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**Do Mergers and Acquisitions Improve Efficiency  
of the Banks?  
-DEA approach in the case of European Banks**

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## ABSTRACT

After the introduction of the Euro, a steady banking system in the European Union was abstractedly ensured through consolidation and over the 1990s, the volume and the number of bank mergers and acquisitions (M&As) increased rapidly. Measuring the efficiency gains from M&As in the banking industry is in the spotlight of managers and shareholders. This study covers domestic bank M&As examining relative pre- and post-merger technical efficiencies of 134 individual bidder banks in 11 EU countries, in the 1994 to 2001 period. The non-parametric Data Envelopment Analysis (DEA) approach is applied to detect potential efficiency gains resulting from bank mergers. The study employs the intermediation model of the production process of the banking firm. We find that consolidation in the banking sector is beneficial and mergers appear to have improved efficiency. The analysis also indicates that savings banks have benefited the most from M&As and that the German banks have experienced smaller efficiency increases compared to the banks of the other countries of study.

**Keywords:** Mergers and Acquisitions, European Banks, Bidder Banks, Data Envelopment Analysis, Technical Efficiency

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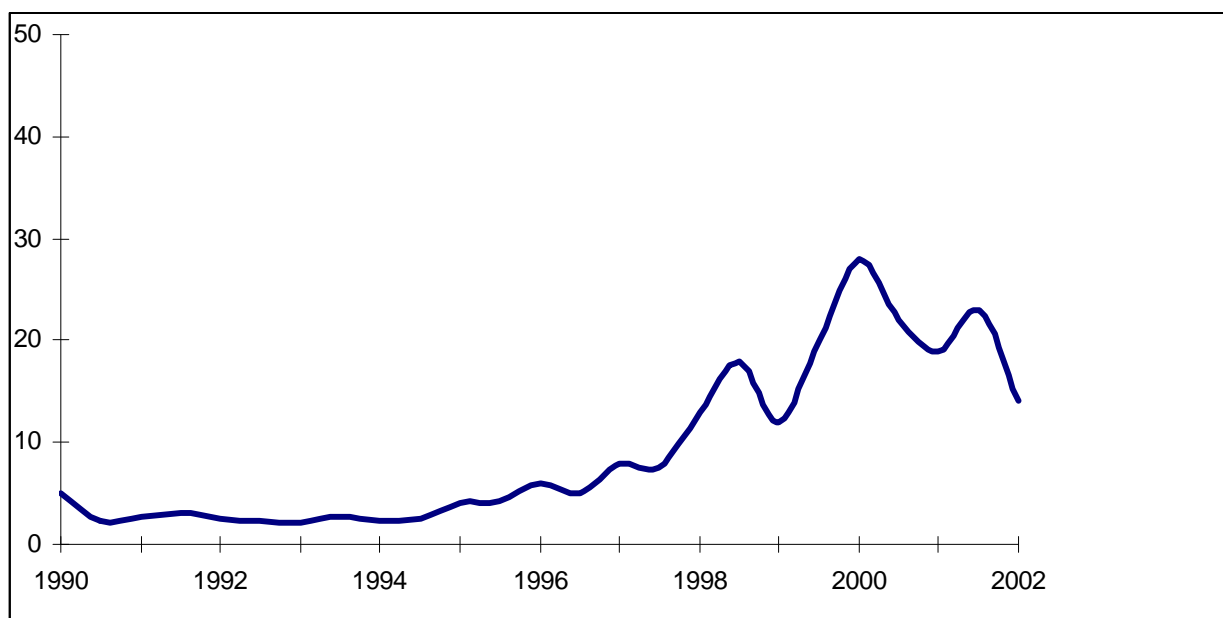
# CHAPTER 1

## 1.1 Introduction

After the introduction of the Euro, a steady banking system in the European Union was abstractedly ensured through consolidation, enabling banks to increase their branch networks over geographic areas and therefore decrease their dependence on the fluctuations in economic policies. Over the 1990s, the volume and the number of the bank mergers and acquisitions (M&As) increased in correspondence to the introduction of the Euro. Figure 1 illustrates the consolidation wave in the EU banking sector during 1990-2002.

Consolidation and consequently globalization of banks in the European Union should be a transformation process, gaining from increased efficiency and decreasing costs and profiting from economies of scale and scope. According to Altunbas and Ibanez (2004), bank consolidation deals will continue during the future periods. Firstly, the main motives for these M&As, such as the effect of technological change and financial globalization, will proceed. Secondly, comparing with the US, the number of banks per 1000 inhabitants is twice as high in the Euro area.

*Figure 1: M&As in the European Union banking sector 1990 - 2002 (EUR billions)*



*Source: Thomson Financial Deals.*

Mergers and acquisitions in the banking industry are in the spotlight of the managers and shareholders and naturally attract attention here as in other industries. Bank consolidation is an

ongoing process and the driving force is to maximize value to shareholders and enhance the bank's overall competitive position. Efficiency achievement is the target of almost all the merging banks and the merger process seems attractive to the other banks. The question is whether banks will be able to keep tract with the growing business expectations given the changing banking environment. Its central role in reallocating capital to different sectors in the economy, facilitate risk spreading, ensure low cost transaction and transparency is highly exposed to risk.

Bank mergers have been widely studied in the US banking sector (see e.g. Berger et al. (1999) and Shaffer (1994)). Despite the high level of M&A activities in the EU banking industry, there are few studies of this region (see Berger et. al. 1999), especially concerning bank efficiency frontier analysis(Drake (2001), Hauner (2004), Vander (1996) and Huizinga et al. (2001) examined performance effects of M&As on European financial institutions, Lepetit et al. (2004) examined stock market reactions to the merged banks' returns, Altunbas and Ibanez (2004) examined the impact of strategic similarities between bidders and targets on post-merger financial performance.

Improved bank efficiency through M&As should enable customers and shareholders to accumulate significant benefits and might also raise the level of competition in the banking sector. M&As may be an efficient way to compete effectively in the EU banking sector. Consecutive deregulation, technological changes and the level of competition have forced banks to adjust their strategies. Although most bank consultants think that M&As improve efficiency, science-based studies usually claim that there is no such improvement on average (Berger et. al 1999).

A crucial point of justification for this thesis is that most previous empirical studies investigate bank efficiency by using accounting indicators and their average size, or by the total balances of assets and liabilities (Vander (1996) and Rhoades (1998)). The main purpose of this study is to examine M&As in the EU banking sector by applying the Data Envelopment Analysis (DEA) method to measure pre- and post-merger efficiencies of individual 134 bidder banks in 11 countries and to survey how the efficiency changes. The bidder bank is the bank which entails transfer of firm control from the target bank through M&A deals and the main reason for choosing bidder banks as the object of study is that bidder banks are generally larger than the target banks and are likely to absorb the targets in the consolidation process. The sample covers 207 domestic bank mergers over the period 1994-1999, which as indicated by Figure 1 above, is the period when the number of M&As increased considerably. Consequently, it might be

expected that bank efficiency may differ before and after consolidation and probable improved efficiency effects of M&As would indicate a continued process of M&As in the banking sector. To our knowledge, this study is the first to measure individual productive (technical) EU bank efficiency in connection with M&As.

The study is organized as follows. Chapters 2 and 3 review the general characteristics of EU banking, and the motivations for M&As respectively. Potential efficiency consequences of M&As are also discussed. Chapter 4 presents the methodology of this study; the main concepts of efficiency and the DEA approach. Chapter 5 discusses different potential banking industry production models and also presents the data statistics. Chapter 6 presents empirical results and analysis while concluding remarks are made in Chapter 7. The names, types and origins of the banks are listed in Appendix A. Appendix B identifies the fully efficient banks and Appendix C summarizes efficiency results by countries and bank types.



## CHAPTER 2

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*This chapter provides a comprehensive overview of the European banking sector during the 1990s, 11 countries are included in this study. The chapter first defines the common characteristics of European banking followed by more detailed examination of the banking sector of each country. The final parts of this chapter aim to study European bank M&As and also to analyze M&As in the EU.*

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### **2.1 Country Specific Characteristics of the European Banking Sector**

The European banking industry is distinguished by some main and commonly shared characteristics. According to the report of Group of Ten (2001), universal banking as an operating function is a major principle of the European banks. Secondly, there is a high level government participation in the European banking industry. Although far reaching privatisation took place at the end of the 1980s in most of the EU countries, we observe a large scale of public ownership of banks, mainly in France, Spain, Italy and Germany. Another characteristic of the European banking is the generally limited role of institutional investors. Italy and Spain are typical examples, while institutional investors play a more significant role in the Netherlands. Below, the case of specific countries is presented separately.

#### **Austria<sup>1</sup>**

The Austrian banking market has been going through restructuring and consolidation since the 1990s. A small number of domestic banks constitute the main part of the Austrian banking sector. In 2004 the banking industry consisted of 101 commercial banks, 57 savings banks, 10 mortgage banks and 67 credit cooperatives. The main characteristic of Austrian commercial banks is universal banking, which makes insignificant difference between retail and corporate banking. The main motive behind bank M&As in the Austrian banking sector is the cost cutting factor. Thus, Austria's largest credit institution, Erste Bank der Oesterreichischen Sparkassen AG (Erste Bank), was established through the merger between Erste Bank and GiroCredit Bank in 1997. Every year, since 1990, the Austrian banking market concentration increases through bank merger. The share of the government ownership has significantly decreased since that same time.

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<sup>1</sup> See International Monetary Fund (2004) and <http://www.hsbcnet.com>.

## **Belgium**

The majority of the banks in the Belgian financial sector are commercial banks and they can be classified as universal banks conducting investment banking activities, especially in connection with public debt operations. Small private savings banks and some financial companies, especially highly specialised institutions in mortgage financing constitute the main part of the Belgian banking industry. At the beginning of the last decade until the middle of the 90s, the number of banks increased, while the weight of consolidation in the banking sector grew. After 1996, when the M&A process increased rapidly, the number of banks has significantly declined. Although consolidation transactions at the beginning of the decade were restricted to small and medium-sized banks, at the end of the decade the mergers' deals implicated a small number of the large banks. As a consequence of the large bank mergers, the concentration in the banking market increased due to the decline in the number of large banks.

## **France**

During the last decade, the growth rate of the French banking industry was not significantly changed and the assets to GDP ratio remained fairly stable. But the number of banks decreased through M&As in the French banking sector. The drop was particularly driven by small banks, as a consequence of the fact that the majority of M&As deals occurred between small banks.

## **Germany**

In Germany, banks generally have been liberated to operate as universal banks. Although the universal banking concept had been appreciated from different aspects, banks have been able to fulfil all sorts of commercial and investment banking functions. Nevertheless, four of the largest private universal banks (Deutsche Bank, Bayerische Hypo- und Vereinsbank, Dresdner Bank and Commerzbank) are currently dominating in the German banking industry, while there are several multi-type and specialised financial institutions as well as mortgage banks and small local corporate banks that have been playing a significant role in the banking industry. Landesbanken and Sparkassen are stated-owned savings banks and they play quite significant roles in the German banking market since the 1990s. Despite the large number of M&As deals among savings banks during the same period, the presence of these banks in the banking industry remained unaltered. At the current wave of consolidation postal giro offices have merged in the form of the Postbank, which is being privatized. During the 1990s, the German banking industry gained considerable experience in M&As. As a consequence of the merger process among

savings and cooperative banks during the 1990s, the number of banks decreased from 4700 to 3200. Despite that in the consolidated industry the total assets to GDP ratio relatively increased, concentration among big banks has not changed so much.

## **Greece<sup>2</sup>**

Since the 1990s, the Greek banking sector has gained from the liberalization in the reinforcing of the portfolios and capitalization. Financial system progress significantly improved after the boom in the Greek economy during 1997-1999 and further strengthened the Greek banking financial services' scope. At the second half of the 1990s, the wave of M&As increased the degree of concentration in the Greek banking market. In 1998 the total number of commercial banks was 39 and 17 of these were Greek, while the other 22 banks were foreign commercial banks. As a consequence of M&As activities the largest five banks were dominating in the Greek banking industry in terms of total deposits in 1998. In 1998 the share of these banks of the total deposits exceeded 79% and 77% of the total assets of the Greek banking market were controlled by these banks.

## **Italy**

Traditionally, banks in Italy have been faced with regulations concerning the government financing. The share of the savings banks is very high and plays an important role in the banking industry. Also regulation among short and long-term lending banks is markedly distinguished, while medium and long-term funding to the corporate sector is provided by the special credit institutions. Moreover, the geographic boundaries restricted the potential of Italian banks in establishing new branch offices. During the 1980s most of the banking limitations were overcome and banks had more branches, ability to lend and held participations in non-financial firms. The effect of the consolidation in the Italian banking industry increased in the 1990s and the number of banks decreased by more than a third. Simultaneously, the bank concentration significantly increased. For instance, although in 1992 the 10 biggest banks controlled nearly 40% of the total deposits, this number became about 60% in 1999. Despite the rapid growth of the banking industry in the beginning of the last decade, the asset to GDP ratio declined due to the economic liberalisation and privatisation reforms.

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<sup>2</sup> See The Hellenic Bank Association (HBA), [www.hba.gr](http://www.hba.gr) and Sophocles et al. (2001)

## **Netherlands**

In the beginning of the 1990s, the financial market in the Dutch area experienced some major changes. Concentration in the banking industry increased as a result of large size mergers and direct cooperation between saving banks. The effect of the M&As in the Dutch banking sector was positive, but not distinctively. During the 1990s, the total number of banks was invariable, as a result of the new banks' entrance to the market. Concentration of the banks also increased by a small percentage, while the growth of the largest banks was substantial. In general, the banking industry in the Netherlands grew very fast in the last decade, though not as fast as the largest banks.

## **Portugal<sup>3</sup>**

The Portuguese banking system is characterized by strong management, universal risk control and a good breadth of product available. The country has been involved mainly in the European domestic bank consolidation<sup>4</sup>. Five banks are dominating the Portuguese banking market: Millennium BCP, CGD, Banco Espirito Santo (BES), Banco Santander Totta and Banco BPI. In 2004 these five banks controlled 85% of the total assets and a majority of the banking services in the market. During the 1990s foreign investment and consolidation significantly influenced the restructuring and reorganization of the Portuguese banking market. The main wave of bank consolidation was during 1996-1999, where the largest three banks, Banco Comercial Portugues (BCP), Banco Pinto and Sotto Mayor and Banco Portugues de Investimento merged in 1996. Furthermore, in 1999, Spain's Banco Santander Central Hispano (BSCH) merged with Champalimaud.

## **Spain**

Universal banking is the main characteristic of the Spanish banking sector. M&As have had quite a negligible effect on the Spanish banking market. In the 1990s the total number of banks decreased and the number of commercial banks increased slightly. Banking sector concentration remained invariable during 1992-1997.

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<sup>3</sup> See Neville L. (2006)

<sup>4</sup> In this study, mergers and acquisitions and consolidation are considered as synonyms.

## **United Kingdom**

M&As in the UK banking industry has caused substantial changes in the financial sector and these changes resulted in many UK securities firms being acquired by domestic retail banks and foreign investors. During the 1990s, as a result of the bank consolidation, the number of banks declined by about 20%. Although the concentration ratio declined for the top five banks over the 1990s, this ratio significantly grew among the largest top 15 banks. Ultimately, bank concentration decreased during the late 1990s.

## ***2.2 Studying European Bank Mergers and Acquisitions***

Vander (1996), by using accounting indicators, examined the performance effect of 422 domestic and 70 cross-border M&As in European Community (EC) credit institutions during 1988-1993. The analysis made comparison of the pre- and post-merger performance of banks starting three years before and ending three years after the transactions. Findings reveal a significant improvement in performance due to mergers and acquisitions. Also cross-border M&As has improved the cost efficiency through mergers.

Tourani-Rad and Van Beek (1999) surveyed M&As in a sample of 17 target and 56 bidding banks from the European financial institutions merged between 1989-1996. According to the authors target's shareholders gained more positive abnormal returns than the bidders' shareholders. Also they argue that the larger the size of the bidder, the more positive the return.

In another study, Huizinga et al. (2001) investigated performance effects of European banks M&As during 1994-1998 in the case of 52 bank mergers. They examined economies of scale and profit efficiency for merged European banks and found unexploited scale economies and large X-inefficiencies. Also studying profit efficiency of pre- and post-merged banks, the authors claimed that large merging banks generated a lower degree of profit efficiency than average ones, while small merging banks generated a higher level of profit efficiency than their peer group.

Lepetit et al. (2004) studying bank M&As during 1991-2001 for 13 European countries, examined stock market reactions to merged bank returns at the announcement time. They found that M&As announcement positively affected to the returns of the merged banks while the value of the target banks significantly increased.

Diaz et al. (2004) investigated the bank performance derived from both the acquisition of another bank and the acquisition of other non-banking financial entities, using panel data for the period 1993–2000 in a sample of 1629 banks, where 181 acquisitions were noted. They found that the acquisition of financial entities by European banks can increase their profitability and that there is a lag of at least two years between the acquisitions and improvement in performance. Also they observed that the acquisition of other banks affects acquirers’ ROA, through an increase in the long-term profitability.

### ***2.3 Recent Mergers and Acquisitions in the European Union***

Merger is “*the combining of two or more companies, generally by offering the stockholders of one company securities in the acquiring company in exchange for the surrender of their stock*” whereas an acquisition takes place “*when one company purchases a majority interest in the acquired*” (Investopedia). In other words, mergers and acquisitions (M&As) are a main method of consolidation, which refers to transactions arising from the combination of independent existing firms. In the European banking sector the number of M&As deals significantly increased over the last decade. For instance, during 1990-1999 the number of European banks dropped from 12378 to 8395 (ECB 2000)<sup>5</sup> and in total 1919 M&As transactions occurred between 1995-1999<sup>6</sup>. Table 1 provides more detailed information about the structure of the M&As transactions.

***Table 1: Bank M&As (domestic<sup>7</sup> and cross-border) in the EU 1995-1999***

	1995	1996	1997	1998	1999	Total
Total bank M&As	326	343	319	434	497	1919
Domestic	275	293	270	383	414	1635
Within EEA	20	7	12	18	27	84
With third country	31	43	37	33	56	200

Source: ECB (2000)

Approximately 85% of the total M&As were domestic deals and around 4% and 11% of the transactions were within EEA and with third countries respectively. Geographical distribution of

<sup>5</sup> European Central Bank

<sup>6</sup> Data does not allow us to determine the number of banks exiting the market due to other reasons than M&As

<sup>7</sup> Domestic merger is transaction involving firms located in the same country.

these M&As by country is provided in Table 2. The highest figures are obtained from Germany, Italy, France and Austria where about 80% of total M&As took place.

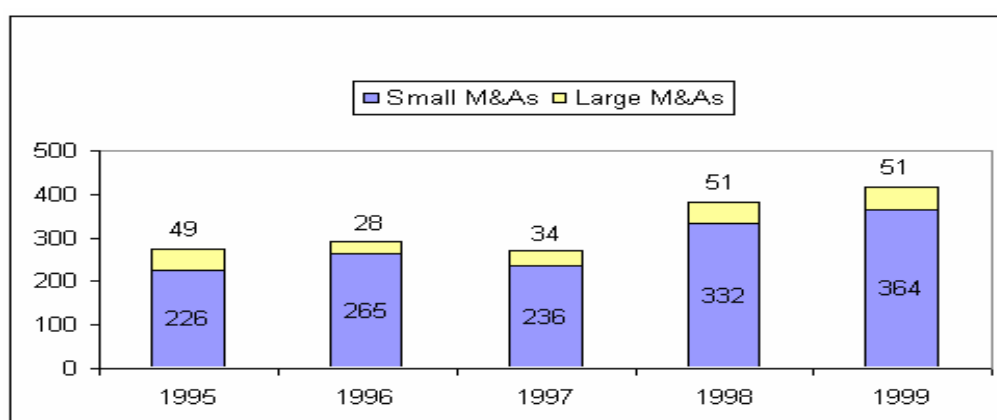
**Table 2:** Credit institution M&As (domestic and cross-border<sup>8</sup>) in the EU 1995-1999

	1995	1996	1997	1998	1999	Average 1995-99
Austria	14	24	29	37	24	26
Belgium	6	9	9	7	11	8
Germany	122	134	118	202	269	169
Spain	13	11	19	15	17	15
France	61	61	47	53	55	55
Greece	0	1	3	9	8	4
Ireland	3	4	3	3	2	3
Italy	73	59	45	55	66	60
Luxembourg	3	2	3	12	10	6
Netherlands	7	11	8	3	3	6
Portugal	6	6	2	5	2	4
UK	6	11	21	24	19	16
Total	314	333	307	425	486	372

Source: ECB (2000)

From Figure 2 it is evident that in 1999 domestic bank M&As attained its maximal point with 415 transactions, an increase by about 50% compared to 1995. Furthermore, domestic M&As occurred primarily between small<sup>9</sup> banks. An evident interpretation is also that the number of small banks is higher than the number of larger banks operating in the EU.

