure 4, it appears that the drawn line representing weighted mean cost efficiency lies below the dotted line for unweighted mean cost efficiency in every year. This is especially the case in 1992 and after 1995. In addition, the figure shows that weighted mean cost efficiency is relatively variable over time. In the years 1992 and 1996-1997 weighted mean cost efficiency is substantially higher than in the period 1993-1995. The evidence casually suggests that on average larger firms are more cost efficient than smaller firms. Only in the period 1993-1995 the larger firms seem to lose their competitive edge on the cost efficiency side. We tentatively hypothesize that this temporary effect could be due to the necessary adjustment of especially large FIs to both the merger wave in the early nineties and the European liberalization process. The combination of a deteriorating frontier and a more or less stable level of mean cost efficiency relative to the frontier sug-

Figure 3: Scatter Plot Cost Efficiency [CE] and Profit Efficiency [PE]

gests that all market participants were affected by the structural changes in the market²⁸.

Figure 4: Cost Efficiency [CE] Trend

In figure 5 unweighted mean profit efficiency is stable at a level around 0.6. As with cost efficiency, the drawn line representing weighted profit efficiency is closer to the full efficiency level - now higher - than the dotted line which indicates unweighted profit efficiency. Again, larger firms appear more profit efficient. However, the difference becomes negligible in 1996 and 1997. To what extent the widening of the gap in 1998 is permanent cannot be judged on the basis of our data. Clearly, the European integration and

²⁸See footnote 20.

Figure 5: Profit Efficiency [PE] Trend

liberalization process and the consequent expected increase in competition hardly affected mean profit efficiency in the first half of the nineties.

The observed decrease in profit efficiency for especially the larger FIs in our sample in 1996-1997 may be a lagged response to the change in European market conditions. Certainly, larger general banks operating internationally might be expected to be affected more than smaller general banks, operating only within the Netherlands. On the other hand, small domestic specialized FIs might feel the pressure of increased competition from abroad too, due to the fact that market entry is probably easier in specialized market segments than in the retail market that small general banks operate in normally.

In summary, we conclude that firm to firm profit efficiency varies more than cost efficiency. Secondly, in both models average performance remains stable over time, suggesting little overall impact of consolidation and deregulation on industry efficiency. Thirdly, whereas many banks have a relatively high cost efficiency, profit efficiency for many banks is relatively low. This is in line with Berger, Hancock, and Humphrey (1993) and Akhavein, Berger, and Humphrey (1997), who show that the inefficiencies arising from the output side appear to be of larger magnitude than those appearing on the input side. Finally, when comparing all observations, there is no clear correlation between profit efficiency and cost efficiency.

In section 5.2 we will go into the difference in efficiency performance between large general banks, small general banks and specialized banks in more depth.

5.2 Size and Specialization Effects on Efficiency Scores

In this section, we analyze differences in cost and profit efficiency across individual banks in more detail. To this purpose, we first distinguish between large and small banks. The large banks in our sample are ABN AMRO, ING, and Rabobank, all three of which have a balance sheet size exceeding 80 billion Dutch guilders. Note that these three banks account for around 85 percent of the Dutch deposit and loan markets. Of the total number of available bank-year observations (210), 17 are for the three large banks, while the remaining 193 correspond to observations for the other banks.²⁹ In the group of small banks both general banks and specialized institutions are included. Before we discuss the results, we would like to make the caveat that the number of observations in our tests is generally quite low.

Large Vs Small Banks					
		N	Mean	SD	
CE	Large	17	1.248	0.227	
	Small	193	1.356	0.540	
PE	Large	17	0.709	0.177	
	Small	193	0.564	0.272	
	Test*	F	Sig.	t	2-tailed Sig.
CE	test 1	1.594	0.208	-0.819	0.414
	test 2			-1.608	0.117
PE	test 1	9.163	0.003	2.442	0.015
	test 2			3.480	0.002

* = Levene's test: test 1 (2) = equal variances (not) assumed

Table 9: Independent Samples Large Vs Small

In table 9 we report independent sample t-tests for the null hypothesis of equality in mean cost and profit efficiency respectively for large versus small banks. We report two t-test statistics. In the first test (test 1) we assume equal sample variances, while in the second (test 2) we release this assumption. In addition, we report an F-test (F*) on the null hypothesis that the sample variances are indeed equal³⁰.

The results in table 9 show that mean cost efficiency is marginally higher - closer to unity - for large banks than for small banks. However, the two t-tests show that this difference is statistically insignificant. Since the F* test on equal variances is not rejected at conventional significance levels,

²⁹Note that the 1992 observation for ING Group is missing in BankScope.

³⁰Here, we opt for Levene's robustness test since it is less dependent on the assumption of normality than most tests.

we prefer test 1. In the case of profit efficiency, the conclusions are quite different. First, the difference in mean profit efficiency between large and small banks is considerably more pronounced than was the case for mean cost efficiency. Second, the assumption on equal variances is strongly rejected, so that t-test 2 is more appropriate. Both t-test 1 and 2 give the same message, though. According to our results, large banks are significantly more profit-efficient than small banks. Overall, our results suggest that large banks are unable to exploit their size advantage on the cost side, while they do have a better performance on the profit side. A possible explanation is the presence of more opportunities of scale economies on the output side than on the input side. Alternatively, the dominance of the big three on the Dutch market may allow them to reap gains from price leadership and a lack of effective competition.

