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Study of efficiency in the Greek banking system

Αικατερίνα Γερογιαννάκη

Διατριβή υποβληθείσα
προς μερική εκπλήρωση των απαραίτητων προϋποθέσεων
για την απόκτηση του Μεταπτυχιακού Διπλώματος

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Εγκρίνουμε τη διατριβή τής Αικατερίνα Γερογιαννάκη

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ABSTRACT

Research on bank efficiency has developed in two separate streams: econometric studies and Data Envelopment Analysis, a linear programming technique. In this study, these two approaches have been tested on a common panel of 28 Greek banks. In particular, this study estimates empirically cost and alternative profit inefficiency in the Greek banking system over the period 1993-2005, a period characterized by major changes in the banking sector brought about by gradual financial deregulation, using Stochastic Frontier Approach. The beginning of the examination period coincides with the acceleration of liberalization and deregulation of the Greek financial system, in view of the country joining the Economic Monetary Union (EMU). These reforms were supposed to provide an opportunity to Greek banks to improve their efficiency and to enhance their competitiveness in view of the ongoing financial integration in the European Union and the introduction of the euro. In order to investigate the relative cost and alternative profit efficiency level, we employ the stochastic frontier methodology and estimate a common frontier through a translog cost and profit function. The results indicate a generally low level of cost and an even lower level of profit efficiency for Greek banks. Some evidence is provided that bank characteristics such as bank size, type of ownership do play a role in explaining differences in measured inefficiencies. Our evidence suggests that Greek banks seem to be more efficient in controlling costs than in generating profits and that underperforming banks tend to have a lower fraction of bank deposits.

In addition this study compares the results of cost inefficiency between the two approaches (SFA and DEA). To be sure that the results do not depend upon any one particular economic environment of the banking industry or any peculiarities of any one small group banks, we estimate the average inefficiency over time of a panel of 28 banks over a 13-year period, from 1993-2005. In addition, to be sure that the applications are comparable, the two techniques use the same efficiency concept (cost inefficiency-technical inefficiency), the same sample of banks, the same time interval and the same specification of inputs and outputs. Overall, the DEA method yields much higher average inefficiencies and ranks the banks differently from the

parametric method. These results suggest that there may be "fragility" in drawing regulatory policy conclusions that may differ according to whether DEA versus SFA approach are specified.

CHAPTER 1

INTRODUCTION

In the Greek financial system, the banking sector plays an important role and contributes substantially to the finance of the national economy, despite the fact that the depth of the capital and money markets has gradually increased considerably. During the last two decades, Greek banking has undergone substantial developments, which were mainly caused by modifications occurred in the external environment, as a consequence of the increasing monetary and financial integration, as well as the deregulation of domestic financial system and the liberalization of capital flows. Indeed, the macroeconomic stabilization and policy reform, the liberalization of interest rate determination, the annulment of various credit rules, the release of capital movements, the application in advanced information and communication technologies, the internationalization of banking activities, the product/service innovation in financial markets, the euro circulation, and the phenomenon of disintermediation have triggered major structural changes in the Greek banking environment and enhanced competition in both price and quality levels of the services offered by the banking system. These changes have brought the issue of performance in the forefront and banks have made considerable efforts at increasing efficiency, reducing costs of bank services and diversifying in other business area.

A specific structural feature of the Greek financial system, characterizing the old banking regime, was the significant state intervention, which for a long time hindered competition and created a distorted market environment. As a positive development, the number of directly or indirectly state-controlled banks has been reduced significantly from 10 in 1993 to only 2 in 2005. Since the mid 1990s, a number of new, mainly small, commercial banks have opened and a series of mergers and acquisitions were undertaken which altered the level of bank concentration and substantially changed the structure of the Greek banking system. These mergers and acquisitions have reversed the downward trend observed in bank concentration during the previous decade. Nowadays, the Greek banking system is characterized by a high degree of concentration and competitiveness. Moreover the changeover towards the

monetary union and the new technological innovations herald major changes in the banking environment and challenge all banks to make timely preparations in order to enter into the new competitive monetary and financial environment. Therefore it is interesting to investigate the efficiency of Greek banks.

Overall, the investigation of bank efficiency has fuelled a large body of literature globally, and is of vital importance from both a microeconomic and a macroeconomic point of view (Berger and Mester, 1997). From the micro perspective, the issue of banking efficiency is crucial, given the enhancement of competition due to the improvement in the institutional, regulatory and supervisory framework. From the macro perspective, the efficiency of the banking industry influences the cost of financial intermediation and the overall stability of financial markets, as banks constitute the spinal cord of financial markets. Indeed, an improvement of banking performance indicates a better allocation of financial resources, and therefore an increase of investment that favours growth.

The efficiency of the financial services industry has long been a focus of banking research. Most of the publications, covering the theme, study the banking system of the U.S.A. Relatively few European studies have been published on efficiency, and the analysis of the financial systems of transition economies from an efficiency point of view has been very limited. Comparative research analyzing the efficiency of banking systems in different countries is also very scarce, possibly owing to the difficult management of problems arising from different operational environments and their impact produced on efficiency.

Up to the present the Greek banking system has not been studied adequately due to data deficiencies. The first comprehensive study on Greek banks efficiency was Christopoulos et al. (2002) covering period 1993-1998. The empirical results show that larger banks were less efficient than smaller ones. Also, it is found that economic performance, bank loans and investments were positive related to the cost efficiency of the Greek commercial banking sector. Cost efficiency in Greek banking was evaluated also in Kamberoglou et al. (2004) extending the time period on 1993-1999. The obtained results indicated that mean efficiency did not exceed 60 per cent and some evidence was provided that bank size, type of ownership and risk behavior may explain differences in measured efficiency scores. Finally, Noulas and Karampasi (2006) evaluate the efficiency, in the Greek banking system, over the period 2000-2004, using the Data envelopment analysis (DEA) method. The results

indicate that the efficiency differs significantly across banks and there are big margins for improvement of efficiency. In addition, they found that large banks are more efficient than small banks.

This study aims at evaluating cost and alternative profit efficiency of the banking system of a medium-sized country like Greece over the period 1993-2005. Up to the present the Greek banking system has not been studied adequately due to data deficiencies and its features have not been thoroughly analyzed. We believe that the assessment and quantification of cost efficiency of the Greek banking system over the liberalization period is necessary for the evaluation of its performance and future prospects within the EMU framework. The conclusions drawn could prove useful for the analysis of the cost and profit structure of the banking sectors in other medium-sized economies that are undergoing structural changes. To do so, we estimate banks' cost and profit efficiency using the stochastic frontier approach. At a second stage, we look at the factors that may influence firm's efficiency. By doing so, we investigate the main determinants of the observed inefficiency score, analyzing how different bank characteristics, such as capitalization, problem loans ratio, funding mix ratio and liquidity, influence our efficiency estimates. To do so, we employ a flexible methodological approach, the Stochastic Frontier Approach (SFA). By doing so, this study seeks to contribute to the identification of the sources of inefficiency, a finding that may help remove some obstacles on the way to catch-up more efficient banks and furthermore more developed countries, in the banking intermediation.

In addition this study compares the results of cost inefficiency between two approaches (SFA and DEA). Research on bank efficiency has developed in two separate streams: econometric studies and Data Envelopment Analysis, a linear programming technique. In this study, these two approaches have been tested on a common panel of 28 Greek banks. To be sure that the results do not depend upon any one particular economic environment of the banking industry or any peculiarities of any one small group banks, we estimate the average inefficiency over time of a panel of 28 banks over a 13-year period, from 1993-2005. In addition, to be sure that the applications are comparable, the two techniques use the same efficiency concept (cost inefficiency-technical inefficiency), the same sample of banks, the same time interval and the same specification of inputs and outputs. The rationale for using two different methods is twofold. First, there is the opportunity to examine the robustness of our findings. Second, you can examine the relative informativeness of the efficiency

scores obtained using the stochastic and programming methodologies. The relevant question is not which is the "better" method but how to weight the information the alternative approaches provide.

The rest of the study is organized as follows. Chapter 2 presents some stylized facts about the Greek banking system. Chapter 3 reviews the relevant literature evaluating banking efficiency, while Chapter 4 describes the data set and presents some statistical description. Chapter 5 outlines the methodology. Chapter 6 develops the empirical results, while some concluding remarks are drawn in Chapter 7.