**Figure 2:** Domestic M&As in the European Union by size, 1995-1999



Source: ECB (2000)

<sup>8</sup> Cross-border mergers occur between firms from different countries.

<sup>9</sup> Large size M&A implies that at least one of the involved institutions had assets above 1 billion Euros

In terms of value, M&As transaction in the EU during 1990-1999 increased from \$22.769 million to \$147.025 million (SDC, Thomson Financial Security Services). Also during this period both total and average values of the domestic mergers were higher than those of the international mergers.

#### ***2.4 Recent Trends in Bank Mergers and Acquisitions***

In the current competitive environment, a host of forces has exerted a significant influence on the wave of bank consolidation. Importantly, deregulation and laws governing financial services, technological advances, and globalisation of the market place and most interestingly the introduction of the Euro are examples of main forces that frequently occupy the present day debate on mergers.

The reformation processes that have taken place in financial services the in Euro area have in major instances affected ongoing deregulation in European financial markets for 50 years. According to Tourani-Rad and Van Beek (1999) the merger wave in the European banking sector was noticed in the late 1980s, but over the 1990s under the Second Banking Directive, all financial institutions authorised in EU were able to create branches and international financial services in other countries inside EU without further authorization. As a result, the EU banking directive established competition in the European financial market through the structure of the home country rules. Similarly, Dermine (2002) classified the European Commission's action towards deregulation in five main stages; liberation of domestic markets from entry barriers, coordination of banking regulation, completion of the domestic market, and the formation of an economic and monetary union. In conjunction with deregulation, technological advances driven by high investment cost with low margins have established the need for suppliers of technological services to often treat consolidation as a means to spread their high set up cost of new technology over a large customer base. Technological change has thus played a catalyst role in the recent wave of bank mergers and its associated progress in technology inherent in banking structures and operations. According to the Group of Ten (2001), the impact of technological progress on financial service reformation has led to increasing realistic scales of production of products and services, applied advantages of risk management such as derivatives contracts, and economies of scale in the provision of bank services. While technological progress and



deregulation expands capability and makes global relations easier, deregulation opens new markets in economy.

An exciting concern to this aspect has been the advent of globalisation which has become a very strong force to reckon with towards encouraging consolidation in the financial services. Pasiouras et al. (2005)<sup>10</sup> mention that globalisation has led to the increase of foreign banks in EU countries and consequently increased the level of competition in the banking sector. In addition, the introduction of the general guidelines of the Euro significantly reinforced the merger processes. It is certainly true that many changes of the EU banking sector, including the maintained efforts towards liberalisation of capital, are largely as a result of the induction of the Euro.

Of course, the effect of a host of external and internal factors discouraging M&As cannot be minimised. Regulation stands as a considerable potential obstacle when antitrust laws in different countries interplay to create difficulties for domestic mergers within transnational banking. Legislation and regulation of the different countries differ considerably through regions with respect to the role of the executive committee and management. Corporate governance differences impact the mutual relation with company owners and other interested parties such as employees, clients and governments.

The most striking case of factors discouraging consolidation is where capital requirements differ between countries to an extent that trans-border consolidation becomes impossible. Cultural discrepancies emerging in M&As processes at corporate level is another important factor to be reckoned with. This may constitute a serious barrier complicating mergers deals. A new corporate culture that affects employee's sight and behaviour definitely originates. Beets and Styger (2001) estimated that, approximately 85% of failed mergers are attributable to mismanagement of cultural issues.

Another important factor is the flow of information. Insufficient information flow, or rather information asymmetries, may enhance the uncertainty regarding the results of consolidation. Inadequate information as a form of market inefficiency leads to divergence in accounting standards across countries. Deep discrepancies may the cause stakeholders to reject M&As deals. Based on the aforementioned debate, the outcome of bank consolidation has not always been gloomy leaving interacting bidders and targets firms with mixed feelings. Paul (2003)

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<sup>10</sup> See also Goddard et al., (2001)

established that in larger trans-national M&As during 1990, mergers achieved between 70 to 80% of their objectives, but growth declined after mergers for both the targets and the bidders. This is consistent with the findings of Paul (2003), that remarked on the ambiguity of M&As processes in the banking industry: *“Measured against industry peers, only 36 percent of the targets maintained their revenue growth in the first quarter after the merger announcement.”* (Bekier et al. (2001). On a positive note, Beitel and Schiereck (2001) allude to the fact that M&A in the banking industry create positive performance and both target and bidder shareholders get considerable positive earnings. Drawing also from a survey Epstein (2005) on a stronger note, argued that although there are many barriers to merger success, the causes of failure have often been shallow and the measure of success weak such that merger success based on short-term changes in stock price is unreasonable. He presents six key factors to M&As that generate significant value. These six factors are defined in Table 3.

**Table 3:** *The 6 keys to merger success*

<b>Key</b>	
Strategic Vision and Fit	Clear merger rationale articulated and focused on long-term competitive advantage and designed for synergies in size, geography, people, or services. Partners are the right choices for merger to fulfil the strategic vision.
Deal Structure	Price paid and type of financing are appropriate and beneficial
Due Diligence	Conducts a formal review of assets, liabilities, revenues and expenses and evaluation of culture, organizational fit and other non-financial elements.
Pre-Merger Planning	Formulation of the key integration processes and decisions are coordinated, communicated and completed quickly.
Post-Merger Integration	Processes including the management of human resources, technical operations and customer relationships are carefully blended and important decision made.
External Factors	External factors that damage the long-term merger value are distinguished from those that only damage the short-term perception due to temporary stock declines.

Moreover, there are other claims that acquiring banks perform better in the pre-merger period as stated in Craig and Santos, (1996). *“Acquiring banks generally perform better than the banks they acquire in the period prior to acquisition”* (see also Beitel et al. 2004). DeLong and Claudia (2001), however, argues that M&As create negative abnormal returns for bidding banks.

Furthermore Bekier et al. (2001) found a negative revenue effect of M&As transactions in the banking industry<sup>11</sup>. It is evident that research in this field comes to somewhat conflicting results. Most of the studies find that merger outcomes are mixed.

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<sup>11</sup> See also Paul (2003)

## CHAPTER 3

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*This chapter is concerned with the fundamental causes of consolidation and distinguishes between motives for consolidation and the environmental factors encouraging consolidation, which include technological change, deregulation, globalisation and the introduction of the euro that influence the form and pace of consolidation and the factors that may discourage financial sector consolidation, such as regulations and differences in culture and corporate governance. The relationships between M&As and efficiency are also investigated in this chapter.*

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### **3.1 Motivation for Bank Mergers and Acquisitions**

The rationale to undertake M&As decisions by financial institutions is quite substantial. For obvious reasons, the motive of going into such deals varies from the bidder to the target bank perspective. Motives for bank M&As also differ due to bank objectives, region and type. Probably a good explanation for the present wave of bank consolidation in the EU will be justified by the common financial motives driven in the region. Though each bank has its own motive for getting into mergers, we can generally categorise these as either value maximisation motives or non value maximisation motives.

#### **3.1.1 Value-maximising motives**

The value of a financial institution is defined by the present discounted value of expected future profits. By increasing expected revenues and decreasing expected costs, mergers can raise expected future profits. From the value maximization point of view, the following are the main M&A motives:

- economies of scale
- economies of scope
- increased market power
- replacement of managers or management techniques
- risk diversification
- capital strength

The expectation of most banks is to raise future profit through economies of scale and scope as well as ensuring a growing market power. These are definitely the fallouts of mergers policy to banks. Replacing management techniques, diversifying risk and gaining capital strength also are amongst a host of aspects vitally considered by mergers.

Much of the research carried out on the significance of economies of scale in the banking industry appreciated the correlation between average cost and bank size. An earlier study by Alhadeff (1954) observed the existence of economies of scale for commercial banks irrespective of their sizes. In support of this view, Shaffer (1994) analysed the cost structure of a sample of 100 large banks in the US and revealed economies of scale present through the total sample cut down cost to over \$140 billion of assets. After this disclosure, most researchers and bankers were positive that economies of scale is a guide to cost saving in banks. Vander (1996) argued that the essence of economies of scale emerged only for small banks with assets size below 10 billion euro with constant returns and he also found diseconomies of scale for the largest banks with assets levels higher than 100 billion Euros. As indicated by Amel et al. (2004), economies of scope as a complement to bank scale principally lies behind bank's discussions and consequent actions to go into mergers. Banks are most likely concerned with the trends of costs and revenues. More explicitly, in the financial sector, a wide range of services is obtained through input sharing by branches, such as economic research. Although in small banks creating such kinds of common departments is not effective, some inputs (e.g. computer systems) can be shared in the processing of loans and deposit accounts. Furthermore, studies on economies of scale by Pasiouras et al. (2005) found a negative relation between bank size and performance for both domestic and cross-border mergers in EU during the period 1995-2001.

In the same direction, Pasiouras et al. (2005)<sup>12</sup> stated clearly that, when the motive for mergers is for banks to increase market power, the strategies of product differentiation, barriers to entry and maximising market share are visibly present in merger reflections. Nevertheless, an increase in market share without the former elements recognised, the author claims will end up moving price over marginal cost which may create a centre of attention attracting new rivals and bring down price closer to marginal cost. In addition to these discussions, replacement of managerial techniques offers a passionate drive to M&As by banks. When management is not successful in the market value maximization of the firm, this inefficient management will be replaced with a more efficient one. In the consolidation process, target firms are motivated by an opinion that its resources can be managed more efficiently by the bidder firm's management. Through M&As deals firms are not only obtaining the opportunity to improve management, but also to keeping track of the shareholders' wealth maximization. When shareholders are disappointed with management performance towards the growth of their investment value, merger may be an easy and realistic method of achieving their goals. Consequently, gains from the consolidation are achieved when the management of the bidder firm is more efficient than the target's

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<sup>12</sup> See also Gaughan (1996)

management and the M&As process ensures the replacement of the target's management. Geographical and product differentiation seems reasonable driving forces to bank mergers especially when the risk perspective of banks is directed towards diversification. Consolidation is believed to achieve lower risk and reduce probability of bankruptcy. Reduction of risk is particularly necessary in the banking sector, when return on loans from different locations may have low or negative correlation with other financial instruments. According to Berger et al. (2004) bank earnings across boundaries are correlated quite low or negatively, thus diversification opportunities in cross-border M&As are beneficial to banking institutions. Nevertheless, Winton (1999) claims that reduction of risk through diversification is not always effective. He argues that diversification may lead to engagement in new segments in which the bank might have less experience. One of the required factors for a bank M&As deal is sufficient capital, which is obligatory for banks to uphold a minimum capital adequacy ratio. Even if, loan loss reserves ensure protection against the bad loans, bank's capital is the main source of protection against the bank's technical bankruptcy risk. This problem becomes more evident when loan loss reserves are not adequate to defray bad loans if the bank is faced with a serious asset quality problem. In this case surplus will have to be written off against shareholder's equity.

### ***3.1.2 Non-value-maximising motives***

From the wealth maximization motive, agency problems are considered as non-value maximization motives. Certainly value maximisation of banks does not always conform with the managers' performance. Especially, when the capital market is not perfect and there is separation of ownership from management, consolidation may not be accomplished in the interest of the acquirer bank's owners. In this case managers tend to follow their own interests such as increase in their salaries, personal risk spreading and job security through empire-building instead of maximizing bank profits. Therefore, during the consolidation process managers may be facing a choice between shareholders' and own interests. Thus, when a firm's size is a function of manager salary, the wage factor is a more central motive behind M&As. Bliss and Rosen (2001) investigated the correlation between bank M&As and CEO reward between 1986-1995 and found that CEO rewards increased considerably through the consolidation process. However, Anderson et al. (2004) examining large banks' mergers in the 1990s and the relationship with CEO rewards, found that bank CEOs have no motive for empire-building through mergers. They claim that after mergers CEO rewards are positively related to the expected gains from mergers.

Managers may also endeavour to decrease insolvency risk through M&As by diversifying bank portfolios. Furthermore, managers may for instance, get contentment in managing big companies or by increasing the size of the company and reducing firm risk. There are also some key factors, which can reduce the possibility of the manager actions that are not in the interest of the firm's owners. For instance, creating room for managerial stock ownership that provides managers with ownership of enough stock to boost personal incentives in maximising the firm value, ensuring concentrated shareholder ownership or increasing the presence of independent outsiders on the board of directors to create transparency in managerial performance.

### ***3.2 Mergers and Acquisitions and Efficiency***

Although the effect of the M&As process is not always entirely positive, M&As are the fruitful way to carry out some strategies such as reaching new geographical areas, increasing the number of services and customers. Comparing the performance of merged banks with non-merged banks makes evident the relationship between M&As and efficiency. Efficiency improvement through M&As deal may be available in different potential ways. According to Amel et al. (2004) access to cost-saving technologies and spread of fixed bank costs are main issues in efficiency improvement through bank M&As. Rhoades (1998) argues that in most cases cost reduction in the banking sector is achievable through management and labour reduction. He also claims that although there is no assurance of efficiency gains from mergers, bidder banks are more efficient than the target banks. Humphrey and Vale (2004) indicate that development of new technologies and modernizations of the electronic transactions have more effect on cost savings than the actual consolidation. According to Houston et al. (2001), mergers that happened during the 1990s generated more return than before the 1990s.

Amel et al. (2004) found that some factors, such as social cost or adverse price changes negatively when affected by efficiency. He also argues that according to the outcomes from big bank mergers, consolidation did not improve the efficiency. Moreover, Akhavein et al. (1997) claim that after M&A transactions the structure of the cost efficiency does not change dramatically, but profit efficiency improves significantly. According to the Berger et al. (1999) although there were differences in the cost-efficiency study methodologies, the outcomes from most studies have been similar. Studying the US banking market they argue that there was quite little or no cost-efficiency on average through M&As over the 1980s (Berger et al. 1999).

Profit efficiency as a consequence of M&As transactions are unite scale, scope and product mix efficiencies, which effects for both cost and revenues and also includes some of the diversification effects. Amel et al. (2004) maintained that the reason behind the profit efficiency improvement is that when big banks merge, they use more diversified portfolios and lower equity to asset ratios, which makes gain from the risk diversification. Akhavein et al. (1997) studying mega-mergers (asset size more than \$1 billion) during the 1980s found that, on average, mergers improved bank profit efficiency, especially when both target and bidder banks were relatively inefficient prior to the merger and efficiency were related to the improvement of diversification of risks. After M&As, the banks tended to shift their asset portfolios from securities to loans, have more assets and loans and to raise additional uninsured purchased funds at reduced rates, consistent with a more diversified loan portfolio (Berger et al. 1999).

Based on our comprehensive literature review, it may be concluded that previous research of the field has not established a clear relationship between firm efficiency and M&As. Therefore this study will analyse potential gains in technical (productive) efficiency visible in the individual EU banks after M&As.



## CHAPTER 4

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*The aim of this chapter is first to introduce the definition of the Data Envelopment Analysis (DEA) method used in this study and to give the reader a general indication of the alternatives to our method. The efficiency concept and the applied input-output specifications are also presented in this chapter.*

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### **4.1 Methodology**

This section looks into relevant materials with the aim to prescribe and specify a model for our study. Data Envelopment Analysis is the approach we have elected to analyse the efficiency of the banks under study. In detail, DEA will be reviewed as well as concepts associated to it such as efficiency, input oriented and output oriented approaches to decision making. The aim is to present clearly the relationship between our choice of model and the specific objective set earlier on in this study. Many studies on financial institution efficiency have explored this approach with even more recent studies taking note of developments in the financial sector. In some cases a modelling approach is used, that blends both the non parametric and parametric frontier analyses.

Some characteristics of DEA are regarded by many researchers as the main advantages of this method over the parametric approaches.

- The DEA production frontier is created from the data of the Decision Making Units (DMUs) and requires no assumptions regarding functional forms of the underlying production technology, Banker et al. (1984)
- Measuring efficiency when there are multiple inputs and outputs hence, multiple decision making units (DMUs) and price information constitutes no problem as compared to parametric approach, Berg et al. (1991)
- Possibility of getting DEA facets close enough to the observations, Berg et al. (1993)
- Studying individual production units and not only averages and DMUs are directly compared against the peers, Coelli et al. (1998)

A number of studies have been carried out on the efficiency of financial institutions using DEA analysis and such closely adapted models. The majority of these studies explored the pitfalls of the DEA and made modifications to suite the specific objective and expected results from their findings (see Brown 2006). Casu and Molyneux (2003) made valuable adjustments on a comparative study of efficiency in European banking. Their study found that, adopting bootstrap and the conventional Tobit results, the efficiency differences that existed across Europe are most likely due to country-specific aspects in banking technology.

It is a fact that it is difficult to draw statistical inference with a non parametric approach, the absence of the error term is problematic such that it only leaves the analysis with the option to deal without some factors referred to as environmental factors that in consideration might be necessary to enhance productivity (efficiency) of the decision making units. At times sensitivity to outliers is very hard to deal with in findings of efficiency corresponding to decision making units under evaluation (Brown 2006 and Bauer et al 1998). Some studies put aside extreme units out of the main data pool as a way to deal with this. Of course Brown (2006) makes it clear that, it is imperative to explain the reasons behind exclusion of particular decision making units as outliers when the results are interpreted. The problem of DEA being deterministic and having non homogenous units under assessment is also highlighted and the probable way proposed to deal with it is to cluster the units to homogenous or classify them in hierarchies and groups.

Nevertheless, compared to other methods Lozano-Vivas (1997) in the sense of Ferrier and Lovell (1990) argues that despite that DEA could lead to inefficiency estimates due to the reasons stated above, it is still preferred to other measurement methods. DEA is less arbitrary than the stochastic econometric approach which assumes that the residual term in a regression is self-possessed of the sum of a standard error and the efficiency residual. Ozkan-Gunay and Tektas (2006) point out some glaring advantages attached with the DEA approach to the studies of financial institutions efficiency, for instance, it provides an overall objectively determined efficiency value and ranking of decision making units and areas of input overused or output underproduction are easily identified. The study further employed DEA in studying the Turkish banking sector when subjected to structural weaknesses during their pre-crisis and crisis period (1990-2000). The result was convincing, given that during this period the number of commercial banks dropped (taken over by the Saving Deposit Insurance Fund-SDIF) by 25% because of inefficiency compared to the so called non failure domestic commercial banks in their sample.

In the study of efficiency and technical change for separate panels of Spanish commercial and savings banks over 1958-91, Lozano-Vivas (1997) explains the removal of interest rate deregulation and geographic restrictions on banks efficiency. Compared to the popular DEA, the study applied the DEA approach with a modified frontier analysis termed “thick frontier” that is believed to reduce the influence of high and low cost outlier observations. Put side by side with earlier non parametric productive frontier studies of only operating cost at Spanish saving banks, the result showed lower inefficiency estimates but similar estimates of cost increasing frontier shift in both situations. This difference was attached to the effect outliers had with the later

approach compared with the former that assumed zero error. In another study by Ataullah and Hang Le (2006) the impact of economic reforms on fiscal, finance and private investment and efficiency of banks in India is measured. Rather than separate frontiers they applied a grand frontier that is used to evaluate the efficiency of all banks in the data. The relationship between the efficiency result of various bank specific features and the environmental factor associated with economic reforms is measured with OLS. Findings revealed improved efficiency in public, domestic and private banks in India during the pre- and post-reform period and at the same time the relationship between fiscal deficit and bank efficiency is negative. Hence, reduction in fiscal deficit will be the best option to increase bank efficiency in India.

So far DEA has been a very useful tool for analysing efficiency of financial institutions. The results realised have been informative and reliable with regard to research of the sector as well as of the decision making units. Despite the pitfalls of DEA, it is sufficient from the selected review above that many studies that have applied this modelling guide and modified it to suite the situation and nature of their studies. Based on this background we draw our evidence to rely on DEA to measure the efficiency of merging banks in the European Union.