Large General Banks Vs Small General Banks

		N	Mean	SD		
CE	Large	17	1.277	0.458		
	Small	146	1.380	0.666		
PE	Large	17	0.709	0.177		
	Small	146	0.504	0.272		
	Test*	F	Sig.	t	2-tailed Sig.	
CE	test 1	1.348	0.247	-0.618	0.537	
	test 2			-0.828	0.415	
PE	test 1	8.472	0.004	3.036	0.003	
	test 2			4.235	0.000	

* = Levene's test: test 1 (2) = equal variances (not) assumed

Table 10: Independent Samples Test Large and Small General Banks

Potentially, the joint presence of general and specialized banks in the group of small banks may have an impact on our conclusions from table 9. Therefore, we now repeat the analysis for general banks only, excluding specialized institutions. In table 10 we test for the equality of mean cost and profit efficiency respectively between large general banks and small general banks. Due to the exclusion of specialized banks the number of bank-year observations in the group of small banks falls from 193 to 146.

The test results are qualitatively similar to those in table 9. We confirm the absence of a significant difference in mean cost efficiency between large and small general banks, and the presence of a significant difference in mean profit efficiency. Large general banks perform better than small ones in terms of profit efficiency.

Specialized Small Banks Vs General Small Banks

		N	Mean	SD		
CE	Specialized	47	1.297	0.407		
	General	146	1.380	0.666		
PE	Specialized	47	0.672	0.232		
	General	146	0.504	0.272		
	Test*	F	Sig.	t	df	2-tailed Sig.
CE	test 1	2.990	0.085	-0.805	191	0.422
	test 2			-1.022	128.81	0.309
PE	test 1	4.114	0.044	3.826	191	0.000
	test 2			4.147	89.020	0.000

* = Levene's test: test 1 (2) = equal variances (not) assumed

Table 11: Independent Samples Tests Small General and Specialized Banks

In table 11, we subsequently partition the total group of small banks into general and specialized institutions. Again, we test for equal mean cost and profit efficiency. As before, no significant differences in mean cost efficiency are found. Note that the F* test on equal variances here is rejected at the 10 percent level. This result makes a choice between the two t-tests somewhat difficult. However, since the t-tests give the same outcome, it has no impact on our conclusion. Turning to the results for mean profit efficiency, one clearly sees it to be significantly higher for specialized institutions than for small general banks. We reject the assumption of equal variances at the 5 percent level. The two t-tests unambiguously point to the same conclusion.

Finally, table 12 compares mean cost and profit efficiency for large general banks on the one hand and small specialized institutions on the other. Even more so than in the previous tables, the number of observations is small. Given this caveat, the table suggests that neither mean cost efficiency nor mean profit efficiency differ significantly between large general banks and small specialized institutions.

Large General Banks Vs Small Specialized Banks

		N	Mean	SD		
CE	Large Gen	17	1.277	0.458		
	Small Spec	47	1.297	0.407		
PE	Large Gen	17	0.709	0.177		
	Small Spec	47	0.672	0.232		
	Test*	F	Sig.	t	2-tailed Sig.	
CE	test 1	0.016	0.899	-0.167	0.868	
	test 2			-0.158	0.876	
PE	test 1	2.214	0.142	0.591	0.557	
	test 2			0.670	0.507	

* = Levene's test: test 1 (2) = equal variances (not) assumed

Table 12: Independent Samples Tests Large General and Small Specialized Banks

Overall, two conclusions emerge. First, differences in mean cost efficiency between different groups of FIs in the Netherlands are small. Neither specialization nor size offer a systematic comparative advantage on the cost side. Second, significant differences do exist in terms of mean profit efficiency. Both size - due to market power or scale economies - and specialization in a niche market lead to higher than average profit efficiency. Small general banks are the losers on average. As a corollary, we conclude that the exclusive focus on cost efficiency and the neglect of profit efficiency that is quite common in the literature is inappropriate and may lead to incorrect inferences.

6 Conclusion

In this paper, we investigate cost and profit efficiency in the Dutch banking industry between 1992 and 1998. Prior to this period both a consolidation wave and a major deregulation took place. The period itself is characterized by the absence of major institutional changes. For our analysis we use a stochastic frontier cost and profit model respectively. We estimate a translog functional form, also including linear and quadratic trend terms. Inefficiency is modelled as a truncated normal distribution. Our results show that both the cost and profit frontiers are deterministic. In summary, we conclude that firm to firm profit efficiency varies more than cost efficiency. Secondly, whereas many banks have a relatively high cost efficiency, profit efficiency for many banks is relatively low. This is in line with Berger, Hancock, and Humphrey (1993) and Akhavein, Berger, and Humphrey (1997), who show

that the inefficiencies arising from the output side appear to be of larger magnitude than those appearing on the input side. Thirdly, when comparing all observations, there is no clear correlation between profit efficiency and cost efficiency.

We focus on three issues. First, we analyze whether we can observe shifts in the efficient cost and profit frontiers. We find that the cost frontier initially deteriorates, followed by a four-year stabilization period of four years. The profit frontier remained stable over the full sample period.

Second, we analyze whether average cost and profit efficiency in the period 1992-1998 displays a significant time trend. Such a trend might be the result of a gradual impact of the preceding consolidation and deregulation as suggested by the literature. In both models average performance remains stable over time, suggesting little overall impact of consolidation and deregulation on industry efficiency.

Finally, we distinguish between FIs of different type and size and test for systematic differences in cost and profit efficiency between these groups. We find that whereas all banks appear to perform rather similarly in terms of cost efficiency, in terms of profit efficiency large general banks and specialized banks clearly outperform small, general banks. Large banks appear to benefit from sheer size and perhaps market power, whereas specialized banks continue to operate safely and efficiently in what might be termed a niche market.

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