CHAPTER 2

AN OVERVIEW OF THE GREEK BANKING INDUSTRY

2.1 Historical review of the Greek banking system

The modern Greek banking system began in 1928 when the first governor of the newly founded Greek state, after it attained its independence from Ottoman rule, Ioannis Kapodistrias, established the National Financial Bank. The main goal of that Bank was to help overcome the fiscal and credit problems experienced by the newly-found, largely impoverished Greek state after seven years (1821-28) of revolutionary war. The bank was not getting its funds in the classical manner of receiving customer deposits, but rather through a system of forced loans made to it, since the confidence in the populace that would lead it to deposit its savings to the bank by its own will was missing. However, this bank[1] was not meant to be; exactly the fact that households were loath to deposit their assets at that bank led to its resources drying up and eventually to its dissolution in 1834. The bank never performed banking operations, since its capital was used for covering needs of the state only.

The void in the nascent Greek banking system[2] was eventually filled in the year 1841 by the establishing of the National Bank of Greece. It was the first private bank in the Greek state providing 20 per cent of its initial capital, while the remaining 80 per cent was provided by Greek and foreign investors. In addition to the typical activities of a commercial bank, such as receiving customer deposits and providing loans (both commercial credit and mortgage loans), the National Bank of Greece also played the role of a banker to the Greek state (by providing support to the Greek treasury), undertook the financing of development projects deemed important to the

[1] And a sole one that is; in other words the Greek banking system started out as a pure monopoly!

[2] There was no Greek bank in the interim period between the abolishment of the National Financial Bank in 1834 and the establishment of the (still extant and largest bank in Greece) National Bank of Greece in 1841. If we may coin a term here, the Greek banking industry in those years was a "medenopoly" (*á la* monopoly, duopoly, oligopoly; from Greek *meden* = none). However, according to Psychomanis (2005, p. 21) "during the first years of Otto's reign, English banking houses founded small banks in Nafplion, Piraeus, and Patras"

public welfare, and, last but not least, had the right to issue banknotes. The National Bank of Greece was a monopolist in the Greek banking system, from its establishment in 1841, up until 1864, when the Ionian bank Ltd., a London based credit institution, extended its activities into Greece, providing commercial banking services and issuing bank notes (Gortsos 1998).

More banks than the two aforementioned ones were established, inexorably resulting in increasing the competition in the Greek banking system, in the period 1864-1899. The Bank of Industrial Credit (established in 1873) and the General Credit Bank (established in 1872) were two of the major banks. To them should be added the Privileged Bank of Epirus and Thessaly, based in the city (and port) of Volos in the region of Thessaly. The bank was established in 1882, one year after the region of Thessaly was annexed into the Greek state[3] [4]. Large banks had a physical presence across the whole of the country, while other banks operated only at the local level (a notable case are the bankers financing the Bank of Athens, established in 1893, a bank that would eventually grow to become second only to the National Bank of Greece). Hence, there existed a two-tier system, with banks neatly divided into two categories, the Panhellenic banks and the local banks; this is akin to the distinction currently existing in Japan between city banks and regional banks (see, for instance, Uchida and Tsutsui, 2005). It should be noted here that Greek banking during that period was characterized by deposits not being the main "input" to the banking industry; the banks were financed either by own funds, or by loans contracted with foreign entities (the National Bank of Greece followed this latter approach); deposits constituted the lesser part of banks' liabilities. The 1890s were marked by a consolidation in the Greek banking industry[5]; then, in the 1900s a host of new banks were born. The Commercial bank was established in 1907, and the Greek Postal Savings Bank, a public welfare oriented credit institution catering to household

[3] "In [...] 1878 [...] the Powers decreed that the Ottoman Empire cede the fertile province of Thessaly, together with a part of Epirus, to Greece. [...] The annexation of Thessaly was the second extension of Greece's borders [...]" (Clogg, 2002, p. 67)

[4] The bank was named "Privileged" because it had the privilege to issue banknotes in the recently annexed regions of Epirus and Thessaly.

[5] "In 1898, five banks operated in Greece with the form of a *société anonyme*. In parallel, there existed banks with different corporate legal form and also personal firms of individual bankers" (Psychomanis, 2005, pp. 31-32)

savings, was established in 1909. Two other noteworthy banks that were incorporated during that decade were the Banque de l'Orient (in 1904) and the Popular Bank (in 1909).

During the Balkan wars (1912-1913) and the First World War I (1914-18) the number of Greek banks remained, since the war period was not opportune either for a consolidation or for an expansion of the Greek banking system. After the fighting was over, the pattern of establishment of new banks, prevalent in the 1900s[6], resumed and continued until the late 1920s, when state interventionism kicked in; there were 48 banks operating in Greece by the end of 1928. According to Kostis (1997, p. 27) "the number of banks after the end of World War I has grown significantly. The conditions proved favorable for the multiplication of banking institutions, even if, to a degree, this multiplication was rather fictional, since the new banks that are recorded as operating in the form of a société anonyme operated already as private-sector banks, and merely changed the legal status of their operation in order to benefit from the tax advantages provided by Law 2190/1920 on Sociétés Anonymes (S.A.). A rough calculation gives us more than fifty banking institutions operating in the S.A. form by the end of 1928, without even taking into account the branches of foreign banks and of course the individual bankers, who could still operate legally for a few years more".

Kostis (1997, pp. 27-28) continues his description of the competitive landscape in the banking sector in year 1928 by mentioning that "most banking institutions were of large size, and some actually developed their circle of activities in a purely local level. It is characteristic of the size of those banks, but also of the degree of concentration of the Greek banking system that [...] by the end of 1928 the four large commercial banks had together about 75 per cent of total deposits and loans of commercial banks[7] , the fourteen medium-size banks had 14 per cent, the 15 local ones had less than 2 per cent, while the remainder belonged to the seven foreign banks, that under various legal forms operated in Greece. [...] Inter-bank competition [...] had already led profit margins in some banking operations to exceptionally low levels, in those cases that it had not eliminated them".

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[6] However, Kostis (1997, p. 32) refers to "the small number of banks before the war". More important, of course, for the purposes of this study is his reference to "their exceptional concentration".

[7] Emphasis added.

There is a parallel to the North American experience here: the "roaring twenties", characterized by a rather unrestrained capitalism, were followed by the Great Crash and the ensuing Great Depression in its wake, necessitating state interventionism, as a last resort, to kick-start the economy again (cf. the New Deal). Likewise, in Greece, there was relatively little state intervention in the economy before the worldwide fallout of the Great Crash; in the banking sector in particular, state interventionism, in any form, was totally absent. Another characteristic feature of the Greek banking system in the 1890-1928 period, in addition to the absence of state intervention, was that financial activities of banks were undiversified. This actually simplifies the definition of the market where competition is to be examined, since there are N, uniform in their qualitative characteristics, "players" in the banking sector. In the present age of specialized commercial, investment, car financing, shipping, private, etc. credit institutions, the definition of the banking industry becomes less of a trivial task.

According to Ioannis Manos, former Secretary General of the Hellenic Bank Association, in his foreword to Kostis (1997, p. 12) the examined period "is a period during which there is no specialized institutional framework of operation for the banking system, and there are problems that arise from the most keen competition between banks, and between banks and non-banking enterprises [...] that is characterized by the de-normalization of the banking system". Kostis (1997, p. 18) states that "the Greek banking system of 1928 was a system much more de-normalized than the present one – in fact initially there did not exist any rule beyond those set by the celebrated law 2190 [/1920] that specified in very general lines the regime of establishing and operating a société anonyme – and the competition between banking institutions was clearly much tougher than it is today". Leaving aside the disagreement between Manos and Kostis regarding whether competition was tougher in 1928 or in the late 1990s, it is evident that the Greek banking market was highly unregulated and fiercely competitive in 1928, and actually that the particular historical period can offer useful and instructive analogs for the present deregulated banking environment.