## ***4.2 Firm's Efficiency***

Efficiency simply, is the manner in which resources are utilized in the course of production of a set of output. It is attached to the level of performance during the transformation process of inputs to a given sets of output. This is consistent with Førsund and Hjalmarsson (1974), they set comparison of some economic unit to standard units as efficiency. According to Berg et al. (1991), efficiency measures are based on the distance of an observation to a best practice on the efficiency frontier. Such distance though may be measured in two directions, the horizontal and the vertical direction. In which case the former deals with comparing observed inputs utilisation to a set of “best-practice” inputs, hence the observed output level given the frontier technology, and the later, basically keeping the relative composition of outputs as observed, output are compared with potential output at the frontier for observed inputs. While efficiency change depends on the relative distance between the observed production units to the frontier of technology, technology change is more of a shift in the production frontier. The performance of financial institutions is naturally related to their relative level of productivity. A common way to go about this is to separate those production units that, by some standards perform well compared to poorly performing ones. Some kind of benchmarking analysis is essential that

permits one to capture the altering degree of success. Frontier analysis usually in most studies is used for this purpose. In this outlook it is possible to select best practice firms within an industry as well as assign meaningful values that correspond either to inputs overused or output underproduction (Berger and Humphrey 1997). To go about this, we need to develop models that will reasonably guide empirical procedures.

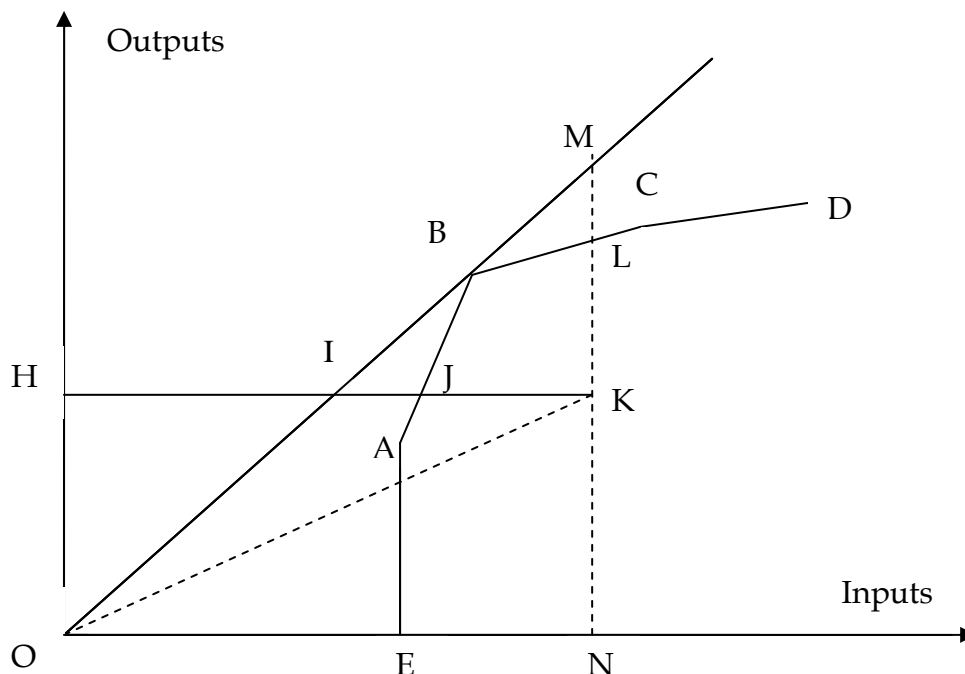
### ***4.3 Data Envelopment Analysis***

*DEA is a linear programming technique where the set of best-practice or frontier observations are those for which no other decision making unit or linear combination of units have as much or more of every output (given inputs) or as little or less of every input (given output),* Charnes et al. (1978). Data Envelopment Analysis put clearly is a non-parametric approach for multivariate frontier ranking and estimation. It is a mathematical programming application for the construction of production frontiers and the measurement of efficiency. The popularity of this approach is underscored by Berger and Humphrey (1997) in their findings; out of 130 financial institutions efficiency studies, far above half used the non parametric approach, 62 of which applied DEA. This method is far more accepted for benchmarking firms' efficiency nowadays than any other. DEA requires that sets of units with similar inputs and similar outputs are homogeneous. Very few assumptions are made and the inputs and outputs do not need to be measured in the same units, which add to the advantages of the methodology. The Berg et al. (1993) study on the technical efficiency of Norwegian Banks, considers DEA more appropriate because of the possibility of getting its facets close enough to the observations. Knowledge of existing technology is not necessary in DEA and also directly the approach can be extended from a single output to multiple outputs. As in parametric methods, such information as price to determine the dual cost function is not necessary. The DEA production frontier is defined from the actual data for the evaluated firms and shaped from the set of the piecewise linear segments which connects the set of "best-practice observations" in the data. The piecewise-linear convex hull point of view to frontier estimation was already suggested by Farrell (1957). Hence, with the DEA approach the efficiency frontier is based on all data points and all observed points lie on or below the efficiency frontier. Technical inefficiency can be measured by using both input saving and output increasing model specifications. In the input-saving method, the technical efficiency measure is intended to show by how much the observed input amount can be proportionally reduced without changing the observed output amount if the firm (DMU) were fully efficient. The output increasing measure is aimed on, how much output quantities can be proportionally

expanded without changing the input amount. Input saving and constant returns to scale (CRS) was applied by Charnes et al. (1978), while Banker et al. (1984) proposed the assumption of variable returns to scale (VRS). The CRS hypothesis is only corresponding when all DMUs are operating at an optimal scale. The choice of the measure is readily understandable in some areas. For instance, when the cost reduction is the main objective, the choice would be input orientation (Ferrier and Valdmanis 1996). Disparity between CRS and VRS technical efficiency scores will point out that the firm has scale inefficiency and this can be estimated from the difference between the VRS and CRS technical efficiency (TE) scores.

This is also a reason why our study applies VRS. When input quantities are the main decision variables input saving measures are likely to be selected. Under constant returns to scale input and output saving methods give the same technical efficiency but when increasing or decreasing to scale is introduced the results are different. In this thesis we intend to focus on the input-oriented model since input quantities will be the main decision variables. Our choice of input-oriented model does not in anyway under look the additional value output model adds to the efficiency studies, but because financial institutions show extensive interest in cost minimisation the input oriented measure is a natural choice (Berg et al. 1991).

**Figure 3:** DEA frontiers and efficiency measures



The discussion is comprehensively illustrated by the Figure 3 adopted from Berg et al. (1991). The interpretation is based on a set of constraints that implied CRS and VRS relatively with multiple outputs and inputs perceptive in the analysis. The VRS best practice frontier is given as

EABCD, and OIBM represents the frontier assuming CRS. Focusing on the input saving model, for unit K, the efficiency is given as HJ/HK for VRS and HI/HK for CRS. When the measure is restricted to reflect inputs only, point J is substituted for point K on the frontier which gives HI/HJ as the correct measure for the scale efficiency at VRS technology. Similarly scale efficiency will be the ratio of input saving measure at CRS on input saving measure at VRS.

The present study, adopts the mathematical programming constraints under the input oriented approach to measuring efficiencies of firms by Berg et al (1991) and Coelli et al. (1998). As stated in Berg et al. (1991), the mathematical programming equations are set as a constraint to minimize the distance in from the observed point to the linear combination of the best practice units along the factor ray of observed input proportion keeping a given input at a given constant output and a sample of given units. The constraint as stated in Berg et al. (1991) can be seen below.

$$\text{Min } E_{ij} \quad (1)$$

s.t

$$Yz_j \geq y_j \quad (1a)$$

$$z_j \leq E_{ij} x_j \quad (1b)$$

$$z_j \geq 0 \quad (1c)$$

Where

$E_{ij}$  represents the input saving efficiency measure for unit j

$Y$  represents  $m \times n$  matrix of outputs from all units

$y_j$  is the  $m \times 1$  vector of outputs from unit j

$X$  represents the  $k \times n$  matrix of inputs for all units

$x_j$  in the  $k \times 1$  vector of inputs for unit j

$z_j$  represents  $1 \times n$  vector of intensity weights defining the linear combination of best practice units to be compared with unit j.

According to Berg et al. (1991), problem (1) states that, the observed outputs must be less or equal to a linear combination of outputs of the best practice reference units, while the next set of inequalities states that input usage at linear combination of reference unit must be less or equal to input usage of unit j adjusted to efficient operations. Hence it is deduced from problem (1) that, the reference technology with output set  $P(y) = \{y: Yz_j \geq y, Xz_j \leq x_j, z_j \geq 0, j = 1, \dots, n\}$  is restricted to CRS. If restrictions on the sum of intensity weights are introduced, DEA can accommodate non-increasing returns to scale and variable returns to scale.

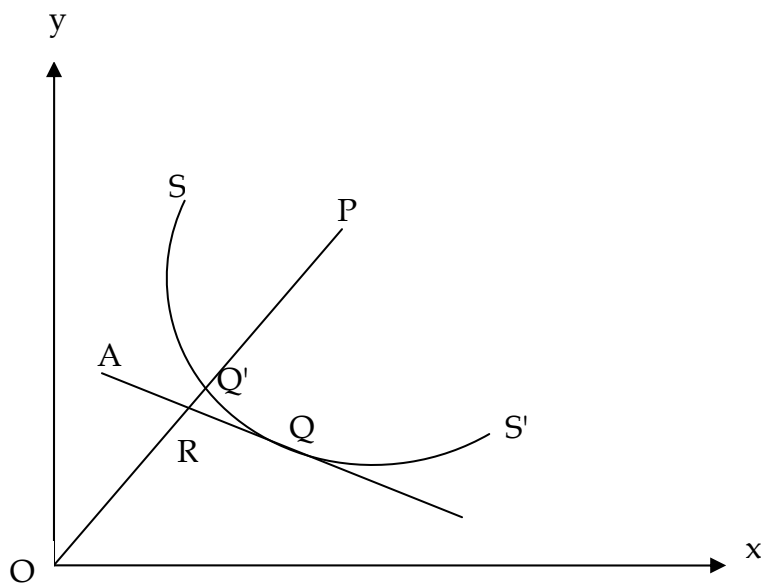
$$z_j I \leq 1 \text{ (non-increasing returns to scale)} \quad (2)$$

$$z_j I = 1 \text{ (variable returns to scale),} \quad (3)$$

where,  $I$  is the sum of vectors.

These constraints, (1), (2) and (3) are well comprehended in association with Figure 3 above. In the same line of reasoning Berg et al. (1991) recommend that, it is convenient to establish technical efficiency measures both with CRS and VRS as the reference technology by solving problem one both without and with the constraint (3).

**Figure 4:** Farrell's definition of efficiency



For specificity, Førsund and Sarafoglou (2000) presented that, according to Farrell (1957) the definition of efficiency frontier is well thought-out as the most pessimistic frontier specification. From the illustration in Figure 4, technical efficiency is estimated by the ratio  $OQ'/OP$ , defined as the inputs needed at best practice to produce observed outputs relative to observed input quantities keeping the ratio. Price efficiency is given as  $OR/OQ'$  assuming technical efficiency it is the cost of producing observed outputs at observed factor price, relative to curtail factor cost at the frontier. When technical and price efficiencies are estimated, overall efficiency is basically how much it cost to produce observed output, summarised by their respective ratios i.e.  $OR/OP$  i.e.  $OQ'/OP * OR/OQ'$ .

#### ***4.4 Input and Output Specification***

Selection of input(s) and output(s) is a problematic area in efficiency studies of financial institutions. It is apparently difficult to find consistency with the type of inputs and outputs specified in a series of similar studies, despite the fact that they all have one main objective i.e. efficiency measure of financial institutions. It is even absurd to think of a statistical framework on which significant tests can be used to choose the right inputs and outputs as would be possible with parametric models like the OLS which takes care also of correlation between inputs. Most studies have relied on literature review and understanding of the sectors under consideration in order to determine the inputs from outputs. Gutierrez-Nieto et al. (2005) study of efficiency of micro finance institutions based their choice on some specialised understanding of microfinance institution activities. Thus, the number of credit officers (number of clients outstanding or number of clients per credit officer) and operating expenses such as inputs while interest and fee income, gross loan portfolio and number of loans outstanding are outputs. In this case, the number of credit officers as well as the operating expenses of institutions are verifiable inputs for which cutting down on the level usage can directly reduce cost. Besides, it is possible from first side to measure the potential of these inputs by the number of clients served and return from the loans made out to customers. Ozkan-Gunay and Tektas (2006) on Turkish banks, used personnel expenses, administrative expenses and interest expenses as inputs and total deposits, total loans, total securities, total interest income are the corresponding outputs. Ataullah and Hang Le (2006) in the India banking set up, developed two models with two sets of inputs that included interest expenses and operating expenses on one model and interest income and operating income in another model matched to a set of outputs that included loans and advances and investments. Referring to these studies it is but normal to go ahead with our study where the choice of inputs and output conveniently satisfy the intermediation modelling approach in measuring efficiency of financial institutions.



## CHAPTER 5

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*In this section, production modelling in financial institutions and the choice of our production model are described. Data collection and summary statistics of the output and input variables are also presented in this chapter.*

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### ***5.1 Modelling Production in Financial Institutions***

Efficiency studies of financial institutions have been under a heated debate especially in specifying a good model that takes in thought the general intuition of determining the outputs and inputs. One of the areas of conflict has been whether to classify bank deposit under inputs or outputs. Since no particular theoretical framework has been exhaustive and convincing enough from a major standpoint, most studies usually base their selection on a review of some of the work on the financial institution efficiencies. In the sense of Berger and Humphrey (1997) two main model approaches have so far been widely applied, the production and the intermediate approach. The flow of services rendered by financial institutions is measured somewhat differently by each of the approaches. Financial institutions are service producers in the production approach with loan applications, credit reports, checks and other payments as well as insurance policy classified as bank inputs for which output is the qualitative and quantitative measure of the transactions made by financial institutions over time. The intermediate approach alternatively, considers financial institutions as intermediaries of funds for investors and savers. Given the problem of lack of important service flow data needed for the production approach, the intermediate model considers loans, deposits and claims as a measure of the stock of financial value in the accounts, hence bank output.

According to the Berger and Humphrey (1992) three alternative models consider the definition of inputs and outputs for the banking industry. These approaches are: “the asset approach”, “the user cost approach”, and “the value-added approach”. According to the authors the asset approach is almost similar to the intermediation model stated earlier on. This approach sees financial institutions as intermediaries between liability holders and funds beneficiaries. Hence loans and other assets are given output quality while deposits and other liabilities are inputs to the intermediation process. However a weakness to this approach is that it is well suited for big financial institutions that are involved in large volumes of transactions compared to small institutions with a variety of functions that are value added. The user cost approach on the other hand determines if a finished product is input or output by locating the source of net revenue given said financial asset or liability. Therefore the opportunity cost of financial returns on assets

and cost of liability are taken as a way to distinguish inputs from outputs. This approach is not without its own shortcoming in that; fluctuations in interest rate are tied to user cost which also tends to fluctuate even more than interest rates so that it becomes difficult to determine inputs and outputs. Hence it becomes ambiguous when we are thrown in situations that a financial product is input in one period and output in another period, besides it is an arduous task to measure marginal cost and revenue for individual liabilities. Finally, the value added approach identifies the output attribute in assets and liabilities and determines the input and output based on their value added quality. Financial products with ability to add value are treated as outputs from those without this quality. Berg et al. (1991) and the line of reasoning also found in Sealey and Lindley (1977), where banking is seen as interdependent activities, leave no option other than the implicit assumption that classifies deposits as output given their resource consuming feature. However as usual, the above authors also noted that deposits in some cases are applied as an input; of course a wayward measure of bank output or input will affect the results. The way out of this they proposed is to carry out parallel analysis in which deposits and loans activities are measured first by the number of accounts and their average, and secondly by the total balances. Serrano-Cinca et al (2002), plainly presents the intermediation model versus to the production model, as primarily collecting deposits and giving loans to create profit. Hence deposits and acquired loans are classified as inputs. Given these modelling inconsistencies, the study covers this gap by means of a more generalised model that considers the philosophies of both models. This study suggests a new specification of the firm production modelling known as principal component analysis, Hierarchical Cluster Analysis (HCA), and multiple regressions which dealt with inconveniencies in the specification of inputs and outputs.

Despite that there are many other models to studies of financial institution efficiencies, we shall narrow our choice to decide between the intermediation and the production model as it is evident from the literature reviewed that these two models are more adaptive and extensively used than any other. Taking side on this issue is very complicated, yet, Berger and Humphrey (1997) cited above, have made a sound and reliable judgement that this study intends to rely on for obvious reasons. Our choice will also depend on the direction we select to classify financial institutions activities. Efficiency studies of financial institutions in most cases use either of the two modelling guides; production or intermediate model. Physical resources as labour and plants are considered in the production model as tools to facilitate transactions like accepting deposits, creating credits or issuing out loans. In this model inputs include assets as well as labour, while deposits, loans and other bank outreach to the public are treated as output.

Besides that each model has got some edge over the other, it is certainly important to realise that none of the models captures totally what is needed in a concise and exhaustive financial institution model. The role of financial institutions as transaction providers, document processing service and intermediates between savers and investors, is far from being included totally in a single model. Hence the production model is well adapted where efficiency studies are limited to branches of financial institutions since branches usually have nothing to do with funding and investment decisions. However, this is not the case in this study where we classify financial institution deposits with related items as inputs and loans as output as in the intermediation model. Therefore this study is underpinned on the intermediation model of financial institution efficiency studies.

Based on this we will have to apply the intermediation model in this study because it is inclusive of interest and more appropriate in a situation where interest expenses make up more than half of the total cost of financial institutions. Secondly, the model is the best suited in frontier efficiency analysis of financial institutions when cost minimisation needs to consider total cost to maximise bank profit rather than only the production cost.

In accordance with the above mentioned studies, the following variables are chosen and in this study one output and two inputs applied respectively.

Y - Total earning assets (loans and other earning assets);

X1 - Total costs (interest expenses, non-interest expenses),

X2 -Total customers and short term funding (total deposits).

Short definitions of the selected variables in our data set:

*Total earning assets* are addition of the total loans that banks can make over a given period given the available inputs plus the earnings from other bank assets. These are all incomes and earned assets obtained by a company. Total earning assets are generally interest-bearing accounts, bonds, and securities available for sale.

*Total Cost* consists of interest expenses and non-interest expenses. More, specifically, interest expense is one of the major categories on a bank's income statement and obtains from interest on deposits from customers, from financial institutions and debt instruments.

Non-interest expenses items consist of the sum of personnel compensation, legal expense, office occupancy and equipment expense, other non-interest expense and loan loss provisions. Because

of different types of accounting reports from different countries, in our data the non-interest expenses concept is appreciated in two ways. The first approach is that non-interest expenses are the sum of the personnel expenses and the other non interest expenses. The second approach is that, it includes overhead expenses which take into consideration, personnel expenses.

*Total customers and short term funding* - the term actually is the same as the term deposit which is used by the banking industry in financial statements to describe the liability owed by the bank to its depositor and not the funds (whether cash or checks) themselves, which are shown as an asset of the bank. Different types of deposit accounts are used to fund investments on the asset side of the balance sheet. Total customers and short term funding are represented here as the total bank deposits.

## ***5.2 Data Description***

This study builds on the same data set used in Altunbas and Ibanez (2004). Our data include registered M&As taking place in the European Union banking sector and we identified 207 domestic M&A-transactions of EU banks between 1994 and 1999 by using Thomson Financial SDC (Securities Data Company – Mergers and Acquisitions Database) data source. Some banks have been involved in more than one merger during the period of study, which leaves us with a total of 134 remaining bidder banks. To be included in our sample, different types of banks have to be independent entities belonging to one of 11 EU member countries: Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain and the United Kingdom.

The accompanying individual accounting data for each of the acquiring banks come from the Bank Scope database. The 134 bidder banks of the EU region were drawn from the London-based International Credit Analysis Ltd's Bankscope database. The restriction to include only bidder banks in the sample is because, bidders are generally larger than targets and they are more likely to absorb the targets in the consolidation process.

The data were extracted from non-consolidated balance sheets and income statement data corresponding to the years 1994-2001, starting by the year of merger and ending two years after the transactions. The main reason for choosing the data period starting by the year of merger is that there is a difference in the corporate culture between bidder banks and also the impact of

national culture dissimilarities appears in post-merger performance. Such differences need a time period for cultural integration as part of the M&As process.