After World War II, the Greek government moved into heavier intervention in the banking system. It should be noted here that there was a virtual lack of alternate means of financing for firms (the stock exchange and the corporate bond market being very thin in Greece). Already by the end of 1945, with laws 675 and 685, the whole

credit industry has come under state control. The disposal of any amount by the banks could henceforth be effected only after a decision of the competent state organs, which would be determined by way of decrees. The Bank of Greece was stripped of any vestige of independence from governmental decisions, through the transferring, in 1946, of the competence for monetary and credit policy to a governmental body, namely the Currency Committee, and the transformation of the Bank of Greece, the country's central bank in name, into a mere executor of the decisions taken by that committee[8]. To add insult to injury, the major banks, along with their subsidiaries, were put under the control and/or the ownership of the Greek state. All small commercial banks that did not meet certain conditions for continuing their operation were closed, and strict controls were imposed in the establishment of new credit institutions. The Greek banking system was not guided any more by the decisions of banking institutions in response to market conditions, but rather by the political will for a concentrated banking system, which would serve the decisions and priorities of the state in matters of economic development. Viewed in this perspective, the many, small banks of the mid-war years were not needed, and possibly were undesirable[9]; the Greek banking system was deemed as best to operate with a small number of banks that would be specialized and strictly controlled by the state.

The banking industry became highly concentrated in the 1950s by way of certain important mergers between the large banking institutions. In particular, in 1953, the largest bank, the National Bank of Greece, absorbed the second largest one, the Bank of Athens[10], and in 1957, Emporiki Bank acquired the Ionian Bank of Greece, which on its turn merged with Popular Bank, resulting in a combined Ionian Popular Bank fully owned by Emporiki Bank. This consolidation of the industry

[8] The Currency Committee was formed in January 1946 as a "temporary" mechanism for controlling credit and channelling foreign financial aid into productive goals. This mechanism was "temporary" enough, to endure more than 35 years! (until 1982; see Kostis pp. 89-90)

[9] Only three banks survived from the mid-war banking world: the Bank of Greek Commercial Credit (currently Alpha Bank, 2nd largest bank by assets) largely thanks to its family tradition, the Bank of Professional Credit that became part of the NBG Group, and the Bank of Krokos & Mouzelis, a small family bank in the city of Lamia, that was later acquired, becoming Bank of Central Greece (eventually Bank of Central Greece was acquired by Egnatia Bank in the late 1990s).

[10] It is hard to see how a competition authority operating under our contemporary decision criteria would have allowed such a merger! Actually, this merger is considered to be a critical juncture in the evolution of the Greek banking system.

created a banking duopoly comprising the NBG group and the Emporiki Bank group. Without by any means disregarding the limitations of the SCP paradigm in deducing patterns of competition from concentration data, it appears highly plausible that the resultant concentration in the banking industry contributed to a decline in competition.

The controls on the banking sector started to loosen somewhat during the 1960s, and consequently the commercial banks obtained more leeway in their choices; this was coined at the time as the "emancipation of banks". At the same time, specialized credit institutions, the so-called "development banks" (ETBA, ETEBA, Investment Bank) were established, with heavy state participation in their shareholder structure, in order to provide long-term financing, in a manner rather akin to full-blown central planning of the economy. In the end of 1963, there were 16 banks operating in Greece, of which, however, 10 (5 each) belonged to the two dominant banking groups (NBG Group: National Bank of Greece, National Mortgage Bank, Bank of Professional Credit, Bank of Mortgages, ETEBA; Emporiki Bank Group: Emporiki Bank, Ionian Popular Bank, Piraeus Bank, Bank of Attica, Investment Bank). Of the remaining six, three were directly or indirectly controlled by the Greek state (Agricultural Bank of Greece, Bank of the Army Pension Fund, ETBA), only two were pre-WW II commercial banks (Bank of Commercial Credit – currently Alpha Bank, Bank of Krokos & Mouzelis), while there was a single foreign bank, namely American Express, which was actually operating in Greece since the 1920s. The duopolistic nature of this market is evident. According to Kostis (1997, p. 194, quoting Psillos, Capital Markets in Greece, 1964 " in 1962, the two large banks, National Bank of Greece and Emporiki [Bank] together had the 87 per cent of assets of commercial banks, 87.2 of their deposits, and the 89.2 of loans; indeed, if the market shares of [the] Ionian [Bank] get added, then the three[11] commercial banks maintained around 95 per cent of the market." Also, in the draft "Program for Economic Development of Greece" by the Center of Planning and Economic Research in 1966 it is mentioned that "the program assigns an all-special significance to the encouragement of external competition in the banking sector. This is deemed necessary, principally owing to the oligopolistic character of the Greek banking system[12]."

[11] However, Ionian Popular Bank belonged to the Emporiki Bank Group, so this *was* a duopoly.

[12] Emphasis added.

The Commercial Bank group coming under state control in 1975 was yet another event that was not without its consequences for the Greek banking system. The small predisposition that the Greek banking system had towards competition would then become even smaller, since about 80 per cent of the total operations of commercial banks would come under direct or indirect state control by way of this nationalization (Kostis, 1997, p. 118).

In the period from the late 1950s to the early 1990s that the deregulation of the Greek banking system, triggered by the need to conform to European legislation and regulations, at last began to materialize, it was rare for new Greek banks to get established. The only significant diffusion of concentration in the Greek banking industry came by foreign banks (e.g. Citibank) establishing branches in Greece[13]. This trend became especially strong after Greece's accession to the European Economic Community in 1981 and the associated relaxation, and eventually abolishment, of restrictions in EU-based banks obtaining a permit to operate in Greece.

To recapitulate, " intense interventionism of the state in the operation of banks, control of credit and foreign exchange, and determination of interest rates was in effect from 1931 to 1992, and, by reason of this situation, the competition between banks was practically non-existent[14] [15]. During the same period the state proceeded, as a rule in manners objecting to the constitutional and European Community legality, in nationalizations of private-sector banks." (Rokas, 2002)

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[13] "The international expansion of American banks during the 1960s seemed to still offer some possibilities for creating elements of competition in the Greek banking system" (Kostis, 1997, p. 99)

[14] Emphasis added.

[15] Kostis (1997, p. 16) presents the issue of lack of competition in ethical terms as some sort of prevalent morality in the banking community whereby "competition [is referred to] in the sense of violation of a virtuous behavior or at least of a sin". In a similar vein is the reference to "the, for the overall economy, dangerous (!) competition" in the preamble of Law 5261/1931, quoted in Kostis (1997, p. 31). It seems as if cartelization of banking was desirable in the view of the drafter of the law! (being it desirable by the bankers themselves would not surprise us at all!). Kostis (1997, p 33) explains this perception as due to the fact that "the vision of liberalism seemed exceptionally vague and state intervention for constraining the catastrophic consequences of uncontrolled competition was continuously gaining ground"

2.2 The deregulation and the restructing of the financial system

Since the early 1950s, the Greek state was intervening in an intrusive and all-encompassing manner in the development of the Greek banking system in general, and in how loans would be allocated in particular. This situation had resulted in what can be termed as "structural over-determination" (Gortsos, 1998) of the Greek banking system. In a deregulated system, the allocation of credit would be governed solely by the market forces of supply and demand. However, in the Greek banking landscape in the period from the early 1950s up to the early 1990s, even the quantity of credit to be allocated to each economic sector (!) was determined by decisions made at the governmental level – by the Currency Committee[16] – until 1982, or at the central bank level thereafter[17]. One could argue that this setup was closer to central control of economy, prevalent in the former communist states of Eastern Europe, than to an unrestrained capitalist economy purely decided by market forces, as for the instance the one existing in the United States of America before the Great Crash. Certainly in the post-war era in Greece the pendulum oscillating between the polar extreme of central planning and market determination of economic decisions with respect to the allocation of credit had moved quite close to the former, and arguably, far more than is optimal for public welfare[18].

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[16] The Currency Committee was made up by the Minister of National Economy (chairman), four other Ministers, and the Governor of the Bank of Greece. The responsibilities of the Currency Committee comprised the formulation of monetary, credit, and foreign exchange policy. The Bank of Greece was the executor of the decisions of the Currency Committee. The Currency Committee was abolished in 1982; the bulk of its responsibilities (as well as its "spirit") getting transferred to the central bank by way of Law 1266/1982 (http://www.bankofgreece.gr/en/bank/history.asp). There had to be a wait of ten more years until this regime ceased to exist and the Bank of Greece undertook the actual responsibility of monetary policy (Kostis, 1997, p. 202)

[17] Manos in Kostis (1997, p. 12) mentions that "during the thirty years 1963-1993 the Hellenic Bank Association increases its activities only to the degree that it is given the chance by way of the subsiding of administrative controls or the transfer [to it] from the monetary authorities of some responsibilities."

[18] The main differences with the socialist countries were (a) the election of the governmental decision-makers by way of democratic processes, with the exception of the 1967-74 military dictatorship and (b) the execution of the decreed financing policies by private-sector banking corporations, which had some leeway of decision-making with private-economy criteria, in those areas that were not determined by the governmental decisions.

According to Gortsos (1998), the intended beneficiaries of financing by the banking sector, as deemed by the state bureaucrats, were, in the main:

- State-owned firms
- Export-oriented producers
- Small- and medium- scale enterprises[19] [20]
- The agricultural sector
- The housing needs of a rapidly growing urban population[21]
- The infrastructure in certain underdeveloped regions of the country[22].

The form of direct credit controls imposed to the banking sector were similar to those in other developing economies of the particular historical period, and included preferential and/or subsidized rates in the extension of credit to entities such as the aforementioned ones, the requirement that banks provide credit guarantees such as letters of credit to particular preferred parties, as well as the establishment of the so-called "development banks"[23], of direct or indirect state control and/or ownership, whose role was to provide long-term credit according to the centrally-controlled directions of the economic policy.

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[19] SMBs (Small- and Medium-size Businesses) still form the backbone of the Greek economy.

[20] Credit institutions were required to hold 10 per cent of their deposits in reserve, so that these could be granted to SMBs in the form of loans.

[21] The phenomenon of "astyphilia", i.e. massive migration of populace from the countryside to the major urban industrial centers of Athens, Thessalonica, Patras, Volos, etc. constituted one of the major social phenomena in Greece of years 1950-1980, i.e. from the end of the civil war up until to the entry of Greece to the European Union (emigration to countries such as the United States, Australia, Germany, and Canada being another; actually these were considered to be in parallel, as evident in the terms "internal migration" and "external migration"). One can see a parallel here to the contemporary phenomenon of massive migration of farmers in China from the Chinese heartland to the large industrial and commercial centers of Beijing, Shanghai, Shenzhen, etc. Both Greece in the period 1950-1980 and China in the period 1978-present are "textbook" cases of developing economies.

[22] Greece still has 5 of the 60 EU regions below the level of 75 per cent of EU average GDP, according to the latest "Regional GDP per inhabitant in the EU25" report by Eurostat (http://epp.eurostat.cec.eu.int) for 2003, issued May 2006. Those regions are the Ionian Islands (€16,218, 74.6%), Thessaly (€15,912, 73.2%), Epirus (€14,439, 66.4%), Western Greece (€13,628, 62.7%), Eastern Macedonia & Thrace (€13,560, 62.4%, 6th poorest region in the old EU-15, ahead only of 3 Portuguese regions and 2 French overseas departments).

[23] Also known as "investment banks" – not to be confused with US-style IB (Goldman Sachs and the like)!

In addition to the heavy regulation imposed to the providing of loans on the part of banks, there was also the requirement that 40 per cent of the deposits at banks get invested in low-yield Greek government Treasury Bills, for purposes of financing the public sector, whose expenditures particularly increased in the 1980s, as a result of the populist distributional economic policies undertaken during that decade.

So, the banking system in Greece in the period 1950-1990, played to a large extent the role of a mere vehicle of the government in implemented its centrally decided economic policies, with little regard to the concept of a market economy. The role of the banking sector in the Greek financial system had been prominent, the local capital and money markets being very thin[24]. Until the mid-1980s, the banking system in Greece was used as a means of implementing economic policy and promoting, mainly, industrial development, by applying a highly complicated system of selective credit controls and regulations along with a wide range of administratively-determined bank interest rates. In practice, however, that system proved to be ineffective and led gradually to allocative inefficiencies and to serious distortions in the functioning of the financial system. The creation of a modern, market-oriented system necessitated the liberalization of interstates, the deregulation of the domestic market and the lifting of restrictions on external transactions. It was only after the mid-1980s that the Athens Stock Exchange started to gain in liquidity, with the stock market boom (and subsequent bust) of the years 1999 and 2000 marking the transformation of the Athens Stock Exchange to a highly liquid market featuring both international institutional investors and the Greek "wide investing public" as major players in it. This transformation of the Athens Stock Exchange has enabled firms to disperse their ownership and at the same time reduce their dependence on bank debt.

State intervention in the banking system was clearly incompatible with the fundamental principles of European Community law, which is based on the freedom

[24] Of course, the banking system in continental Europe in general (Germany, France, etc.) occupies a disproportionate chunk of the financial system, compared to its lesser heft in countries such as the United States and the United Kingdom, where capital and money markets are much deeper. For instance, the market for corporate bonds in Continental Europe is underdeveloped compared to (say) the United States; the banks have a larger hold on corporations in countries such as Germany, where the firms principally rely on bank-provided credit, rather than addressing the households directly by way of issuing corporate bonds. However, the weight of the banking industry in the overall financial system had been too large in Greece during the period 1950-1990, even by continental standards.

of movement in services and capital, the freedom of establishing credit institutions, but also the creation of a single European market by way of economic and monetary unification. Law 2076/1992, entitled "Undertaking and Exercise of Activity by Credit Institutions and Other Related Provisions" (as modified by Article 38 of Law 2937/2001), with which the Second European Banking Directive was transposed into Greek law, established the single banking market in the member states of the European Union and brought about the liberalization of the financial system. At the same time, the so-called universal banking system was instituted; this allows credit institutions to provide investment services too (Rokas, 2002).

The process of deregulation and liberalization of the Greek banking system started in 1982 and intensified after 1987, triggered primarily by the accession of Greece to the European Union in 1981, as well as by the currents of globalization that emerged especially after the collapse of the Eastern bloc in 1989-91. In the period after 1987 radical changes took place in the Greek banking system, including the change of perception for the role of the banking system in the economy and for the place that competition should have in it[25]. Three stages can be distinguished in the process of deregulation of the Greek banking system (Gortsos, 1998):

- 1982 – 86: The foundations were laid for:
    a. Conducting a quasi independent monetary policy and
    b. Rationalizing the credit market
- 1987 – 91: The constraints on the operation of financial markets, intermediaries, and the provision of financial services were gradually lifted, as motivated by international developments and the need for Greece to prepare for participation in the single European market for financial services. A milestone in this process was the laying down of the steps to be taken towards market deregulation and liberalization of services in the report of the Karatzas committee ("Report for the Reform and Modernization of the Greek Banking System")
- 1992 – 2001: The following were the principal initiatives towards deregulation of the banking system, undertaken during that third stage:
    a. Abolition of the few remaining direct controls and interventions

[25] Kostis (1997, p. 17)

b. Implementation of European Union legislation about the establishment of a single European financial market into the Greek law

c. Preparation of Greek credit institutions and the supporting mechanisms of the Greek financial system for the modifications required by the introduction of the single European currency, the Euro.

The time frame examined in our present study spans the third phase of deregulation; the effects of the first two stages, completed by the end of 1991, are regarded as having been phased in by the starting point of our study, which is the beginning of year 1993. Of course, the division of the time continuum into discrete phases, always entails some degree of arbitrariness, since it is virtually impossible to impose a discrete structure into what especially is a continuous (albeit non-uniform) process. Hence, the cut-off time points delineating the above three phases should be taken cum granum salis.

European law has acted as a catalyst in effecting changes in Greek banking law. The Greek banking institutional framework had to undergo a radical transformation and to become harmonized with community directives, to create a single institutional framework in the single economic space, and also for equality in competition to be achieved between credit, financing, and investment institutions.

The most notable structural and conduct developments that took place during the process of deregulation and modernization (essentially of convergence to the status of more developed banking systems in the European Union, such as those of Germany and France) of the Greek banking sector are the following (Gortsos, 1998): interest rate deregulation, liberalization of cross-border capital movement, abolition of direct credit controls, "de-specialization" of credit institutions, modernization of money and capital markets, modernization of monetary policy, and enhancement of prudential banking regulation.