All data are reported in USD and they are in real terms. Although there still are no single accounting principles and standards applied by all bidder banks, balance sheet and income statement data are adjusted by Fitch IBCA Bankscope to improve the comparability across EU countries.

Tables 4-6 present the summary statistics of the output and input variables used in the efficiency frontier estimations over the years 1994-2001.

**Table 4: Descriptive Statistics Output, 1994-2001, thousands of USD**

	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>
<i>Mean</i>	45 295,8	54 328,8	56 971,7	58 491,7	68 977,7	70 699,9	80 067,3	97 942,4
<i>S.D.</i>	75 000,7	91 178,8	95 711,8	98 903,3	120 935,3	128 171,9	130 815,6	144 806,2
<i>Median</i>	10 634,0	13 277,3	14 920,2	15 106,0	15 140,4	15 287,8	17 665,8	25 633,9
<i>Minimum</i>	106,3	118,2	72,2	64,8	83,9	111,7	128,8	276,0
<i>Maximum</i>	366 238,2	441 721,5	487 244,1	507 704,9	639 005,7	700 615,8	590 668,0	589 062,3

**Table 5: Descriptive Statistics Input 1, 1994-2001, thousands of USD**

	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>
<i>Mean</i>	35 000,1	41 566,0	43 567,3	45 491,2	53 666,6	54 303,8	61 033,2	74 080,3
<i>S.D.</i>	58 807,9	69 630,3	73 525,2	78 555,5	94 212,0	98 125,4	98 569,1	108 981,3
<i>Median</i>	9 375,2	11 057,0	11 914,3	11 590,2	12 831,4	12 368,3	11 630,1	17 587,1
<i>Minimum</i>	97,2	107,1	61,9	50,2	69,5	99,8	117,0	231,8
<i>Maximum</i>	323 602,2	371 920,1	416 611,4	436 230,5	498 031,7	545 442,0	424 298,1	446 583,2

**Table 6: Descriptive Statistics Input 2, 1994-2001, thousands of USD**

	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>
<i>Mean</i>	3 424,4	4 030,6	3 997,8	3 773,2	4 352,4	4 148,5	5 197,2	6 308,6
<i>S.D.</i>	5 434,4	6 447,3	6 307,1	6 154,5	7 606,3	7 586,3	8 710,0	9 425,1
<i>Median</i>	1 002,9	1 052,1	1 039,7	975,0	1 007,4	821,9	992,8	1 657,0
<i>Minimum</i>	14,3	8,4	8,8	6,3	4,9	7,2	6,9	15,7
<i>Maximum</i>	25 067,9	29 537,3	29 908,5	30 903,0	37 324,4	40 802,6	43 181,7	40 934,1

*Note: Output is total earning assets in thousands of USD, Input 1 is customer and short term funding in thousands of USD, Input 2 is total costs in thousands of USD and S.D. denotes standard deviation*

These tables show that average size of the output and inputs increased over the period and illustrate the development of the variables over time. In Table 7, the number of different types of banks is presented for each country during 1994-1999.

**Table 7: Number of banks by type and by country, 1994-1999**

	Com:	Coop:	Sav:	RE/Mr.	Spc. Gov.	Inv./Sc.	Bk Hol.	Med.& L.	Non.	Total number of banks by country:
AUSTRIA	2	3	3	1						9
BELGIUM	2	1	0							3
FRANCE	11	4	2		1				1	19
GERMANY	13	6	8	5	2					34
GREECE	3		0							3
IRELAND			0			1				1
ITALY	16	12	6		1	2	1	1		39
NETHERLANDS	1		1				1			3
PORTUGAL	4		0			1				5
SPAIN	6		8			1	1			16
UNITED KINGDOM	1						1			2
<b>Total number of banks by type:</b>	<b>59</b>	<b>26</b>	<b>28</b>	<b>6</b>	<b>4</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>134</b>

Abbreviation expansion of the different bank types are described below:

Com:	<b>Commercial bank</b>
Coop:	<b>Cooperative bank</b>
Sav:	<b>Savings bank</b>
RE/Mr.	<b>Real Estate / Mortgage bank</b>
Spc. Gov.	<b>Specialised Governmental Credit Institution</b>
Inv./Sc.	<b>Investment Bank / Securities House</b>
Bk Hol.	<b>Bank Holding and Holding Company bank</b>
Med.& L.	<b>Medium and Long Term Credit bank</b>
Non.	<b>Non-banking Credit Institution</b>

It is evident that there is a high number of commercial, cooperative and savings banks. Commercial banks constitute 44% of the total number of banks, while 21% of all banks are savings banks and 19% are cooperative banks. Together these types of banks are 84% of the total banks. Moreover, the number of banks in Italy, Germany, France and Spain are considerably higher than in the other countries and 81% of the total banks are from these four countries. Therefore, these types of banks, as well as these countries will be in the focus of our attention and subject to detailed examination.

## CHAPTER 6

*This chapter exhibits the empirical results and presents a discussion of our findings. Pre- and post-merger technical efficiencies are measured and compared under Variable Returns to Scale (VRS) for different countries and types of banks. Fully efficient banks are also presented.*

### 6.1 Empirical Results

#### 6.1.1 Efficiency Results

In this section we present the empirical results and follow the order outlined in the previous chapters by comparing pre- and post-merger efficiency scores under the VRS approach. The main reasons for applying VRS are that as stated previously, the VRS technology is much more flexible compared to CRS and envelops a data in a closer way. Berg et al. (1993) indicates that the VRS may seem to be the most preferred assumption when some DMUs are not operating at optimal scale and under the VRS technology, scale efficiency measures may be acquired for each firm by performing both a CRS and a VRS DEA efficiency calculation.

Table 8 shows the efficiency scores resulting before and after mergers under the intermediation model for all banks. The interpretation of the technical efficiency measure used in this study is intended to show by how much the observed input amount can be proportionally reduced without changing the observed output amount with frontier production technology.

**Table 8:** Pre- and post-merger efficiency

<i>All Banks</i>												
		<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
Year	Bank no.	Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	16	16	0.55	0.18	0.35	72	0.61	0.19	0.27	80%	20%	0%
1995	29	58	0.47	0.15	0.24	72	0.51	0.14	0.22	83%	14%	3%
1996	20	57	0.51	0.18	0.31	54	0.59	0.17	0.37	85%	5%	10%
1997	25	103	0.53	0.15	0.34	74	0.64	0.15	0.43	81%	15%	4%
1998	21	97	0.50	0.15	0.13	54	0.59	0.12	0.34	81%	5%	14%
1999	23	127	0.55	0.15	0.24	46	0.62	0.15	0.41	70%	17%	13%
<b>1994-1999</b>	<b>134</b>	<b>458</b>	<b>0.52</b>	<b>0.16</b>	<b>0.13</b>	<b>372</b>	<b>0.59</b>	<b>0.16</b>	<b>0.22</b>	<b>80%</b>	<b>13%</b>	<b>7%</b>

Our general findings is that on average 80% of all bidder banks improved their efficiency scores after the M&A transactions, while 13% of the banks did not obtain any definitive result after the consolidation and their efficiency scores fluctuated after mergers. Also technical efficiency scores of 7% of the banks decreased after the consolidation. The average inputs could be potentially reduced by 48% without affecting the level of pre-merger output, while this indicator

was 41% for the post-merger transactions. After the consolidation the banks were on average 59% efficient compared with the most efficient banks in the study. Consequently, these banks should be able to produce the observed amount of outputs using 41% less of the inputs if it applied best practice technology. The highest percentage of the efficiency improvement was obtained for the EU banks which merged in 1996 and 85% of these banks increased their technical efficiency scores after the consolidation.<sup>13</sup>

As previously mentioned, since the number of the commercial, cooperative and savings banks are considerably higher than the other types of banks and the banks from Italy, Germany, France and Spain are constitute main part of the total banks, our detailed analyze focused on the technical efficiency of these types of banks as well as for these countries. In particular, these types of banks and the four countries indicated above constitute 84% and 81% of the total banks respectively. Table 9 presents comparative pre- and post-merger efficiency scores by bank types.

**Table 9: Pre- and post-merger efficiency by bank type**

<i>Commercial Banks</i>												
Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	7	7	0.54	0.15	0.38	32	0.58	0.17	0.37	57%	43%	0%
1995	5	10	0.38	0.12	0.24	19	0.42	0.11	0.22	80%	20%	0%
1996	9	27	0.46	0.16	0.31	26	0.53	0.15	0.39	89%	0%	11%
1997	15	60	0.58	0.18	0.35	45	0.68	0.18	0.43	80%	13%	7%
1998	11	51	0.52	0.17	0.25	31	0.59	0.14	0.34	73%	9%	18%
1999	12	66	0.53	0.15	0.24	24	0.61	0.14	0.41	67%	17%	17%
<b>1994-1999</b>	<b>59</b>	<b>221</b>	<b>0.53</b>	<b>0.17</b>	<b>0.24</b>	<b>177</b>	<b>0.59</b>	<b>0.17</b>	<b>0.22</b>	<b>75%</b>	<b>15%</b>	<b>10%</b>

<i>Cooperative Banks</i>												
Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	4	4	0.53	0.18	0.39	19	0.61	0.21	0.27	100%	0%	0%
1995	7	14	0.43	0.09	0.34	15	0.50	0.12	0.35	57%	43%	0%
1996	4	12	0.54	0.16	0.36	11	0.62	0.12	0.43	100%	0%	0%
1997	5	20	0.42	0.06	0.34	14	0.54	0.03	0.49	100%	0%	0%
1998	3	15	0.48	0.09	0.37	6	0.64	0.06	0.55	100%	0%	0%
1999	3	18	0.49	0.07	0.38	6	0.54	0.04	0.47	100%	0%	0%
<b>1994-1999</b>	<b>26</b>	<b>83</b>	<b>0.47</b>	<b>0.11</b>	<b>0.34</b>	<b>71</b>	<b>0.57</b>	<b>0.14</b>	<b>0.27</b>	<b>88%</b>	<b>12%</b>	<b>0%</b>

<sup>13</sup> The complete list of the sample banks is presented in the Appendix A, while Appendix C presents histograms of the efficiency distributions



**Savings Banks**

Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	3	3	0.42	0.08	0.35	13	0.53	0.13	0.38	100%	0%	0%
1995	9	18	0.44	0.05	0.35	18	0.49	0.06	0.38	100%	0%	0%
1996	3	9	0.44	0.08	0.35	9	0.54	0.08	0.38	100%	0%	0%
1997	4	15	0.47	0.05	0.40	10	0.62	0.09	0.50	75%	25%	0%
1998	4	18	0.48	0.08	0.37	11	0.60	0.04	0.55	100%	0%	0%
1999	5	25	0.57	0.14	0.42	10	0.64	0.14	0.49	60%	20%	20%
<b>1994-1999</b>	<b>28</b>	<b>88</b>	<b>0.49</b>	<b>0.10</b>	<b>0.35</b>	<b>71</b>	<b>0.56</b>	<b>0.11</b>	<b>0.38</b>	<b>89%</b>	<b>7%</b>	<b>4%</b>

These tables indicate that all three types of banks improved their technical efficiency scores through consolidation transactions. Regarding the savings banks, the obtained efficiency improvement percentage is higher than the other counterparts and savings banks benefited from the consolidation more than the other types of banks. 89% of savings banks increased their efficiency scores after the M&As. Although this indicator does not differ much for the cooperative banks where 88% of the banks display efficiency improvement, it should be noted that the average efficiency score for cooperative banks was higher than for the savings banks. Moreover, commercial banks seem less likely to experience the same extent of efficiency improvement comparing with the other types of banks and only 75% of the commercial banks increased the efficiency scores after the consolidation. Also the average efficiency scores of these three types of banks increased after the M&A deals. The average inputs for the commercial banks could be potentially reduced by 47% before merger, while this indicator declined to 41% after merger without affecting the level of the outputs. The substantial growth of the average efficiency score after consolidation was 10% for the cooperative banks and the average input savings percentage declined by 10% after M&As. These indicators fluctuate for the savings banks and the difference between pre- and post-merger average input savings are higher for savings banks also. After the consolidation the banks were on average 56% efficient compared with the most efficient banks in the study. Consequently, these banks should be able to produce the observed amount of outputs using 44% less of the inputs if it applied best practice technology.

In 1996, the obtained percentage of the efficiency improvement after the consolidation for all types of banks was higher comparing with the other years of the study period. For the commercial banks the highest percentage of the efficiency improvement was obtained during the 1995-1997 merger years. All cooperative banks increased their efficiency scores through

consolidation during the entire study period, excluding the banks merged in 1995. This tendency is observed for the savings banks during the 1994-1996 and 1998 merger years.

Table 10 presents comparative pre- and post-merger efficiency scores by country.

*Table 10: Pre- and post-merger efficiency by country*

**FRANCE**

Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	3	3	0.49	0.08	0.42	15	0.50	0.08	0.37	67%	33%	0.0%
1995	2	4	0.28	0.07	0.24	11	0.36	0.07	0.22	100%	0%	0.0%
1996	3	9	0.64	0.19	0.37	9	0.71	0.23	0.39	100%	0%	0.0%
1997	5	20	0.55	0.12	0.40	14	0.64	0.15	0.46	80%	20%	0.0%
1998	3	15	0.58	0.21	0.38	6	0.63	0.16	0.47	100%	0%	0.0%
1999	3	18	0.58	0.12	0.44	6	0.66	0.13	0.54	100%	0%	0.0%
<b>1994-1999</b>	<b>19</b>	<b>69</b>	<b>0.56</b>	<b>0.17</b>	<b>0.24</b>	<b>61</b>	<b>0.57</b>	<b>0.18</b>	<b>0.22</b>	<b>89%</b>	<b>11%</b>	<b>0.0%</b>

**GERMANY**

Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	5	5	0.77	0.16	0.53	22	0.82	0.11	0.56	60%	40%	0.0%
1995	9	18	0.59	0.18	0.41	18	0.64	0.18	0.46	100%	0%	0.0%
1996	4	12	0.54	0.13	0.42	12	0.62	0.19	0.48	100%	0%	0.0%
1997	7	28	0.61	0.20	0.40	20	0.69	0.22	0.43	43%	57%	0.0%
1998	1	5	0.52	0.04	0.48	3	0.57	0.01	0.56	100%	0%	0.0%
1999	8	44	0.60	0.16	0.45	16	0.66	0.19	0.46	38%	25%	37.5%
<b>1994-1999</b>	<b>34</b>	<b>112</b>	<b>0.60</b>	<b>0.17</b>	<b>0.40</b>	<b>91</b>	<b>0.69</b>	<b>0.19</b>	<b>0.43</b>	<b>68%</b>	<b>24%</b>	<b>8.0%</b>

**ITALY**

Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	6	6	0.41	0.05	0.35	27	0.48	0.13	0.27	100%	0%	0%
1995	10	20	0.39	0.03	0.34	21	0.44	0.06	0.35	60%	40%	0%
1996	4	12	0.37	0.01	0.35	12	0.51	0.08	0.38	100%	0%	0%
1997	6	24	0.43	0.08	0.34	18	0.56	0.07	0.46	100%	0%	0%
1998	7	31	0.50	0.14	0.13	17	0.65	0.11	0.37	71%	29%	0%
1999	6	31	0.49	0.15	0.26	12	0.60	0.14	0.46	83%	17%	0%
<b>1994-1999</b>	<b>39</b>	<b>124</b>	<b>0.45</b>	<b>0.12</b>	<b>0.13</b>	<b>107</b>	<b>0.53</b>	<b>0.12</b>	<b>0.27</b>	<b>82%</b>	<b>18%</b>	<b>0%</b>

**SPAIN**

Year	Bank no.	<i>pre-merger efficiency</i>				<i>post-merger efficiency</i>				<i>efficiency change</i>		
		Obs.	Mean	Sd.Dv.	Min	Obs.	Mean	Sd.Dv.	Min	Incr.	Fluc.	Decr.
1994	1	1	0.53	-	0.53	3	0.51	0.05	0.47	0%	100%	0%
1995	3	6	0.42	0.08	0.33	12	0.52	0.10	0.39	100%	0%	0%
1996	2	6	0.53	0.23	0.38	5	0.52	0.09	0.42	50%	0%	50%
1997	4	16	0.47	0.06	0.40	12	0.62	0.08	0.53	75%	25%	0%
1998	3	13	0.47	0.08	0.37	9	0.61	0.04	0.55	100%	0%	0%
1999	3	18	0.52	0.10	0.35	6	0.60	0.04	0.55	67%	33%	0%
<b>1994-1999</b>	<b>16</b>	<b>60</b>	<b>0.49</b>	<b>0.11</b>	<b>0.33</b>	<b>47</b>	<b>0.57</b>	<b>0.09</b>	<b>0.39</b>	<b>75%</b>	<b>19%</b>	<b>6%</b>

It evidently seems that all four countries indicated above improved their technical efficiency after M&As. The country that benefited the most from the consolidation was France where 89 % of the banks show efficiency improvements. German banks are less likely to experience efficiency improvements of the same magnitudes as the other countries of the study region and only 68% of the German banks increased their efficiency scores after consolidation. These indicators for the Italian and Spanish banks are 82% and 75% respectively. Also the average efficiency scores of the banks from all four countries increased after consolidation. The average input saving percentages for the French banks do not differ much comparing before and after M&As and could be potentially reduced by 43% after the consolidation without affecting the level of the outputs. The growth of the average efficiency scores after consolidation is similar for the German, Italian and Spanish banks and the average input saving percentage potentially decreased by 8-9% after M&As and after the consolidation, potential average input saving for the German, Italian and Spanish counterparts were 31%, 47% and 43% respectively.

All French banks that merged during 1995-1996 and 1998-1999 gained and show efficiency improvements after M&As. After consolidation, efficiency improvement is also observed for all German banks that merged during 1995-1996 and in 1998. This tendency is also found for the Italian banks merged during 1996-1997.

### **6.1.2 Fully Efficient Banks**

In this section we present fully efficient banks considering during pre- and post-merger periods. It is worth noting that regarding the three types of banks included in our analysis, fully efficient units are observed for only commercial banks.<sup>14</sup> Three commercial banks achieved full

<sup>14</sup> The complete list of fully efficient banks is presented in Appendix B

efficiency after the consolidation transactions, while one commercial bank did not maintain its pre-merger efficiency level and the efficiency score of this bank declined from a fully efficient point after the M&As.

With regard to the countries, two French and four German banks achieved full efficiency after M&As, while one French and one German bank did not maintain the full efficiency after the consolidation. Also one German bank maintained its pre-merger fully efficient score after the consolidation transaction.

## ***6.2 Relationship Between Business Cycle and M&As***

Macroeconomic factors are other aspects that affect the decision of firms to merger with other firms. Mueller (1989) investigated the relationship between merger waves and business cycles and found that merger waves correspond with economic booms. He argues that during booms the economy benefits from a rapid growth rate and the stock market prices surge. In this study when examining the European banking sector of 11 countries during the 1990s, we observed that the peak point of the economic boom in EU was in 1996. We also found that the highest level of efficiency improvement after consolidation was for the banks which merged in 1996. So, in this study we find indications that make us assume that the business cycle might concur with efficiency change.

## **CHAPTER 7**

### **7.1 Conclusions**

In this study we have focused on the pre- and post-merger efficiencies of European Union banks during the period 1994-2001. Since, the deposits related items are considered to be inputs and loans to be outputs as in the intermediation model and the financial institutions are regarded as being financial intermediaries that transfer funds from suppliers of funds to users of funds, we have employed the intermediation approach when modelling bank production in this study. The estimation is based on a large sample of individual banks of different types and we examine technical efficiency across countries and bank type categories.

Empirical results show that:

Firstly, regarding the types of banks and their obtained average post-merger efficiency, results improved for both commercial and cooperative as well as for savings banks. Also savings banks obtained the highest efficiency results after the mergers, while the commercial counterpart is the type of bank that exhibits the smallest efficiency gain after consolidation. Secondly, comparing the efficiency improvement results for countries after M&As, the French and Italian banks on average obtained higher efficiency scores than their German counterparts.

Generally, this study found that obtained efficiency after the consolidation is the highest for the banks which merged in 1996. Finally, it may be concluded that M&As in the banking sector are beneficial and that mergers appear to have improved technical efficiency.