By the early 1990s, bank interest rates had been gradually liberalised and all quantitative credit restrictions and investment requirements concerning the financing of specific economic sectors, notably the public sector, had been phased-out. Moreover, the central bank had authorised the introduction of new financial products, such as leasing, factoring, forfeiting and venture capital, while specialised credit institutions had been given permission to expand their activities to sectors formerly

open only to commercial banks and vice versa. At the same time, restrictions on capital movements and current transactions were also gradually lifted. Thus banks were increasingly able to grant loans on their own terms and differentiate their lending rates based on liquidity and risk considerations only, as well as to choose the types of activity on which they wished to focus, to expand their operations in preferred segments of the market and use new techniques for hedging against interest rate and foreign exchange risks.

Important measures were also taken to promote the operation of the capital market and new institutions were introduced such as brokerage firms. Furthermore, the operating framework of undertakings for collective investment in transferable securities (UCITS) was improved and the supervisory role of the Capital Market Committee was enhanced. As a result, the capital market gradually became an important source of capital for the funding of enterprises as an alternative to bank financing. It also became an important source of funds for the banks themselves, especially in the late-1990s.

The environment that emerged gave impetus to the establishment and operation of new banks, either domestic institutions or branches of foreign banks. Indeed, from the late-1980s to the late-1990s, ten commercial banks were incorporated in Greece. In addition, since 1993 when the Bank of Greece set the operational and supervisory framework concerning cooperative banks, fifteen cooperative banks have been established and operate, although their market share remains very low (less than one per cent of total assets of the banking system). Regarding foreign banks, the picture is mixed. On the one hand, seven foreign banks established branches in Greece from the late-1980s to the late-1990s. On the other hand, some foreign banks, in the context of their broader strategies, have withdrawn from the Greek market over the past few years.

Following financial deregulation and the enactment of new legislation implementing EU directives, banks operating in Greece had to adjust to new conditions and cope with the ensuing intensified competition, both domestically and cross-border. Besides, the completion of the European internal market along with the major advances in information technology and telecommunications, which have led to the globalization of the financial services market, necessitated the reorientation of banks' activities and resulted in a restructuring of the banking system. Another factor putting pressure on banks was the increasing role of institutional investors, which

made it more difficult for the former to attract deposits and, consequently, induced banks to search for alternative sources of funds and for ways of reducing their operating costs.

Moreover, Greek banks pursued restructuring policies in order to become more efficient and obtain a size that would enable them to increase or, at least, maintain their domestic market shares, facilitate their access to international financial markets and exploit any possible economies of scale. To this end, since the mid-1990s several Greek banks have been involved in mergers and acquisitions. Most of them concerned the domestic market, including not only banks but also non-bank financial enterprises. Some large credit institutions opted to merge with their subsidiaries with a view to restructuring their activities and cutting their operating expenses. Others have forged strategic alliances with major European institutions in order to benefit from the latters' know-how, large branch network and presence in international financial centers. Some Greek banks have also expanded their operations in countries to the wider area of south-eastern Europe, notably in the Balkans, either via subsidiaries or through the establishment of branches.

At the same time, Greek credit institutions have taken important steps towards improving their efficiency by installing modern information technology systems, cutting their operating costs and improving their organizational structure, while they have extended their scope of business by offering new products and services. They have merged their subsidiaries engaging in the same line of business and integrated several of their activities in an effort to reduce costs and improve control and service quality. Additionally, several banks have tried to expand or further develop their activities in such sectors as bank assurance, where they can profit from synergies and cross-selling by both bank networks and insurance companies. Another very important aspect on which Greek banks have focused their attention is on the branch network and alternative distribution channels. Branches offer the advantage of (physical) proximity to customers, especially in retail banking. On the other hand, the maintenance of an extensive branch network entails high operating costs, with negative implications for bank efficiency. Technological advances have allowed banks to develop remote banking channels: ATMs, telephone banking, online PC banking and Internet banking, the first two being the most commonly used in the Greek market at present. The number of bank branches in Greece continues to rise (2005: 3,543, 2004: 3,403), contrary to the EU, where a declining trend prevails.

However, the density of the branch network in Greece (32 branches per 100,000 inhabitants) is still lower than in the euro area (54 branches per 100,000 inhabitants In any case, banks continue their efforts to further develop alternative distribution channels, such as automatic teller machines (ATMs), phone banking and e-banking, which are increasingly being used by customers. In particular, the number of ATMs rose from 5,787 in 2004 to 6,230 in 2005 and at the same time their operations expanded to include fund transfers to third-party accounts, credit card and utility bill payments. In addition, new technologies changed the way in which bank branches are organized, by favoring the operation of smaller branches with fewer but more highly qualified staff, focused on a better promotion of bank products and meeting of customers' needs. Mergers and acquisitions have resulted in higher concentration in the banking industry. This, however, has not led to less competition, as evidenced by the reduction in interest rate spreads, especially in the segments of consumer and housing loans, in the past few years, which can only partly be attributed to convergence to the rates prevailing in the euro zone. Accordingly, this indicates that, if anything, oligopolistic rents have been reduced in Greek banking.

The deregulation of interest rates had been completed by 1993 already. Thus, the whole time period, 1993-2005 of our study reflects a financial milieu where interest rates were determined solely by market forces (naturally with the intervention of the central bank, which controls the money supply in the economy). Since January 1, 2001, when Greece entered the Euro zone, the rates are no longer determined by the Bank of Greece, but rather by the European Central Bank; the Bank of Greece is one of the 12 national central banks that participate in the European System of Central Banks.

The movement of capital by Greek residents in and out of Greece was heavily regulated until 1994[26], when cross-border movement of capital by Greek residents became almost fully liberalized by way of Directive 88/361/EEC[27]. The last remaining barriers were lifted in 1997. At the same time, Greek banks were spared of the requirement, hitherto in effect, to hold 70 per cent of their deposits in foreign currency with the Bank of Greece.

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[26] "The strict foreign currency restrictions [...] had as their aim the bolstering of the national currency [(the drachma)] and the safeguarding of the national foreign currency reserve" (Rokas, 2002, p. 31)

[27] And Presidential Decrees 96/1993 and 104/1994, by which the Directive was transposed into Greek law. (Rokas, 2002, p. 31)

The direct credit controls imposed on Greek banks were totally lifted by the mid-1990s. In 1993, banks were relieved of the theretofore requirement to hold 10 per cent of their deposits in reserve in order to be able to provide loans to SMBs. In the same year, the requirement that banks invest 40 per cent of their deposits in Greek government Treasury Bills was also abolished, after having gradually been phased out during the previous years; by 1994 banks were allowed to convert their accumulated stock of such Treasury Bills into Treasury Bonds and use those bonds in entering repurchase agreements (repos) with their customers. The preferential access to the banking sector that the Greek government enjoyed was also abolished in 1993, since it was contrary to the provisions of the Maastricht Treaty[28]. The mandatory financing by banks of public-sector firms and organizations, at the level of 9 per cent of bank deposits, ceased to be in effect at that time too.

There was (and remnants of it still remain, although at the vestigial level) a major dichotomy in the Greek banking system between commercial banks and so-called "specialized credit institutions". These specialized credit institutions (to be examined in more detail later in this study) were not created by way of market forces that led some entrepreneurs to forego breadth and strive to attain depth into attractive and profitable niches (M & A comes to mind as an obvious example); instead this specialization was legally mandated (cf., for example, the aforementioned "development banks"). This dichotomy had been a prominent structural attribute of the Greek banking industry. In the process of deregulation and modernization of the banking system this distinction gradually became blurred; currently the existence of the Deposits and Loans Fund, the supervisory responsibility of the Agricultural Bank of Greece over agricultural cooperatives, and the control and ownership of the Greek state over the Agricultural Bank of Greece (84 per cent) and the Greek Postal Savings Bank (100 per cent), are the remaining traces of the old regime.

As regards monetary policy, since 2001 this falls under the purview of the European Central Bank; indubitably, the transition of exercising the monetary policy

[28] The Maastricht Treaty, formally "the Treaty on European Union", signed in Maastricht, Netherlands, on February 7, 1992, and put into effect on November 1, 1993, created an economic union, which consists, *inter alia*, in the "removal from public organs, community ones and national ones, of the privileges that they disposed, compared to the private sector, with respect to their ability to access financial institutions both public and private" (see Skandamis, 2003, p. 75). The relevant article is Article 104 of the Maastricht Treaty; it later became Article 101 of the Amsterdam Treaty.

from the Bank of Greece to the European Central Bank constituted the final step in the trek towards modernization of the Greek banking system. However, major changes in how Greek monetary policy was exercised had already taken place, while maintained at the responsibility of the Bank of Greece; in particular, open market operations had become the main means of controlling monetary aggregates and the Bank of Greece had enlarged the framework for providing lending and deposit facilities to banks.