### **7.2 Suggestions for Further Research**

Our suggestion for the future research includes a study of the relationship between merger waves and the business cycle. From a theoretical perspective, we believe that there is a relationship between economic booms and M&As. This research would naturally pursue our assumption. It would be very interesting to study how macroeconomic factors influence the M&A waves.

Furthermore, another interesting direction of future work might be to test dependence of technical efficiency of the banks after merger on the asset size of the merger partners. The study would be providing important insights into the size-efficiency relationship in the banking sector.

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## APPENDICES

### *APPENDIX A: Sample banks' name, type and country*

	<b>Bank name</b>	<b>Bank type</b>	<b>Country</b>
1	Bank Austria AG	Commercial Bank	Austria
2	Oesterreichische Postsparkasse PSK	Savings Bank	Austria
3	Raiffeisen Zentralbank Oesterreich AG - RZB	Cooperative Bank	Austria
4	Erste Oesterreichische Spar-Casse-Bank	Savings Bank	Austria
5	Creditanstalt AG (Old)	Commercial Bank	Austria
6	Oesterreichische Volksbanken AG	Cooperative Bank	Austria
7	Bausparkasse Wuestenrot	Real Estate / Mortgage Bank	Austria
8	Raiffeisenlandesbank Steiermark	Cooperative Bank	Austria
9	Erste Bank der Oesterreichischen Sparkassen AG	Savings Bank	Austria
10	BACOB Holding SC	Cooperative Bank	Belgium
11	Bank Brussel Lambert - BBL-Banque Bruxelles Lambert s.a./n.v. - BBL	Commercial Bank	Belgium
12	Kredietbank KB	Commercial Bank	Belgium
13	BNP Paribas	Commercial Bank	France
14	Crédit Agricole Centre France	Cooperative Bank	France
15	Banque de Baecque Beau	Commercial Bank	France
16	Banque Française de Crédit Coopératif BFCC	Cooperative Bank	France
17	Natexis Banques Populaires	Commercial Bank	France
18	Crédit Mutuel de Loire-Atlantique et du Centre-Ouest	Cooperative Bank	France
19	Via Banque	Commercial Bank	France
20	Crédit Industriel et Commercial - CIC	Commercial Bank	France
21	Crédit Commercial de France	Commercial Bank	France
22	Sovac	Commercial Bank	France
23	Caisse Nationale de Crédit Agricole CNCA	Cooperative Bank	France
24	Caisse des Dépôts et Consignations	Specialised Governmental Credit Inst.	France
25	Crédit du Nord	Commercial Bank	France
26	Fortis Banque France SA	Commercial Bank	France
27	Comptoir de Banque	Commercial Bank	France
28	Caisse d'épargne Provence - Alpes - Corse	Savings Bank	France
29	Caisse d'épargne des Pays de la Loire	Savings Bank	France
30	Crédit Foncier de France	Non-banking Credit Institution	France
31	Société Générale	Commercial Bank	France
32	GZB-Bank Genossenschaftliche Zentralbank AG Stuttgart	Cooperative Bank	Germany
33	Commerzbank AG	Commercial Bank	Germany
34	Deutsche Genossenschaftsbank DG BANK	Cooperative Bank	Germany
35	Bayerische Landesbank Girozentrale	Specialised Governmental Credit Inst.	Germany
36	Westdeutsche Landesbank Girozentrale WestLB	Specialised Governmental Credit Inst.	Germany
37	Frankfurter Hypothekenbank Centralboden AG	Real Estate / Mortgage Bank	Germany
38	Sparkasse Trier	Savings Bank	Germany
39	Landescreditbank Baden-Württemberg	Real Estate / Mortgage Bank	Germany
40	Volksbank Ludwigsburg eG	Cooperative Bank	Germany
41	SGZ Bank Südwestdeutsche Genossenschafts - Zentralbank AG	Cooperative Bank	Germany
42	Kreissparkasse Kassel	Savings Bank	Germany
43	Sparkasse Chemnitz	Savings Bank	Germany
44	Sparkasse in Bremen	Savings Bank	Germany
45	Deutsche Bank AG - IAS	Commercial Bank	Germany

46	Hamburger Sparkasse	Savings Bank	Germany
47	Vereins- und Westbank AG	Commercial Bank	Germany
48	SchmidtBank KGaA	Commercial Bank	Germany
49	Bankhaus H. Aufhäuser	Commercial Bank	Germany
50	Kasseler Sparkasse	Savings Bank	Germany
51	M.M. Warburg Bank - M.M. Warburg & CO Kommanditgesellschaft auf Aktien	Commercial Bank	Germany
52	Bayerische Hypo-und Vereinsbank AG - IAS	Commercial Bank	Germany
53	Südwestbank AG	Commercial Bank	Germany
54	Dresdner Bank AG	Commercial Bank	Germany
55	Wüstenrot Bausparkasse AG	Real Estate / Mortgage Bank	Germany
56	Wüstenrot Bank AG	Commercial Bank	Germany
57	Sparkasse Heidelberg	Savings Bank	Germany
58	Landesbank Baden-Wuerttemberg	Savings Bank	Germany
59	Deutsche Bausparkasse BADENIA AG	Real Estate / Mortgage Bank	Germany
60	Bankhaus Partin GmbH & Co. Kommanditgesellschaft auf Aktien	Commercial Bank	Germany
61	VR-Bank Rhein-Sieg eG	Cooperative Bank	Germany
62	Deutsche Postbank AG	Commercial Bank	Germany
63	Allgemeine Hypothekenbank AG - AHB	Real Estate / Mortgage Bank	Germany
64	Frankfurter Volksbank eG	Cooperative Bank	Germany
65	Allgemeine Deutsche Direktbank AG	Commercial Bank	Germany
66	EFG Eurobank SA	Commercial Bank	Greece
67	Piraeus Bank SA	Commercial Bank	Greece
68	Alpha Bank AE	Commercial Bank	Greece
69	Cassa di risparmio di Verona Vicenza Belluno e Ancona Banca SpA - CARIVERONA	Commercial Bank	Italy
70	Banca Antoniana Popolare Veneta SCaRL-Banca Antonveneta	Commercial Bank	Italy
71	Credito Valtellinese SCaRL	Cooperative Bank	Italy
72	Cassa di risparmio in Bologna SpA - CARISBO	Savings Bank	Italy
73	Cassa di Risparmio di Parma e Piacenza SpA	Savings Bank	Italy
74	Cassa di Risparmio delle Provincie Lombarde SpA - CARIPLO	Savings Bank	Italy
75	Banca Popolare di Novara SCaRL	Cooperative Bank	Italy
76	Istituto Mobiliare Italiano SpA - IMI	Medium & Long Term Credit Bank	Italy
77	Cassa di Risparmio di Padova e Rovigo SpA	Savings Bank	Italy
78	Banca Popolare di Puglia e Basilicata	Cooperative Bank	Italy
79	Banca Agricola Mantovana SCaRL	Cooperative Bank	Italy
80	Banca di Legnano SpA	Commercial Bank	Italy
81	Monte dei Paschi di Siena (Gruppo)	Bank Holding & Holding Company	Italy
82	Gruppo Banca Carige	Savings Bank	Italy
83	Banca CRT SpA - Banca Cassa di risparmio di Torino	Savings Bank	Italy
84	Banca Popolare di Milano SCaRL	Cooperative Bank	Italy
85	Banca Popolare di Ancona SpA	Commercial Bank	Italy
86	Banca di Valle Camonica SpA	Commercial Bank	Italy
87	Banca Popolare di Bergamo - Credito Varesino	Cooperative Bank	Italy
88	Cassa di Risparmio di Firenze SpA	Savings Bank	Italy
89	Credito Italiano	Commercial Bank	Italy
90	Banca popolare dell'Emilia Romagna	Cooperative Bank	Italy
91	Banco Ambrosiano Veneto SpA	Commercial Bank	Italy
92	Banca Popolare di Lodi	Cooperative Bank	Italy
93	Banca Popolare di Verona - Banco S. Geminiano e S. Prospero SCaRL	Cooperative Bank	Italy
94	Mediocredito Centrale SpA	Specialised Governmental Credit Inst.	Italy
95	Banca IMI-Banca d'Intermediazione Mobiliare IMI SpA	Investment Bank/Securities House	Italy
96	San Paolo IMI	Commercial Bank	Italy

<b>97</b>	Banca Monte dei Paschi di Siena SpA-Gruppo Monte dei Paschi di Siena	Commercial Bank	Italy
<b>98</b>	Banca Popolare di Vicenza SCarl	Cooperative Bank	Italy
<b>99</b>	Credito Agrario Bresciano SpA - CAB	Investment bank/ Securities House	Italy
<b>100</b>	Banca Popolare di Brescia Scarl	Cooperative Bank	Italy
<b>101</b>	UniCredito Italiano SpA	Commercial Bank	Italy
<b>102</b>	IntesaBci SpA	Commercial Bank	Italy
<b>103</b>	Banca Carige SpA	Commercial Bank	Italy
<b>104</b>	Banca Lombarda e Piemontese SpA	Commercial Bank	Italy
<b>105</b>	Banca Popolare Commercio e Industria	Cooperative Bank	Italy
<b>106</b>	Credito Emiliano SpA	Commercial Bank	Italy
<b>107</b>	Banca Bipielle Centrosud SpA	Commercial Bank	Italy
<b>108</b>	Anglo Irish Bank Corporation plc	Investment ank/ Securities House	Ireland
<b>109</b>	SNS Reaal Groep	Bank Holding & Holding Company	Netherlands
<b>110</b>	SNS Bank Nederland N.V.	Savings Bank	Netherlands
<b>111</b>	ABN Amro Holding NV	Commercial Bank	Netherlands
<b>112</b>	BANIF Group - Banco Internacional do Funchal, SA	Commercial Bank	Portugal
<b>113</b>	Banco Portugues de Investimento, SA - BPI	Investment ank/ Securities House	Portugal
<b>114</b>	Banco Espirito Santo e Comercial de Lisboa BESCL, SA	Commercial Bank	Portugal
<b>115</b>	Banco Comercial Português, SA	Commercial Bank	Portugal
<b>116</b>	Banco Totta & Açores, SA	Commercial Bank	Portugal
<b>117</b>	Caja de Ahorros y Monte de Piedad de las Baleares - Sa Nostra	Savings Bank	Spain
<b>118</b>	Caja de Ahorros de Vigo, Ourense e Pontevedra - Caixanova	Savings Bank	Spain
<b>119</b>	Caja de Ahorros y Pensiones de Barcelona, LA CAIXA	Savings Bank	Spain
<b>120</b>	Banco de Sabadell SA	Commercial Bank	Spain
<b>121</b>	Banco Bilbao Vizcaya Argentaria SA (Proforma)	Commercial Bank	Spain
<b>122</b>	Caja de Ahorros y Monte de Piedad de Navarra - Caja Navarra	Savings Bank	Spain
<b>123</b>	Banco de Valencia SA	Commercial Bank	Spain
<b>124</b>	Banco Santander Central Hispano (Proforma)	Commercial Bank	Spain
<b>125</b>	Caja de Ahorros del Mediterraneo CAM	Savings Bank	Spain
<b>126</b>	Caja Madrid	Savings Bank	Spain
<b>127</b>	Banco Gallego, SA	Commercial Bank	Spain
<b>128</b>	Banco Santander SA	Commercial Bank	Spain
<b>129</b>	Argentaria, Caja Postal y Banco Hipotecario SA	Bank Holding & Holding Company	Spain
<b>130</b>	Banco del Comercio SA	Commercial Bank	Spain
<b>131</b>	Banco Urquijo Group	Investment Bank/Securities House	Spain
<b>132</b>	Caja de Ahorros de Galicia - Caixa Galicia	Savings Bank	Spain
<b>133</b>	Gerrard Group plc	Bank Holding & Holding Company	UK
<b>134</b>	Lloyds Bank plc	Commercial Bank	UK

## ***APPENDIX B: Fully efficient banks***

### ***Pre-merger fully efficient banks***

<b><i>Merger year</i></b>	<b><i>Bank name</i></b>	<b><i>Country</i></b>	<b><i>Bank type</i></b>
1995	Frankfurter Hypothekenbank Centralboden AG	GERMANY	Real Estate / Mortgage Bank
1996	Banco Portugues de Investimento, SA - BPI	PORTUGAL	Investment Bank/Securities House
1998	Comptoir de Banque	FRANCE	Commercial Bank

### ***Post-merger fully efficient banks***

<b><i>Merger year</i></b>	<b><i>Bank name</i></b>	<b><i>Country</i></b>	<b><i>Bank type</i></b>
1994	Bayerische Landesbank Girozentrale	GERMANY	Specialised Governmental Credit Inst.
1996	Caisse des Dépôts et Consignations	FRANCE	Specialised Governmental Credit Inst.
1996	Deutsche Bank AG - IAS	GERMANY	Commercial Bank
1997	BNP Paribas	FRANCE	Commercial Bank
1997	Dresdner Bank AG	GERMANY	Commercial Bank
1999	Allgemeine Hypothekenbank AG - AHB	GERMANY	Real Estate / Mortgage Bank

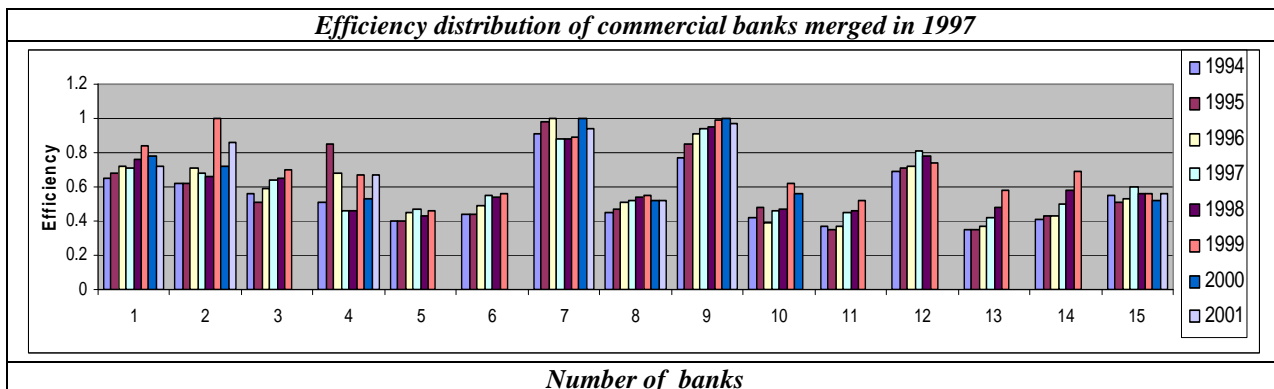
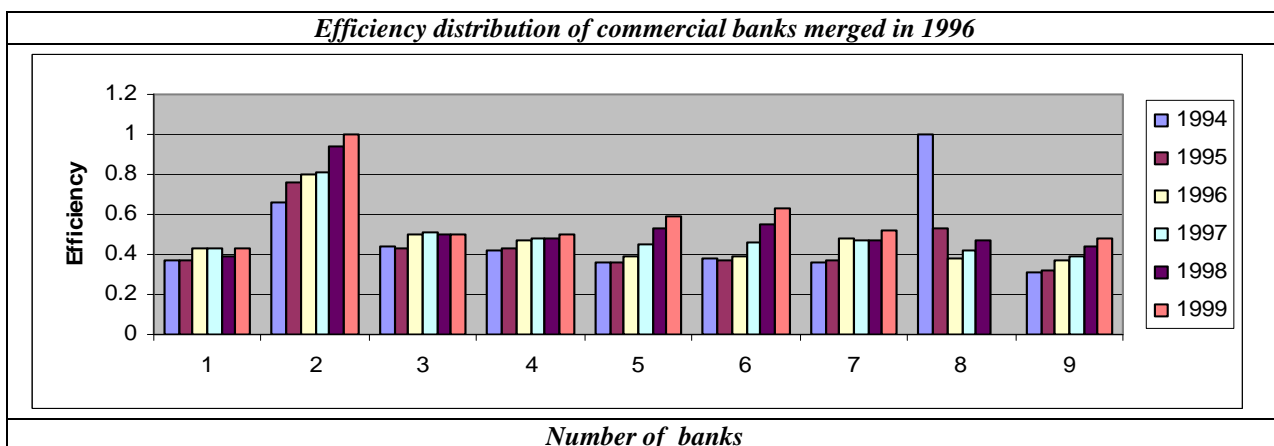
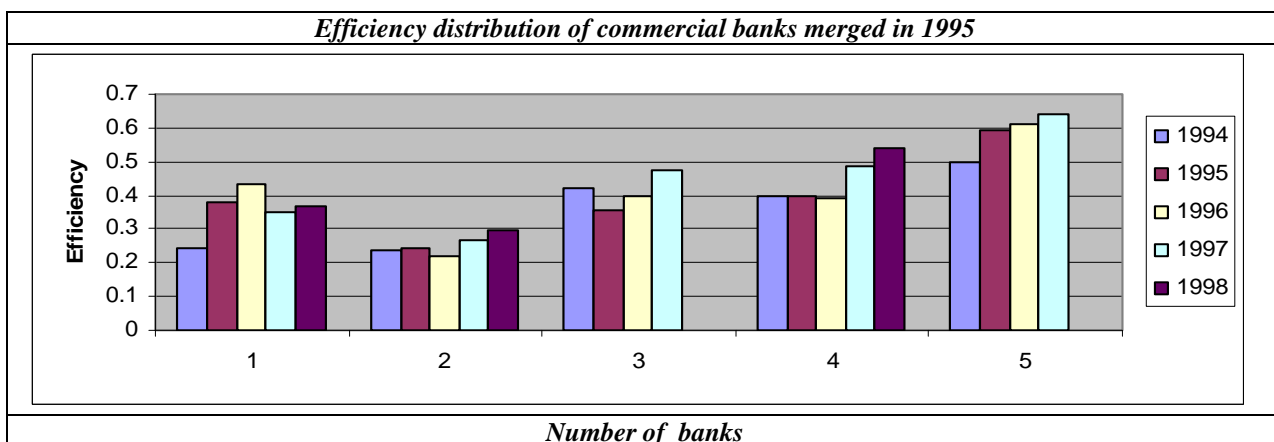
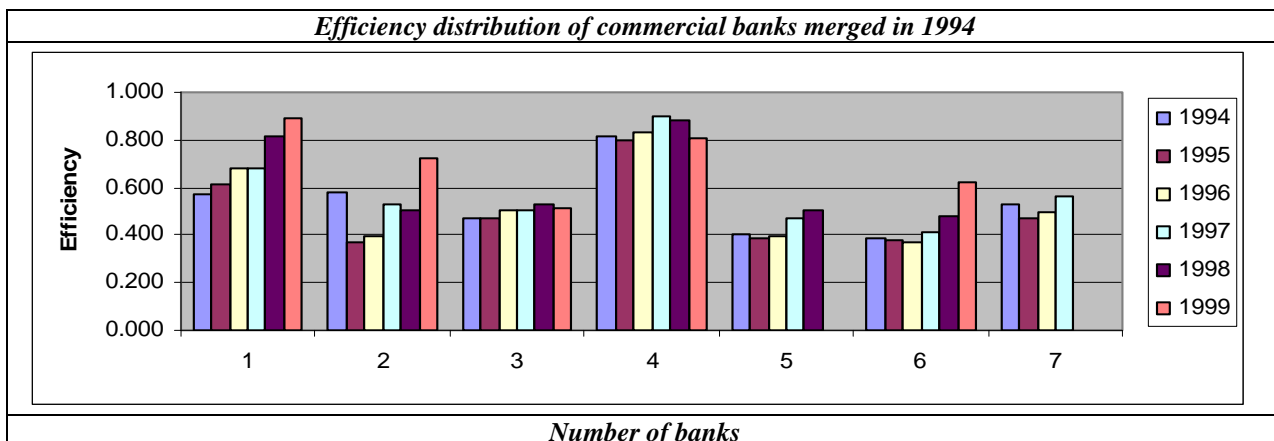
### ***Pre and post-merger fully efficient banks***

<b><i>Merger year</i></b>	<b><i>Bank name</i></b>	<b><i>Country</i></b>	<b><i>Bank type</i></b>
1996	Gerrard Group plc	UK	Bank Holding & Holding Company
1997	Bayerische Hypo-und Vereinsbank AG - IAS	GERMANY	Commercial Bank

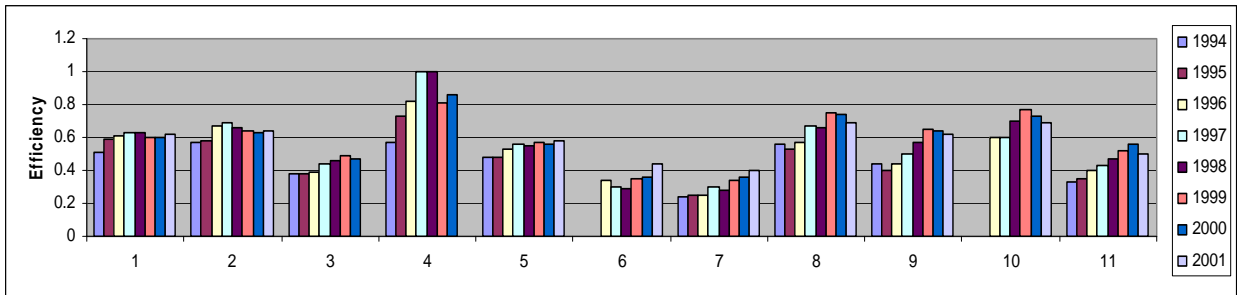
It may be pointed out that although a number of German banks are found to be fully efficient, on average German banks have experienced smaller efficiency improvements compared to the banks in the other countries of study.