When competition in banking creeps in, there comes the need for prudential regulation, to maintain stability in the market (prevent failures) as well as to protect consumers (when failures occur). The Greek state, along with the Bank of Greece, implemented certain prudential regulations to mitigate risk. Also, a deposit guarantee scheme, akin to the one provided in the United States by the FDIC, was created to safeguard the stability of the banking system (run avoidance, protection of deposits in case of failures). In general, "owing to the massiveness, the complexity, but also the continuously increasing range of banking activities, the regulatory intervention of the state as well as the European Union has become necessary, with its main target the protection of depositors and investors" (Rokas, 2002)

It could not be stressed enough that it was primarily "the accession of Greece in the European Economic Community, in 2001, and its participation in the Economic and Monetary Union (EMU) since January 1, 2001 [that] created new, freer, and more competitive bases in exercising banking activity.[29]

2.3 The regulatory framework

The full deregulation of the credit system, the development of money and capital markets, the expansion of the bank's activities into new operations, the supply of new banking products and, particularly, the expansion of foreign exchange transactions increase the risks to which banks are exposed and necessitate a strengthening of the role of the bank of Greece, which is responsible for the prudential supervision of the banking system.

With the deregulation and liberalization of the Greek banking system, introduction of regulatory measures to maintain market stability and protect

[29] Psychomanis (2005, p. 32)

consumers became of high priority. The Greek parliament and the Bank of Greece closely followed developments in European Union (EU) law. Following so the harmonization of Greek legislation with Community law[30] regarding the supervision and control of financial institutions, substantial changes have been made in the institutional underpinnings of the supervisory powers of the bank of Greece. The Bank of Greece has issued a series of decisions adopting certain regulations on the operation of credit institutions, which are in EU Directives and concern (Bank of Greece, 1994):

a) The adoption of a uniform definition of equity
b) The assessment and monitoring of the solvency of credit institutions
c) The imposition of limits on large financing and lending of each bank

In addition, a deposit insurance system was established to prevent bank runs and protect depositors. These regulations were aimed at the creation of an effective prudential supervisory system, safeguarding the solvency of these institutions and the stability of the financial system.

The internationalization of the Greek banking system and the increased competition among banks has led banks to assume additional risks, because of their expansion into new activities. Against this background, banks need to upgrade their risk management and internal control systems if they are to ensure their soundness and effective operation. To this end and in the context of strengthening prudential banking supervision, the Bank of Greece decided to establish, by Governor' s Act 2438/6 August 1998, general criteria and principles with which banks' internal control systems must comply in order to ensure effectiveness, and instructed credit institutions to take the necessary measures in this direction.[31] Furthermore, to improve the quality and speed up the restructuring of banks' lending portfolios – an objective to which banks themselves attach great importance and which they have been pursuing over a number of years – the Bank of Greece, by Governor' s Act 2442/29 January 1999, specified a general framework of minimum quantitative criteria for

[30] See Gortsos (1998, p. 56) the summary table depicting the implementation of community banking legislation into Greek law. In particular, all directives from the Council of the EU on the operation and prudential regulation of credit institutions were implemented into Greek law.

[31] E.g. by setting up an Auditing Committee and an independent Risk Management Unit. See "The banking system and its supervision", Bank of Greece, Annual report for the year 1998.

assessing the adequacy of bank' s provisions for bad debts and established the requirement for more frequent and systematic reporting on banks' lending portfolios.

Also, a deposit guarantee scheme, akin to the one provided in the United States by the FDIC, was created to safeguard the stability of the banking system (run avoidance, protection of deposits in case of failures). In general, "owing to the massiveness, the complexity, but also the continuously increasing range of banking activities, the regulatory intervention of the state as well as the European Union has become necessary, with its main target the protection of depositors and investors" (Rokas, 2002).

The stability of the Greek financial system was recently assessed by the International Monetary Fund (IMF), following an on-site examination of the relevant institutional framework and financial aggregates, as well as of the supervision methodologies and practices in place. In the assessment report, which was released in January 2006, the IMF concludes that the Bank of Greece supervises banks effectively and generally responds to new challenges by strengthening the supervisory framework, although there is scope for improvement in certain areas. The IMF' s assessment of the adequacy of banking supervision was based on both the essential and the additional criteria used to determine compliance with the Basel Core Principles (BCP) and, therefore, the assessment was made according to internationally acceptable best practices. It was found that Greece is fully compliant with 22 criteria, largely compliant with eight criteria and materially non-compliant with only one criterion.[32]

Panayotis Thomopoulos, Deputy Governor of the Bank of Greece recently mentioned:[33] "Undoubtedly, as regulators of the banking system we are concerned and we know that many things have to be improved. There is a need for better consumer protection and better education of borrowers about the risks of bad financial choices. We should not forget that the experience of Greeks over the last 15-20 years has been one of falling interests rates first as they converged to the Euro area's average and then as the ECB telexed its monetary policy. Now that the ECB is undergoing a phase of monetary policy tightening, the experience of rising interest

[32] For more details about this issue, see "The stability of the banking system", Bank of Greece, Annual report for the year 2005.

[33] Speech at the Covered Bonds Conference, organized by Barclays International, Athens, 1 September 2006.

rates may come as a shock to many households in Greece...As far as the Bank of Greece is concerned, our supervisory role obliges us to ask banks to increase provisions, to tighten credit standards and in general to introduce efficient credit control mechanisms, including state-of-the-art risk management units so that even if non-performing-loans increase their VAR will still remain well above 10%: today is almost 14%. At the same time in collaboration with the host supervisors in the South Eastern European countries, the Bank of Greece monitors closely developments at home and abroad".

Taking into account the principles of corporate governance and the need for ongoing adaptation to best international practices, as well as the increase in the risks assumed by banks, the Bank of Greece, by Governor's Act 2577/2006, amended and supplemented the existing regulatory framework regarding the principles of operation and the criteria for assessing banks' organizational structure and internal systems. The principles and procedures laid down in this Act should be adopted and implemented by banks on both an individual and a group basis. The implementation of the above act, to the extent that it contributes to the improvement of banks' organizational structure and internal control, risk management and compliance systems, will also limit operational risk, which has gained importance worldwide, as bank operations have become more complex. With respect to operational risk, it should be pointed out that the new supervisory framework ("Basel II") introduces capital requirements for covering it.

Moreover, the Bank of Greece cooperates on the one hand with the Ministry of Development in order to clarify issues that arise out of the implementation of provisions on consumer protection and to promote the transposition of EU Directives to Greek law and, on the other hand, with consumer unions in order to investigate and resolve, within the scope of its authority, consumers' requests concerning transactions with institutions supervised by it. Besides, the Bank of Greece devotes considerable resources to examine customers' complaints and to conduct relevant inspections and imposes sanctions on credit institutions when it finds violations of the provisions in force.

Finally, despite the blurring of the classic distinctions concerning financial institutions and services (credit institutions versus investment firms), the supervisory structure of financial services in Greece remains fragmented; banks – regardless of the

products and services they offer – are supervised by the Bank of Greece, while investment firms are supervised by the Hellenic Capital Market Commission.[34]

2.4 Recent developments in the Greek banking system and Banks' strategies

A major structural feature of the Greek banking system in the past was its institutional specialization required by law rather than dictated by market forces. Towards the late 1980s, there was a process of gradual and extensive liberalization of the market, motivated by international developments and the need for participation in the Single European Market for financial services. During the 1990s, the process of liberalization and deregulation of the banking system was carried out at an accelerating pace and the provision of the Second Banking Directive concerning establishment, operation and supervising of credit institutions was passed by the Greek Parliament in August 1992. Various measures were also taken towards his modernization of the capital market... Against this background, Greek banks have to respond and formulate far-reaching strategies, pondering their capabilities and defining their goals. The type of bank which can effectively operate at an EU-wide level must have: (i) adequate size so as to take advantage of any economies of scale, (ii) ability to offer a broad range of services, (iii) presence in international financial centers, and (iv) an extensive and efficient distribution network (Bank of Greece, 1999).

As per Thomopoulos (2006), total credit growth at around 20 percent annually and 30 percent for credit to households since 2001 has been one factor underpinning strong private demand in recent years and has been fuelled by the low Euro area interest rates. Greece is a country with a still relatively low household debt-to-GDP ratio – 38 percent compared with 56 percent for the Euro area. The rapid credit expansion in this area reflects fundamental changes in the Greek economy and has underpinned the transformation of a fragmented stagnant inward-looking banking sector into a dynamic modern banking sector with strong international competitive presence. The lifting of foreign exchange controls in the mid-1990s and of household credit restrictions in 2001 as well as privatizations and the mergers between a large

[34] Insurance firms are supervised by a separate authority, that is, the newly established Committee on the Supervision of Private Insurance (Law 3229/2004).

number of smaller banks since 1997 has created Greek champions (up to the second half of the 1990s almost 2/3 of Greek banks were controlled by the State and were moreover, badly run, compared with about 15 percent presently, which are managed by professionals).

As refers now to the banks' balance sheet key aggregates, we observe positive changes in the figures of 2005 (Bank of Greece, 2006). Major importance should be given to credit growth since it consist a significant result in the new banking landscape that characterize the Greek market (Table 2.1)

Table 2.1

Banks' balance sheet key aggregates (% change)

	All Banks		Greek Commercial Banks	
	2004	**2005**	**2004**	**2005**
Loans	17.0	19.1	17.9	18.6
Own funds	4.9	30.8	4.3	39.9
Deposits	14.0	17.3	12.0	14.9
Deposits and repos	10.5	10.2	8.0	13.0
Total assets	9.4	21.1	7.3	21.5

Total loans increased in 2005 by 19.1%. Also, the significant increase of deposits (17.3%), contributed to the rise of deposits and repos (10.2%).[35] Total assets increased by 21.1% and reached the level of 152.6% of GDP (2004: 135.4%). Greek commercial banks followed this trend. Loans increased by (18.6%), outperforming deposits (14.9%), whereas own funds soared to 39.9%.

Table 2.2 provides a slightly different breakdown, distinguishing between the Key indicators figures of Greek commercial banks during the period 1993-2005.[36]

[35] Repos decreased due to the rise of tax rate (10%).

[36] Source: Organisation for Economic Cooperation and Development, OECD, Bank Profitability – Financial Statements of Banks: 1994 – 2003, OECD, 2004 and Bank of Greece, Annual Report 2005, BoG, 2006. NCB: number of Greek commercial banks; NB: number of branches; NIM: net interest margin i.e. net interest income to average assets (in percentage terms); NoIM: non-interest income to average assets (in percentage terms); OEA: operating expenses to average assets (in percentage terms); LLP: loan loss provisions to average assets (in percentage terms); ROA: return on assets (in percentage terms); LA: loan to assets (in percentage terms); EA: equity to assets (in percentage terms).

Table 2.2

Key indicators of Greek Commercial Banks

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NCB	20	19	18	20	19	19	16	17	20	19	20	21	21
NB	1,200	1,244	1,469	1,599	1,788	2,048	2,070	2,670	2,766	2,854	2,876	2,953	3,035
NIM	1.57	1.36	2.09	1.98	2.25	2.42	2.70	2.69	2.67	2.42	2.72	2.80	2.80
NoIM	2.18	2.85	2.15	2.22	2.21	1.92	3.74	2.16	1.50	0.91	0.96	0.90	0.90
OEA	2.35	2.51	2.73	2.87	2.82	2.57	2.68	2.58	2.44	2.27	2.31	2.30	2.10
LLP	0.34	0.38	0.23	0.52	0.62	0.52	0.64	0.37	0.33	0.39	0.49	0.60	0.60
ROA	1.06	1.31	1.26	0.79	0.99	1.20	3.04	1.86	1.39	0.66	0.87	0.70	0.90
LA	23.78	25.17	28.06	31.53	31.90	36.27	36.58	43.79	47.67	52.46	56.98	62.70	55.30
EA	4.55	4.87	4.84	4.47	5.10	5.98	9.89	8.94	9.28	6.61	6.84	6.70	8.40

With a comprehensive glance at the figures, one might conclude that financial liberalization has not led to any significant increase in foreign presence in the banking sector in the 1990s in terms of the number of banks. Indeed, in 2005, 21 Greek commercial banks are in operation, only one more than the number of banks that were established twelve years ago. However, as it has been already mentioned, financial liberalization has allowed the entrance of new, mainly small, private banks and led to an increase in the number of branches (from 1,200 in 1993 to 3,035 in 2005), resulting in a decline in the, albeit high, concentration ratio of the commercial banking sector.

The liberalization measures introduced in recent years seem to have improved the degree of competitiveness of the Greek banking system and to have decreased its oligopolistic character. Tentative evidence is provided by the development of some key indicators of the Greek banking system The ratio of net interest income to average total assets of banks increases considerably since 1980s (Hondroyiannis et al., 1999). However, the downward trend in the mid-1990s is related to the high concentration ratio and to the need for Greek commercial banks to accumulate reserves and improve their capital base according to the Second EU Banking Directive. As in Georgoutsos et al. (1994), net interest income is low, compared to other EU countries, mainly due to the portfolio structure of the banks (high proportion of public securities held by the banking system whose interest rates are lower than those on loans).

Non-interest income as a ratio to average total assets of Greek commercial banks is relatively high from 1993 to 2001, reflecting the high proportion of income from traditional banking services (commissions). It is noteworthy that non-interest margin takes its highest value in 1999. This is the expected consequence of the stock

market boom (and subsequent bust) of the years 1999 and 2000 that marked the transformation of the Athens Stock Exchange to a highly liquid market, featuring both international institutional investors and the Greek "wide investing public" as major players in it. Since 2002, non-interest margin decreases, standing nowadays at the level of 0.9%, consisting mainly from fees and commissions from traditional banking activities.

Developments in the cost side show an improvement in the productive efficiency of the Greek banking system, as the proportion of banks' operating expenses is decreasing, even though the ratio of operating expenses to average assets still remains over 2%. The high proportion is related to the specific features of the Greek banking system, such as the great number of branches of large banks and the relatively limited and less developed products offered (Hondroyiannis et al., 1999). Nevertheless, although Greek banks' operating expenses relative to their average total assets remain above the average European figures (1.5% in 2004); between 1996 and 2005, they fell from 2.9% to 2.1%. According to Staikouras et al. (2006) "during this period, Greek credit institutions have taken important steps towards improving their efficiency by installing modern information technology systems, cutting their operating costs and improving their organizational structure, while they have extended their scope of business by offering new products and services." The containment of operating costs in 2005 was helped, *inter alia*, by the continued rationalization of branch networks that resulted from mergers, as well as by the downward effect on staff costs of certain banks from the implementation of voluntary retirement plans. Banks' efforts to contain their operating costs should be kept up, since intensifying competition might erode banks' profit margins (Bank of Greece, 2006).

During the observed period, 1993-2005, the profitability of banks has not only not improved, but has even deteriorated on average. Gibson (2005) claims that the profitability of Greek banks has exhibited rather erratic behavior. To a great extent, this reflects the huge surge in profitability provided during the years of the stock market boom (1998-2000); as an important caveat, table 2.6 reveals that return on assets reached the peak in 1999 (3.04%). Gibson concludes that more recently, profitability has returned to more "normal" levels and indications of a long-term downward trend in profitability are evident from the beginning of liberalization (towards the end of the 1980s) onwards. Indeed, the developments in banks' income

in 2005, in conjunction with the containment of operating costs, helped increase return on assets from 0.7% (2004) to 0.9% (2005). Generally, the continued reliance of Greek banks' profitability on income from their lending activities, notably from retail banking, is a positive characteristic, as it enhances the sustainability and quality of bank earnings. Moreover, as was indeed the case in 2005, high profitability enables banks to use retained profits for increasing their capital buffets, thereby improving their shock-absorbing capacity (Bank of Greece, 2006).