## APPENDIX C: Efficiency distribution by country and type

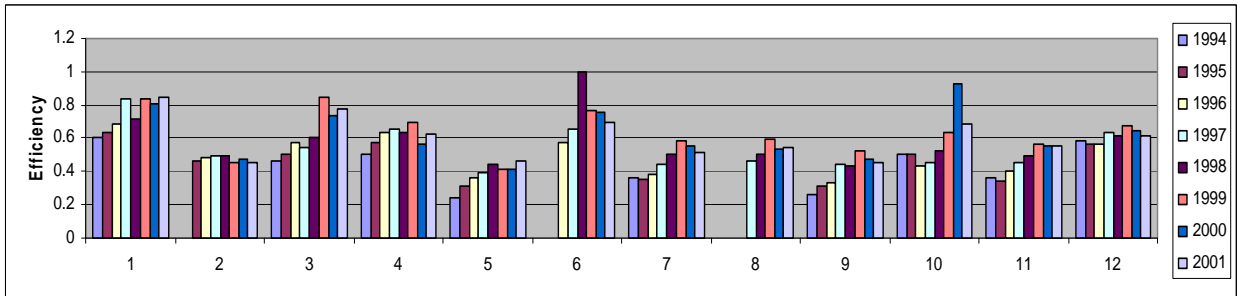


*Efficiency distribution of commercial banks merged in 1998*



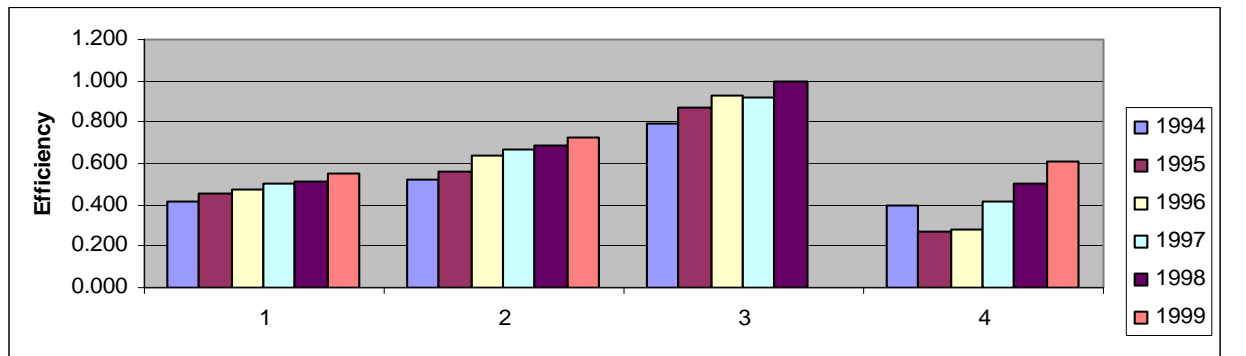
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*Efficiency distribution of commercial banks merged in 1999*



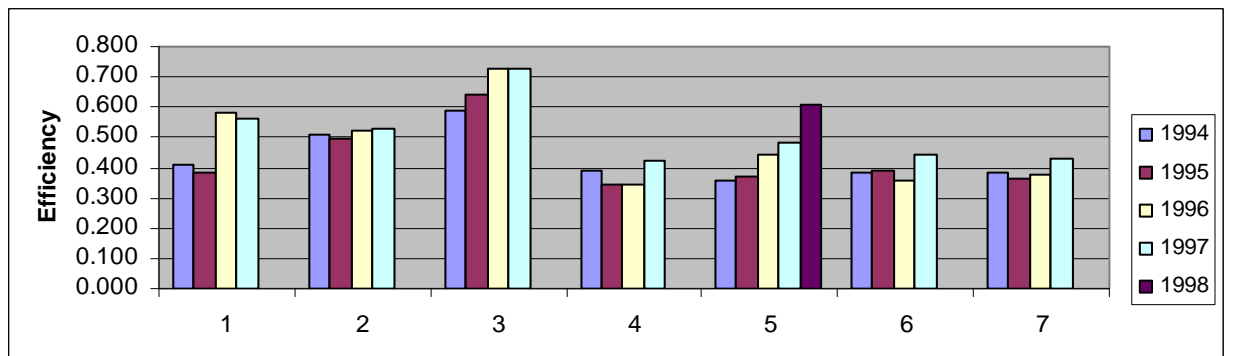
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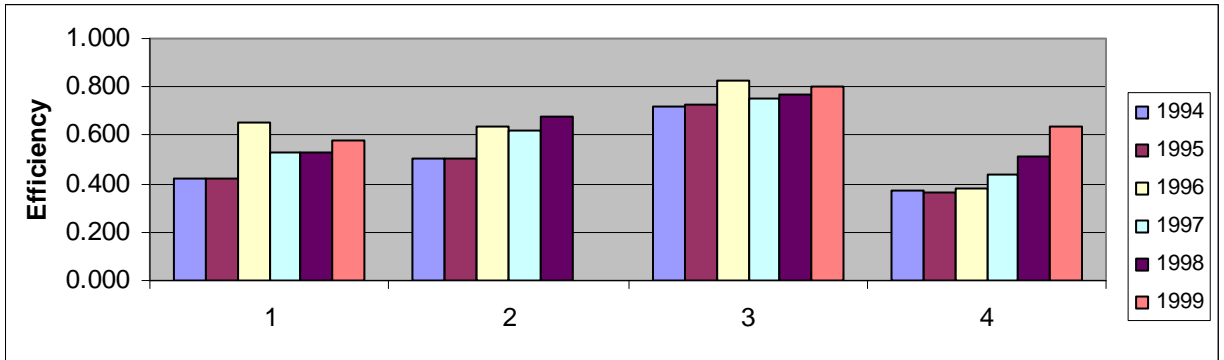
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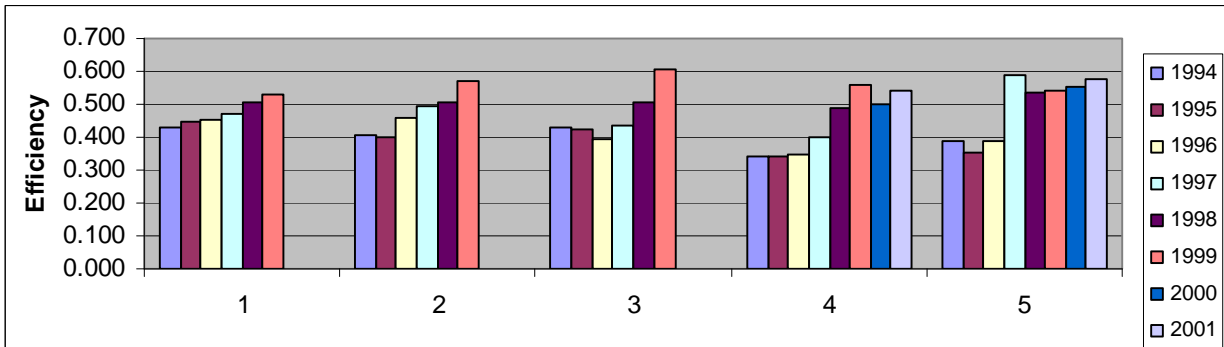
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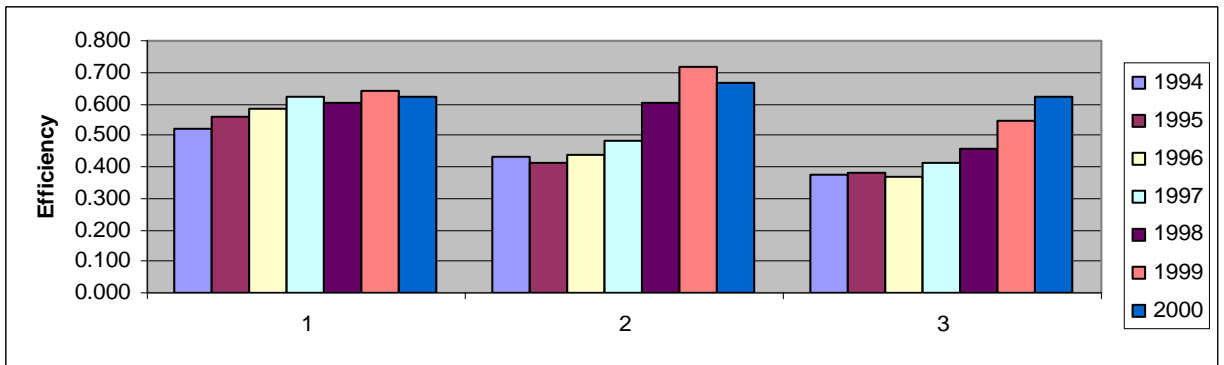
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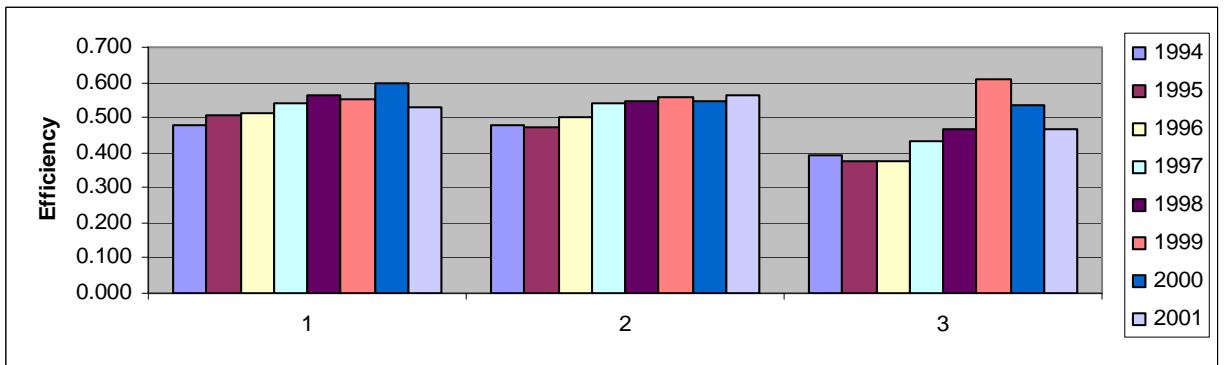
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*Efficiency distribution of cooperative banks merged in 1998*

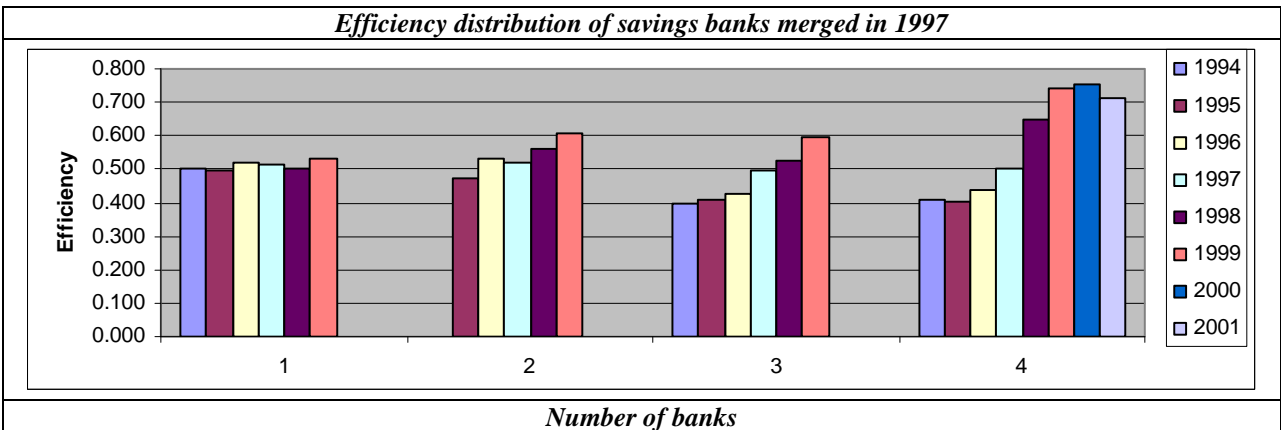
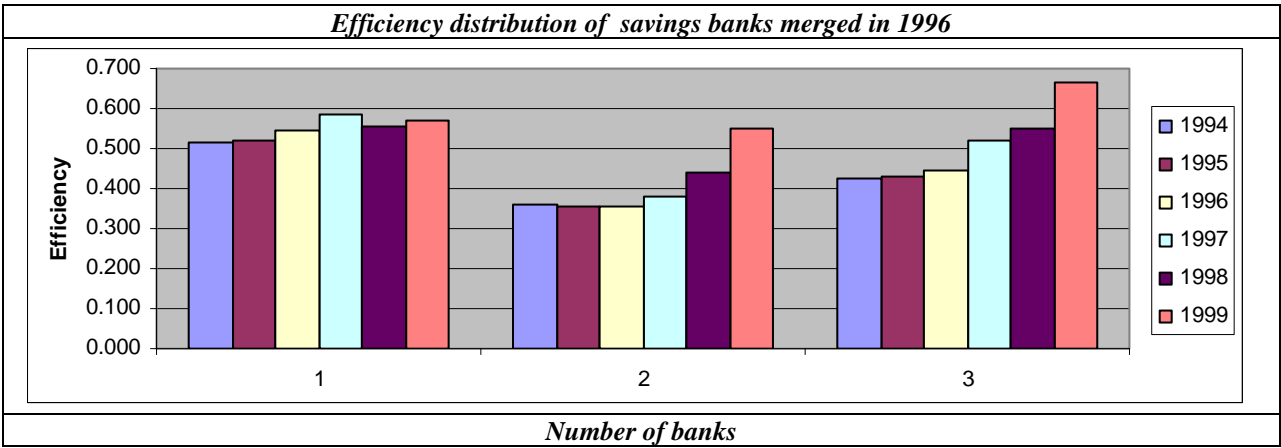
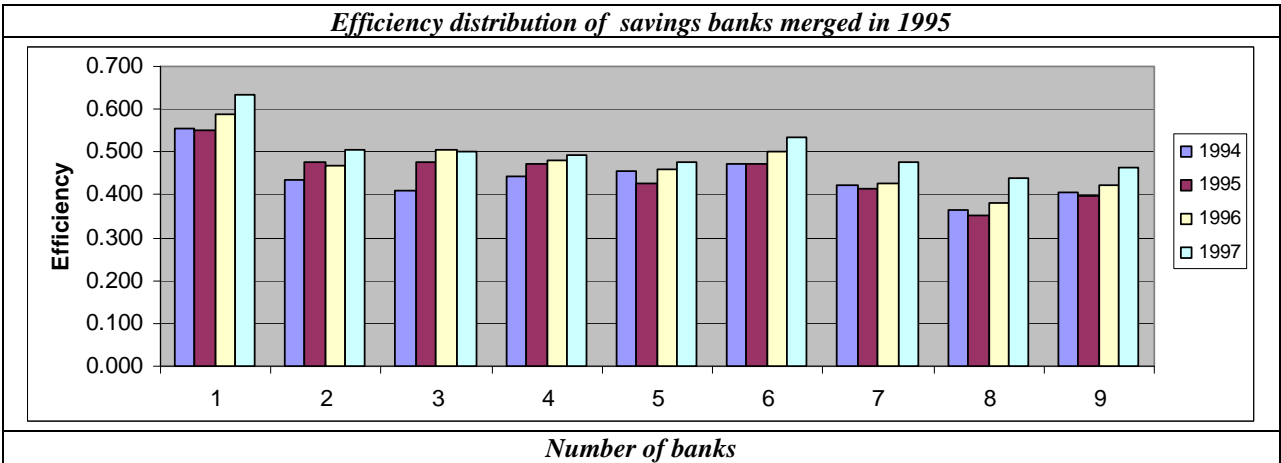
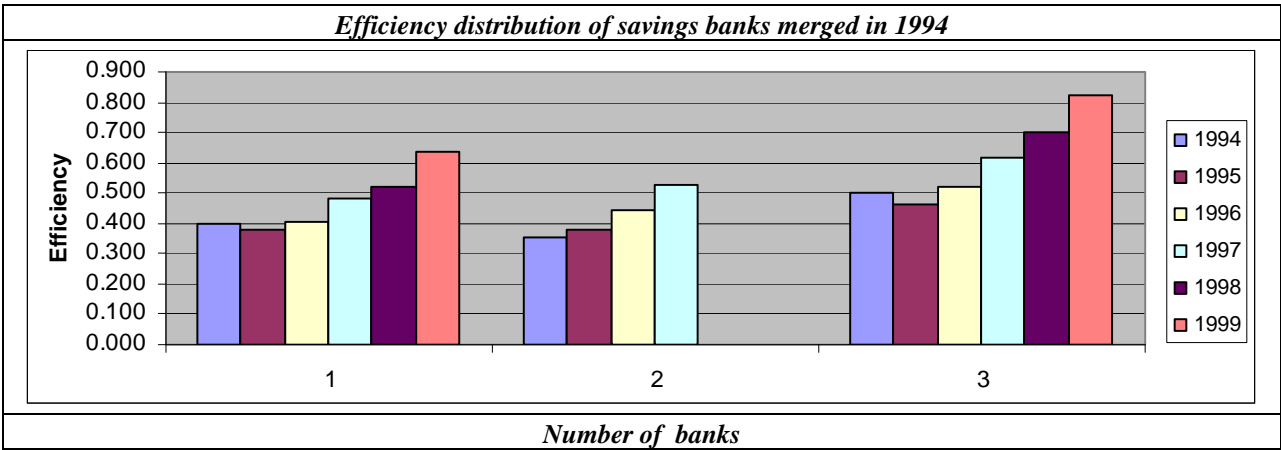


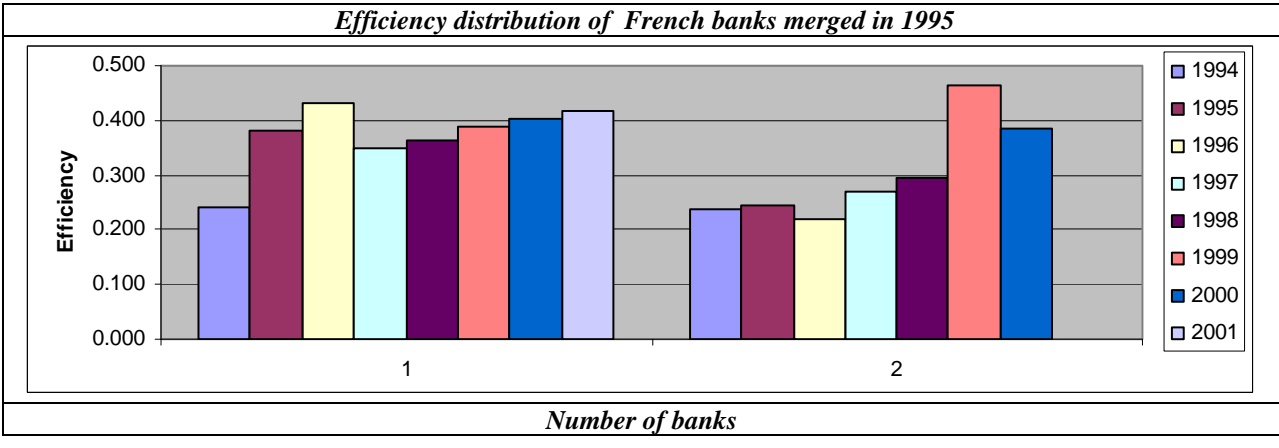
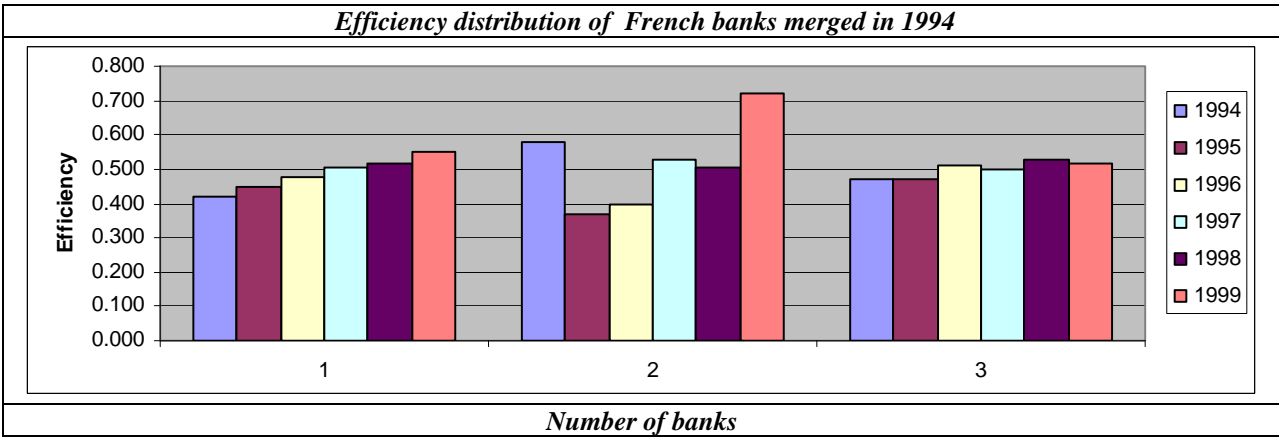
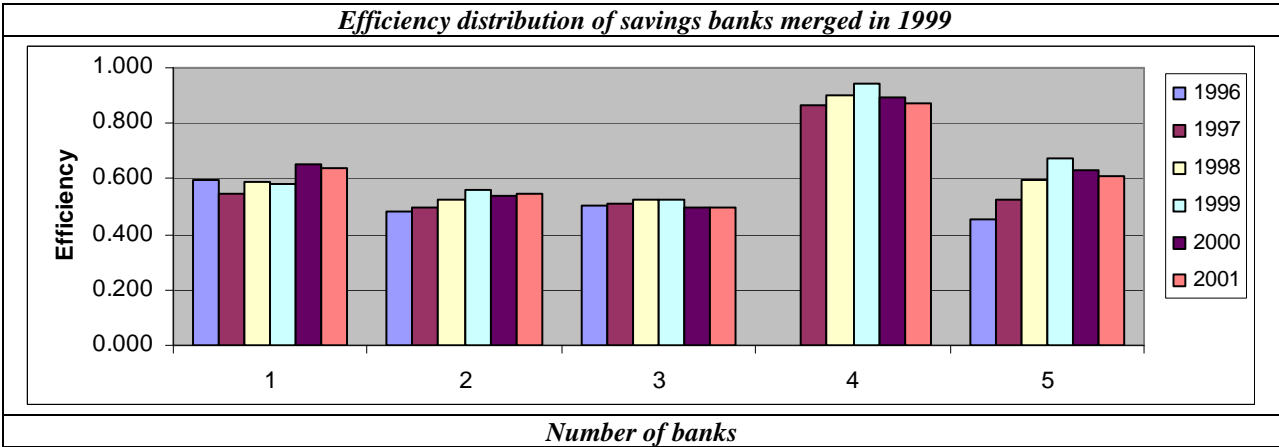
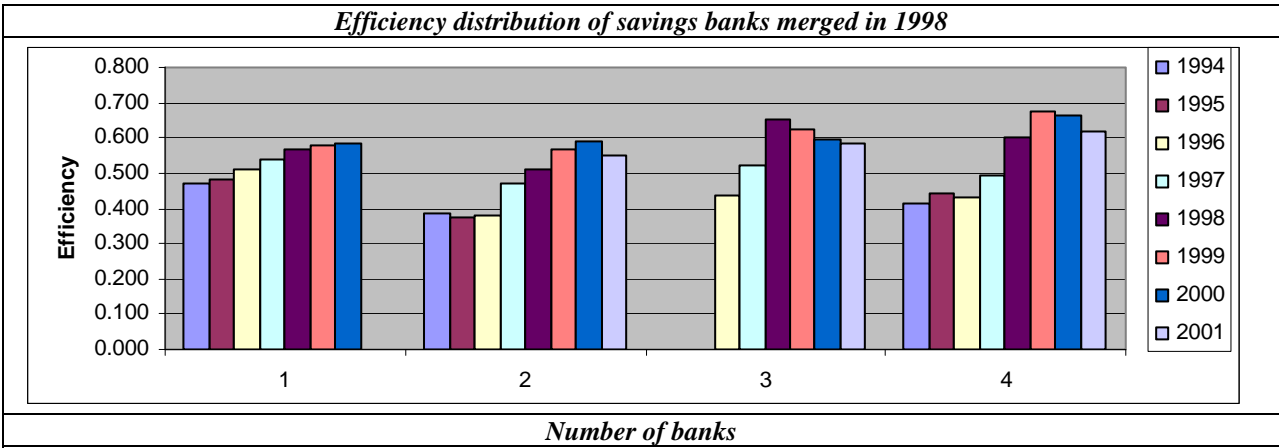
*Number of banks*

*Efficiency distribution of cooperative banks merged in 1999*

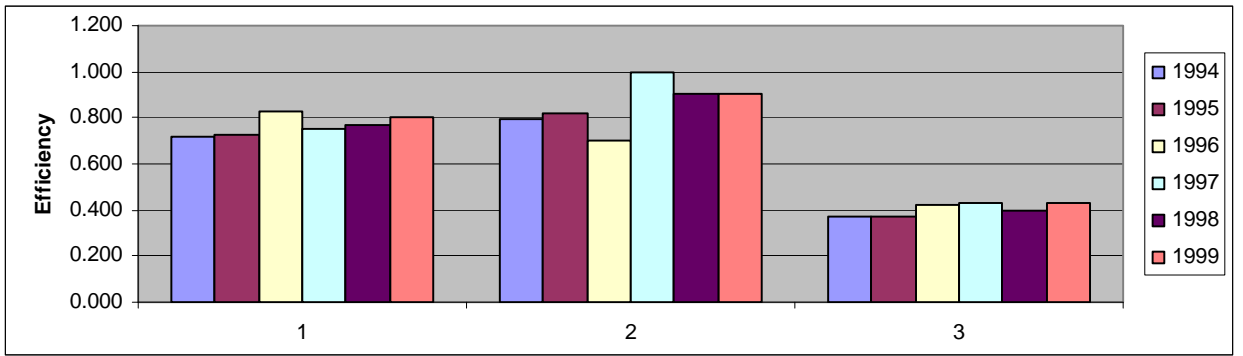


*Number of banks*



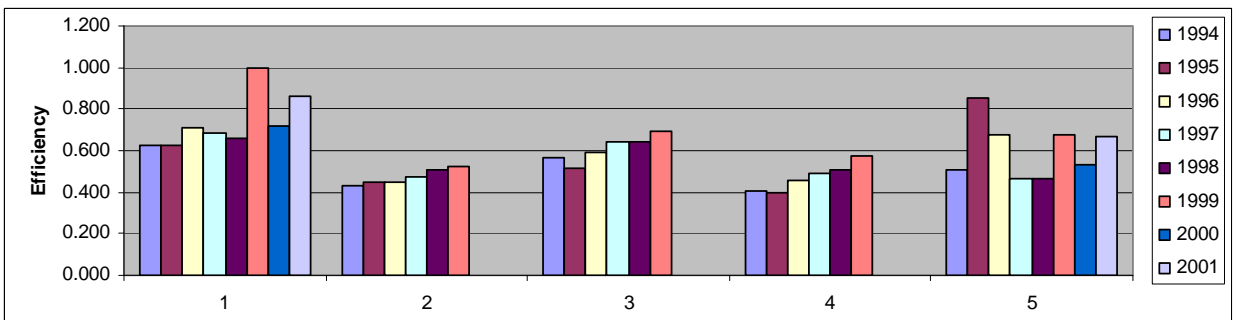


*Efficiency distribution of French banks merged in 1996*



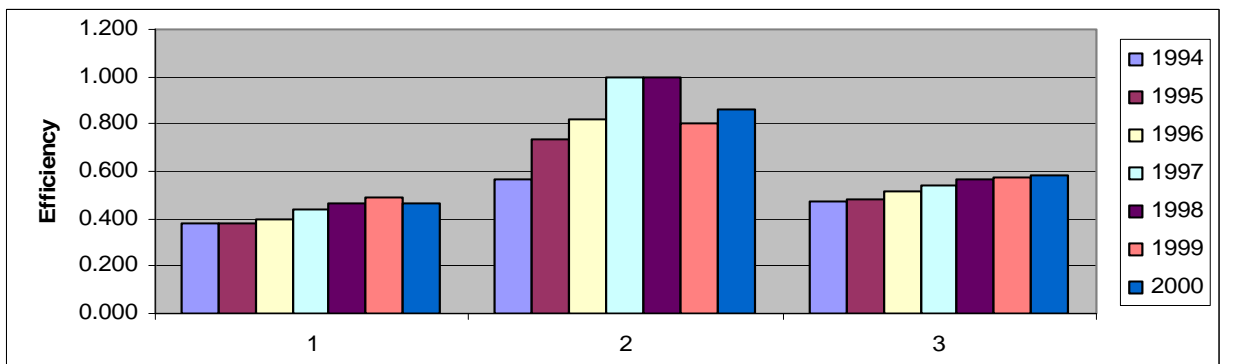
*Number of banks*

*Efficiency distribution of French banks merged in 1997*



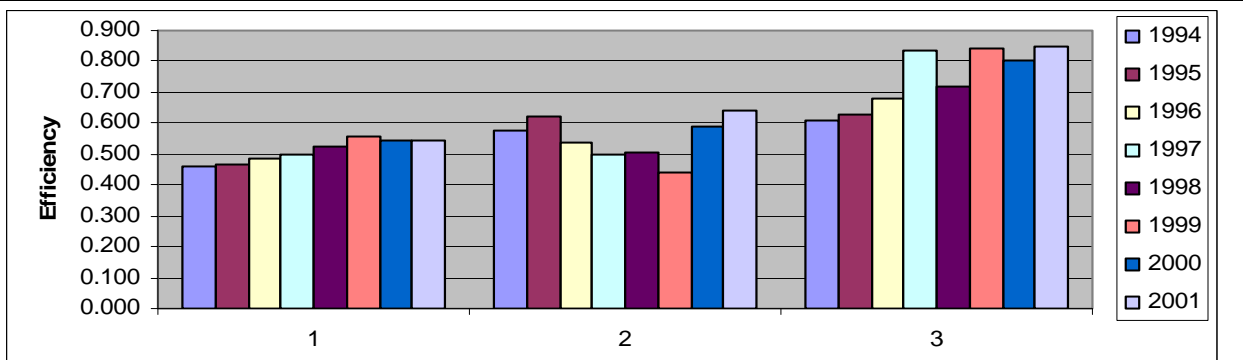
*Number of banks*

*Efficiency distribution of French banks merged in 1998*



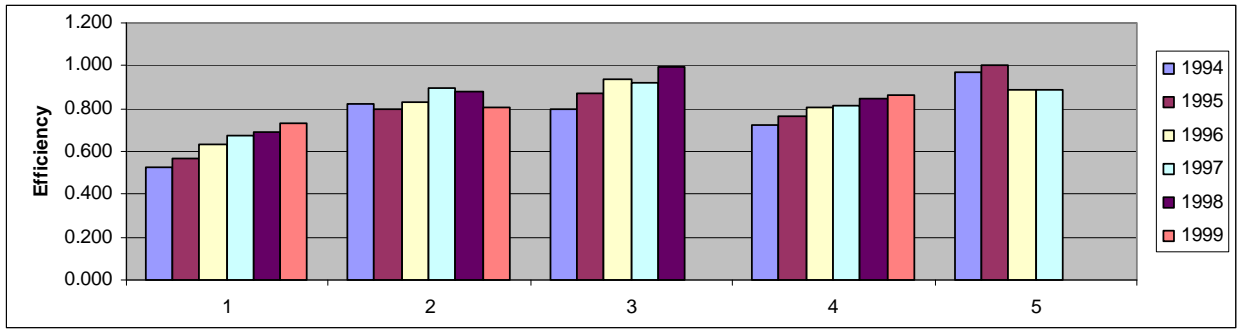
*Number of banks*

*Efficiency distribution of French banks merged in 1999*



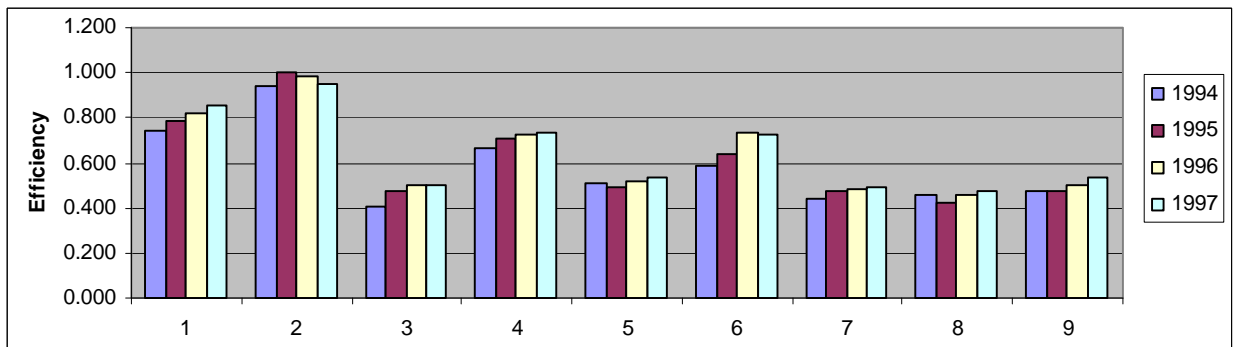
*Number of banks*

*Efficiency distribution of German banks merged in 1994*



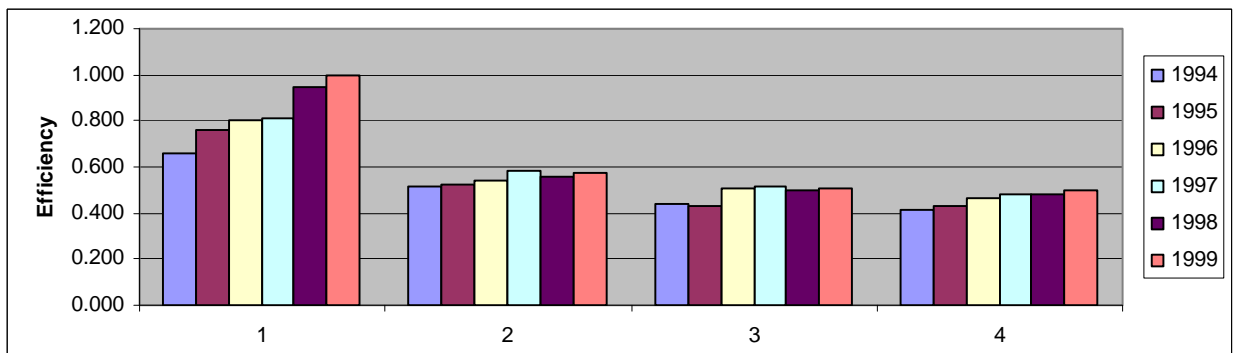
*Number of banks*

*Efficiency distribution of German banks merged in 1995*



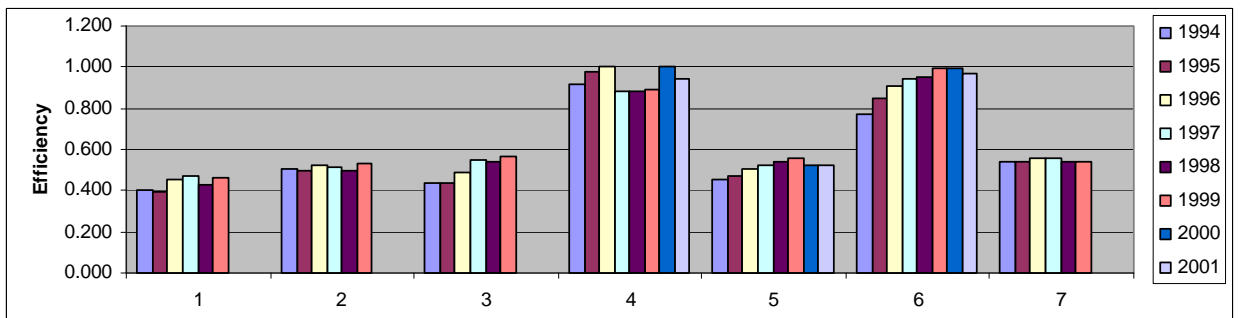
*Number of banks*

*Efficiency distribution of German banks merged in 1996*



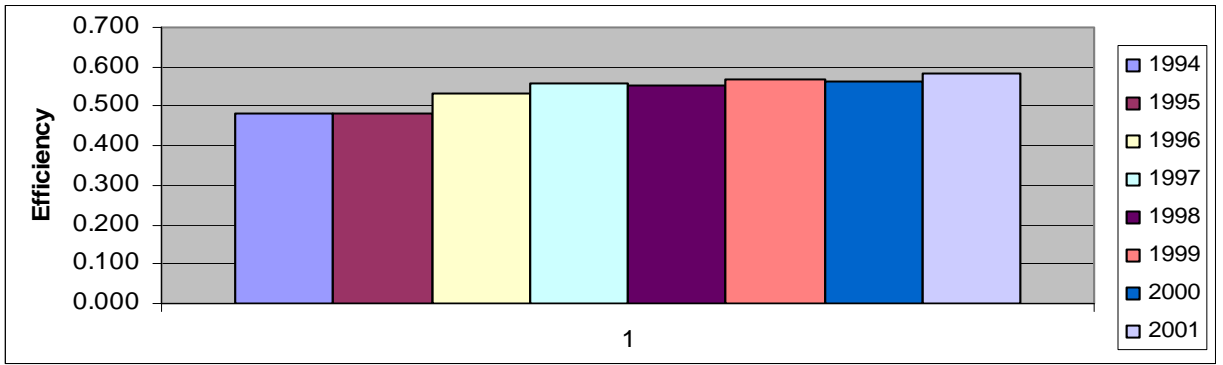
*Number of banks*

*Efficiency distribution of German banks merged in 1997*



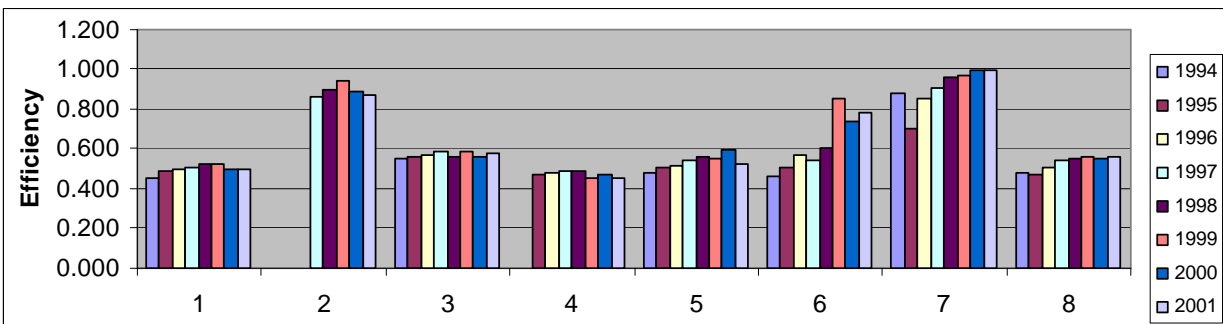
*Number of banks*

*Efficiency distribution of German banks merged in 1998*



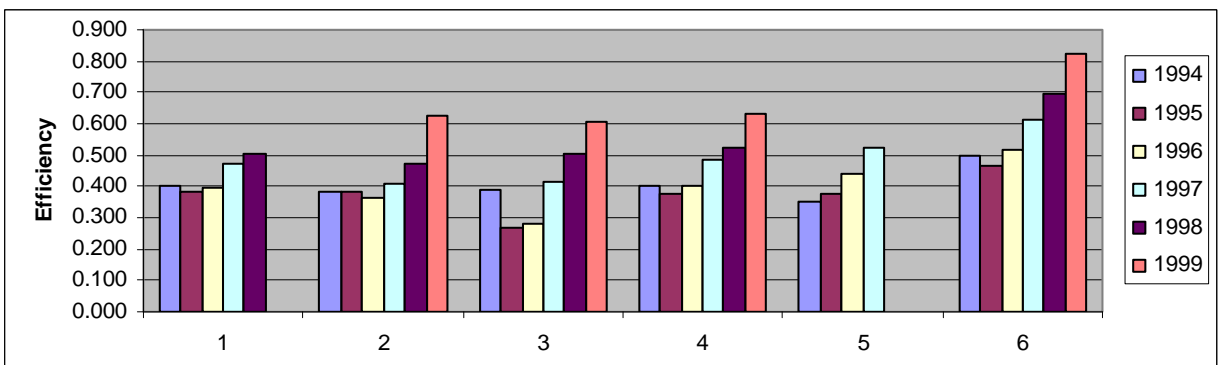
*Number of banks*

*Efficiency distribution of German banks merged in 1999*



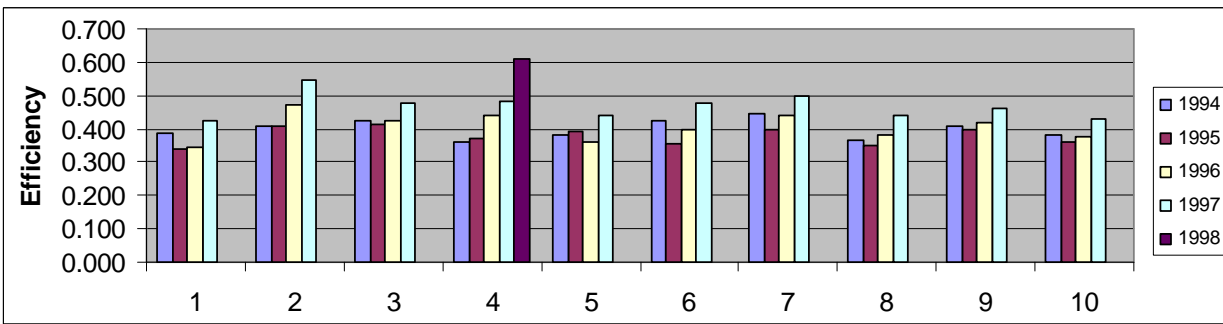
*Number of banks*

*Efficiency distribution of Italian banks merged in 1994*



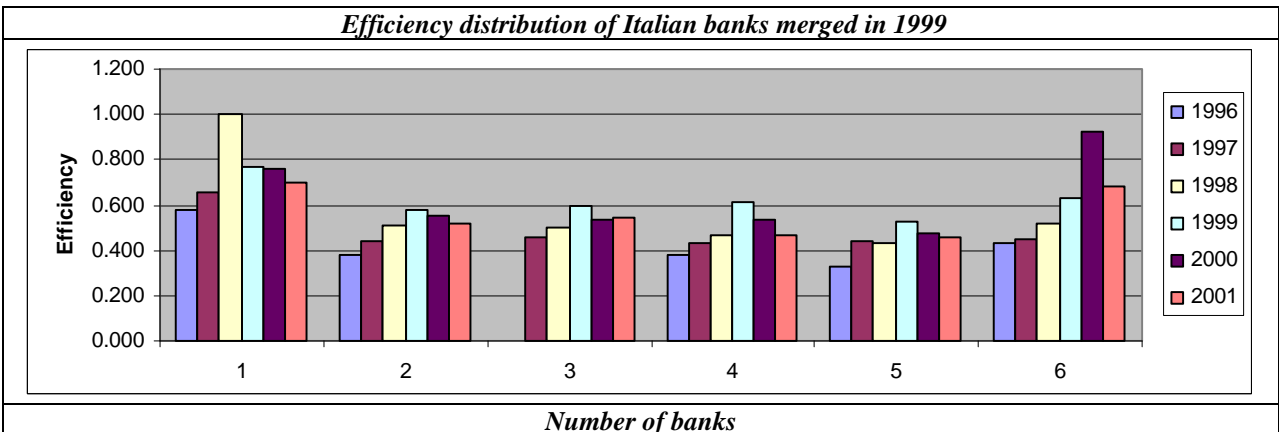
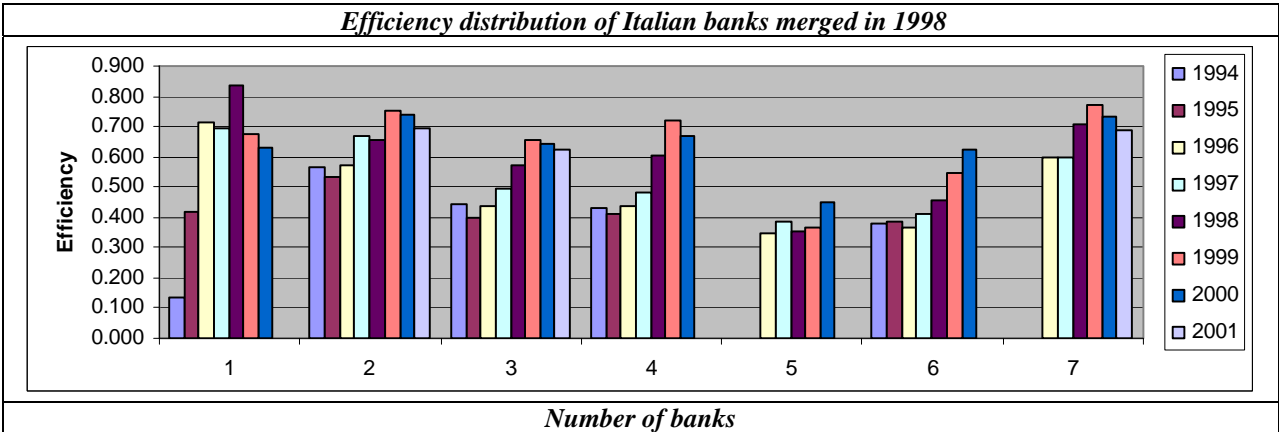
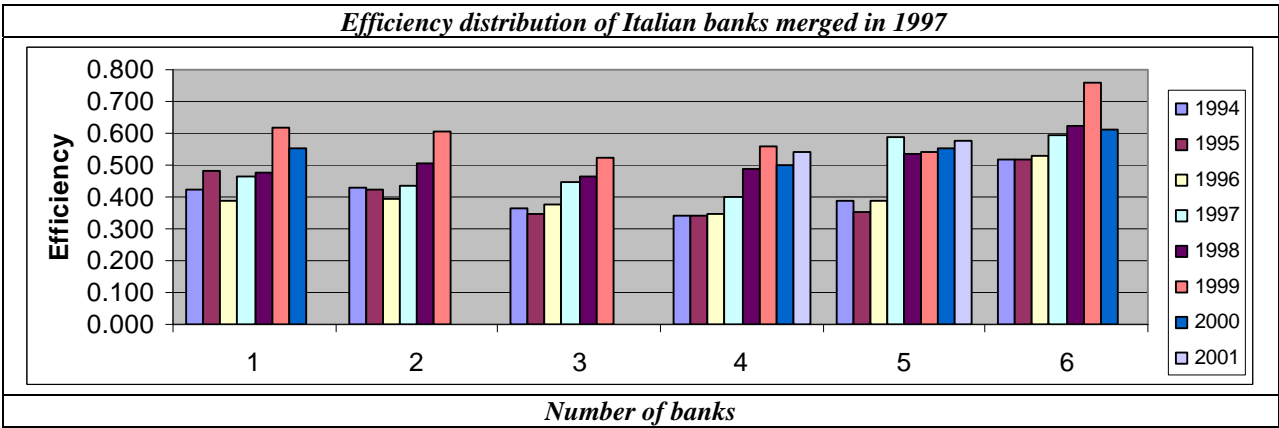
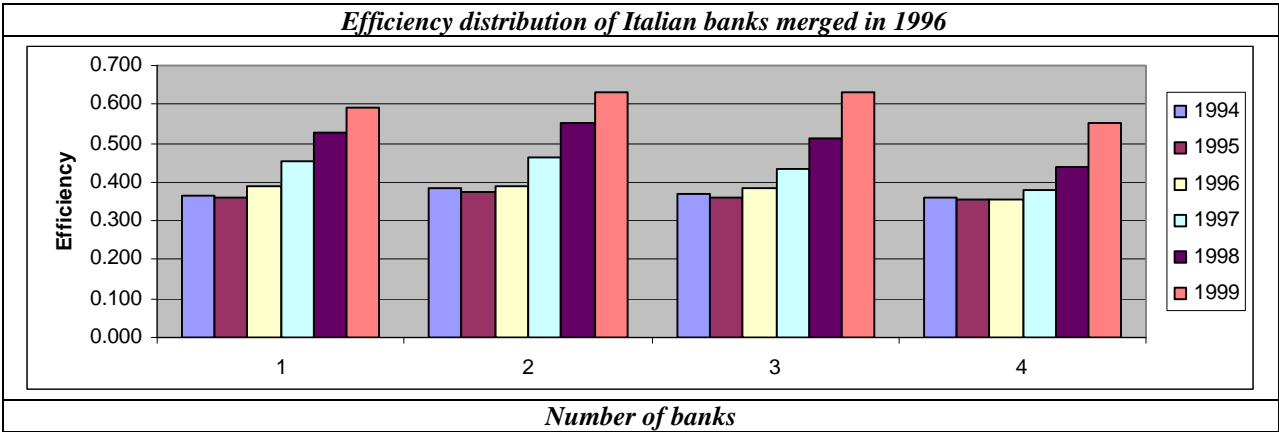
*Number of banks*

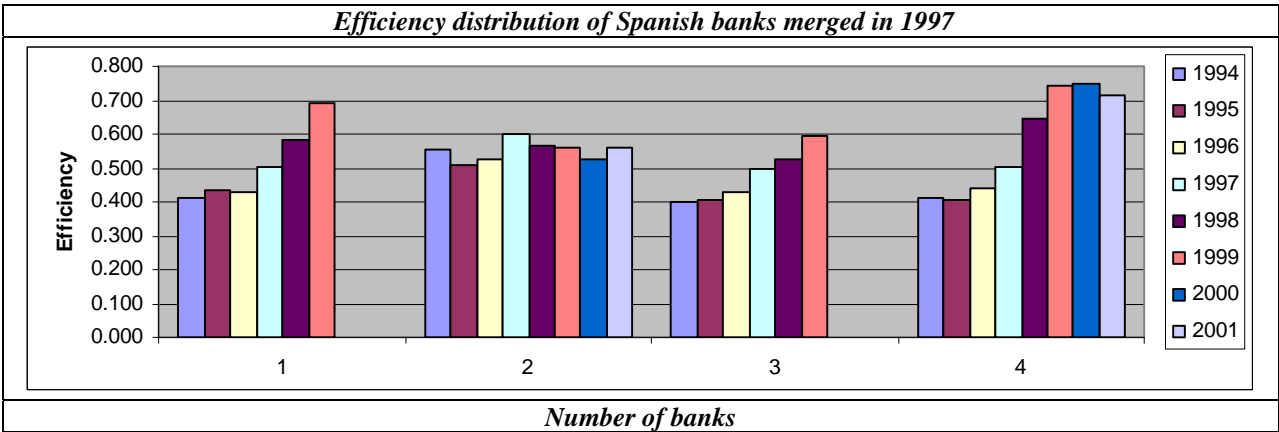
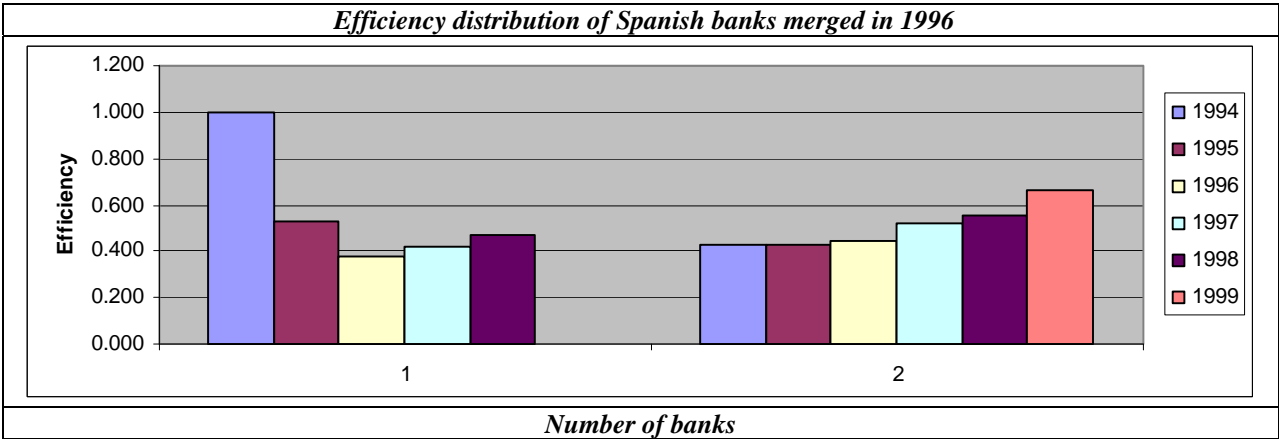
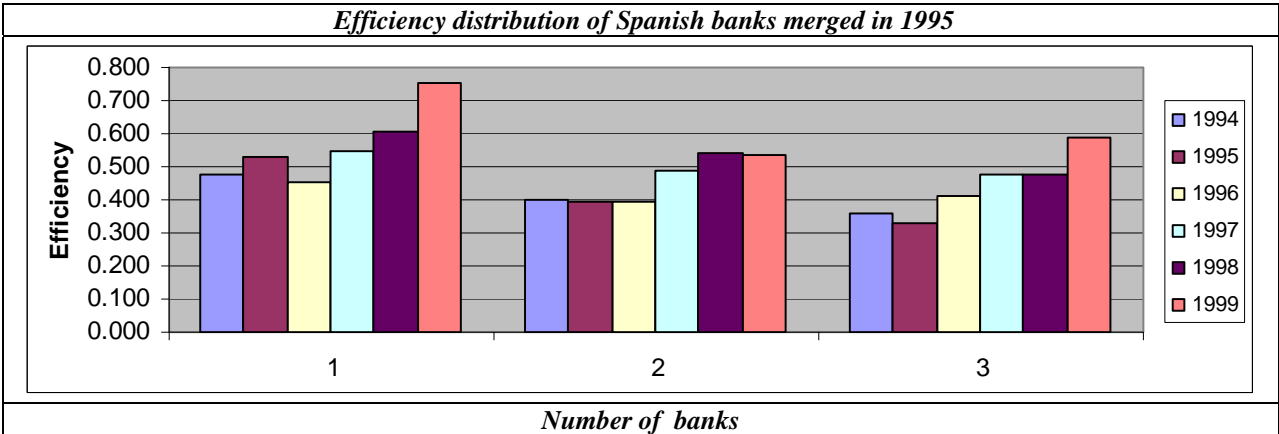
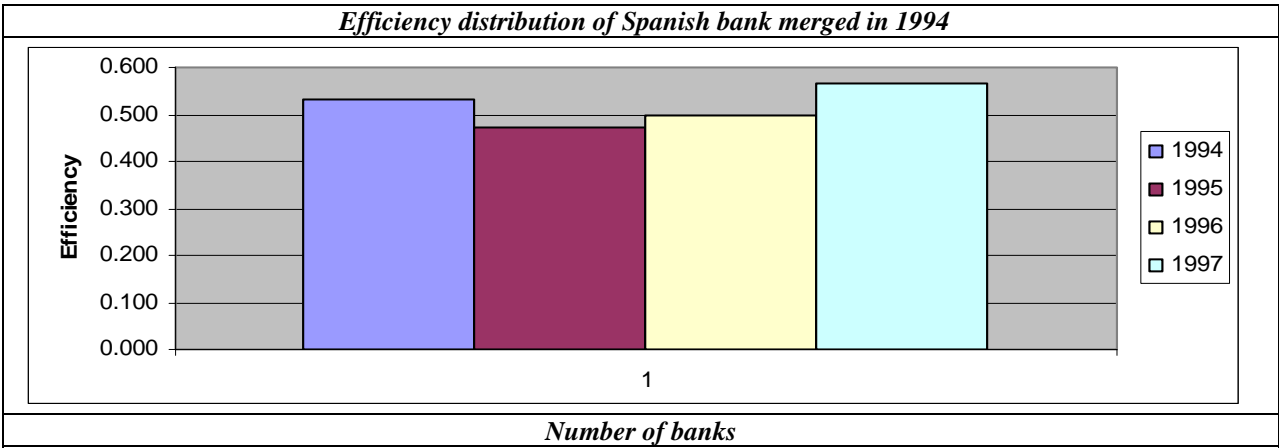
*Efficiency distribution of Italian banks merged in 1995*



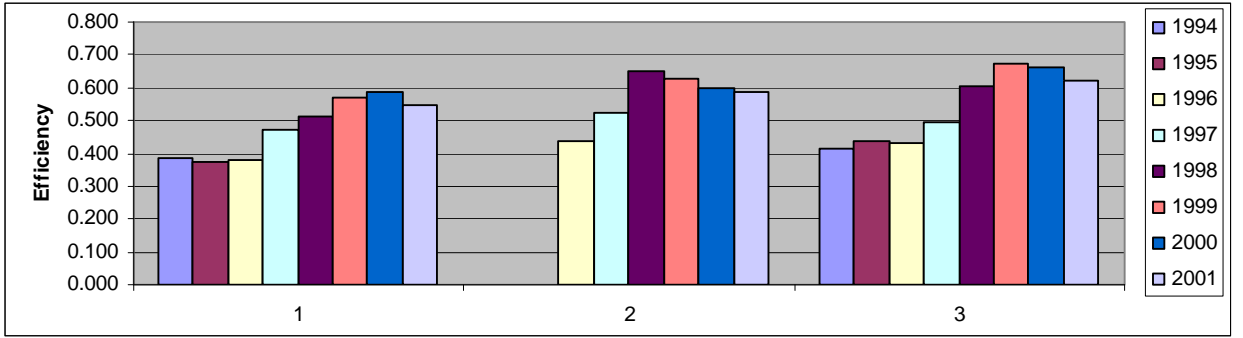
*Number of banks*





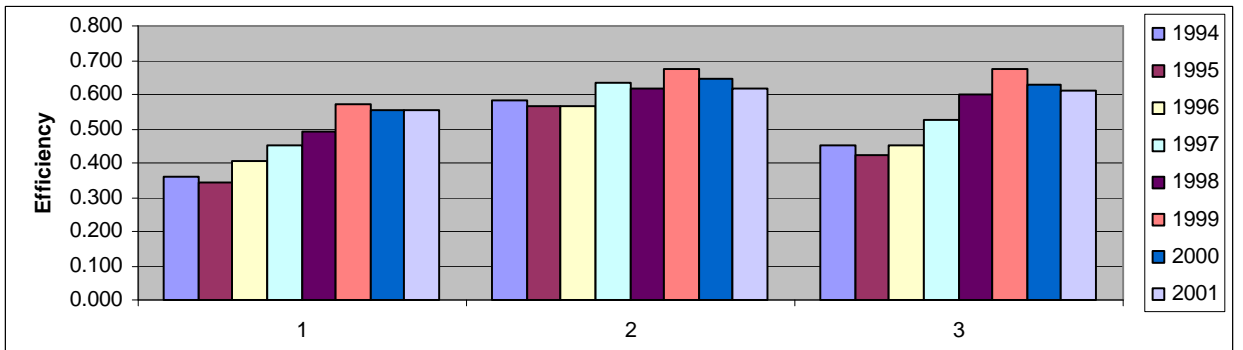


*Efficiency distribution of Spanish banks merged in 1998*



*Number of banks*

*Efficiency distribution of Spanish banks merged in 1999*



*Number of banks*