The proportion of loans to total assets reached 55.3% in 2005 (compared to 23.78% in 1993), catching up rapidly with the average European levels. Staikouras et al. (2006) mention several factors that have been responsible for the high rates of growth of bank lending, including the relatively-high rate of growth of the Greek economy, the convergence of Greek lending rates to those in the rest of the euro area, the enhancement of competition among credit institutions, especially with regard to extending credit to households, and the release of commercial bank funds from the Bank of Greece due to the harmonization of reserve requirements in the Euro system. Finally, Greek banks have increased their levels of loan loss provisions, mainly due to the significant credit expansion, as well as to the more severe supervisory system.

The biggest five banks with a 78 percent market share [2006] have been very active is modernizing their business not only in Greece but also in acquiring or setting up new banks in all the South-Eastern European countries, where the market share of Greek banks is more than 20 percent on average, with a high of over 33 percent in FYROM and a low of somewhat less than 20 percent in Romania. In this region Greek banks employ around 16.000 employees in their subsidiaries or branches, and few thousand more in EU countries, US, Australia, Canada, etc. The recent acquisition of Finansbank, the fifth largest private bank in Turkey by the NBG and of a smaller Turkish bank by Eurobank, as well the purchase of Egyptian bank by the bank of Piraeus, is transforming the scenery of the Greek banking sector, which is becoming more international.

The size of Greek banks is increasing so that the disadvantage of their small size is gradually being removed and banks are now in a position to extend their activities into more profitable lines of banking, e.g. private banking, consultancy for M&A, investment banking, asset management etc. Greek banks can now start enjoying economies of scale and scope. These factors are all reflected in their high profitability: This year [2006] the return on equity is expected to exceed 20 percent.

At the same time, Greek banks are reinforcing their role as a vehicle facilitating trade in goods and services, investment and capital flows as well as migration between the countries in the wider region. This has led to intensive competition between the Greek banks both in the home market and abroad, with the result that the high Greek interest rate spreads over most Euro area countries' bank loans has considerably diminished to the benefit of the consumer.

Indeed, competition and financial liberalization allows households to better manage their portfolios of assets and liabilities and in a fast growing economy most households would find it preferable to bring forward the benefits of their expected higher incomes in the future. There is also a stock adjustment issue; starting from a very low level indebtedness and realizing that Greece has entered a period where interest rates are much lower and risks have diminished, as well as because of their rising wealth, households find it acceptable to carry a larger stock of debt. The flow of borrowing as households adjust to their higher level of desired debt may be very high for a protracted period.

2.5 The structure of the Greek banking system

With the deregulation of the banking system and the liberalization of capital flows between domestic and foreign residents, the Greek financial marketplace has become much more attractive for institutional and private investors seeking to raise funds or invest part of their financial assets through financial institutions operating in Greece. Several financial intermediaries have established a physical presence in Greece either to provide a wide range of financial services or, as Gortsos (1998) mentions, to become niche players[37] because of this market opportunities introduced during the last decade.

The banks operating in Greece are distinguished into four (4) categories:

- Greek commercial banks
- Foreign banks
- Cooperative banks

[37] "Foreign presence was mainly concentrated in niche markets, specialised in areas such as shipping and corporate finance, private and personal banking, asset management, and capital market activities." Staikouras et al. (2006)

- Specialized credit institutions (comprising, as of the end of 2005, the Greek Postal Savings Bank and the Deposit and Loans Fund)

The number of Greek commercial banks, foreign banks, cooperative banks, and specialized credit institutions operating in Greece at the end of 2005, along with the corresponding number of employees, is shown in Table 2.3 below.

Table 2.3

Number of banks and employees thereof (adapted from the Annual Report of the Bank of Greece for year 2005)

	Banks		Employees	
	2004	**2005**	**2004**	**2005**
Greek Commercial Banks	21	21	51,741	53,029
Foreign Banks	23	22	5,133	5,381
Cooperative Banks	16	16	781	875
Specialized Credit Institutions	2	2	1,682	2,010
Total	62	61	59,337	61,295

Since the mid-1990s, the Greek financial and banking landscape has changed rapidly as a result of the new regulatory framework characterizing the market. In 2005, there were 61 credit institutions operating in Greece, a figure much higher than that observed in 1990, when only 39 credit institutions were established (Bank of Greece, 2006). The environment that emerged since 1993 gave impetus to the establishment and operation of new credit institutions, either domestic or branches of foreign banks. Foreign presence was mainly concentrated in niche markets, specialised in areas such as shipping and corporate finance, private and personal banking, asset management, and capital market activities. In addition, since 1993, when the Bank of Greece set the operational and supervisory framework concerning co-operative credit institutions, this type of banks has been established and being in operation.

Thus, as of 2005, the Greek banking system comprises of 21 Greek commercial banks, 22 foreign-owned banks, which constitute a subgroup of commercial banks, 16 co-operative banks, and 2 specialized credit institutions (namely the Greek Postal Savings Bank and the Deposit and Loans Fund). Commercial banks incorporated in Greece have been the dominant group in the banking system. Indeed, these credit institutions hold a high market share, both in

terms of assets (81 per cent), as well as in loans (85 per cent) and deposits (82 per cent). On the other hand the market share of foreign-owned banks stands at 10 per cent in terms of assets (9 per cent and 9 per cent for loans and deposits respectively); while the market shares of the co-operative credit institutions remain very low (less than 1 per cent of aggregate balance sheet figures). Moreover, the dominance of the Greek commercial banking sector can be confirmed by its number of branches and employees. (Bank of Greece, 2006).

The number of credit institutions that are active is Greece fell to 61 at the end of 2005 (they were 62 at the end of 2004), owing to the cessation of operation of a foreign credit institution. On the contrary, the number of branches exhibited an increase, with 3,543 branches active at the end 2005 compared to 3,403 ones at year-end 2004; this trend is the opposite of the one observed in the rest of the European Union.

The number of employees of credit institutions in Greece increased in the year 2005, reaching the figure of 61,295 at the end of 2005, up from the corresponding figure of 59,337 at the end of 2004. This increase is attributed to the additional needs that occurred owing to the expansion of bank branch networks and also to the limited replacement in 2005 of the personnel of some banks that had retired by way of the programs of "voluntary exit". The increased number of employees, combined with the contemporaneous rapid increase in the assets of Greek banks, resulted in the assets per employee to rise to 4.2 mil euros in 2005, from only 3,4 mil euros in 2004; however, even now it significantly lags the EU average, which was 11,4 mil euros at the end of year 2004. This means that Greek banks may be overstaffed.

Next we present a table containing the year of establishment for the Greek credit institutions that were in operation by the terminal date in our study data, i.e. by Dec. 31, 2005. This will help us to illustrate the historical dimension of the Greek banking system.

Table 2.4

Year of incorporation for the Greek credit institutions in our study that are still in operation (Citibank Shipping only nominally is)

Credit Institution	Year of Establishment
National Bank of Greece	1841
Alpha Bank (then Bank of Calamai)	1879
Emporiki Bank	1907
Greek Postal Savings Bank	1909
Piraeus Bank	1916
Bank of Attica	1925
Agricultural Bank of Greece	1929
Geniki Bank	1937
Marfin Bank (then Hellenic-French Bank)	1981
Citibank Shipping	1989
Eurobank (then Euroinvestment Bank)	1990
Egnatia Bank	1991
Aspis Bank	1992
Laiki Bank (then European and Popular Bank)	1992
Nova Bank	2000
Investment Bank of Greece	2000
Probank	2001
Omega Bank	2001
First Business Bank	2001
Proton Bank	2001
Panellinia Bank	2002
Aegean Baltic Bank	2002
Emporiki Credicom	2003

Three clusters of banks may be distinguished here: First, the "oldies", i.e. the banks established before World War II; these are the banks dominating the Greek banking system, including seven (7) out of the (8) largest banks in assets (National Bank of Greece, Alpha Bank, Agricultural Bank of Greece, Emporiki Bank, Piraeus Bank, Greek Postal Savings Bank, and Geniki Bank; only Eurobank is a newcomer); second, the banks that came into the fore during the 1989-1992 period, i.e. during the preliminary phase of banking deregulation in Greece, of which Eurobank especially, and to a lesser degree Egnatia Bank are particularly notable; and third a sleuth of

banks, mostly (still) small ones that came into play in the last few years (2000-03): of these NovaBank and Probank might be regarded as the most promising. Marfin Bank is sui generis, it being the successor of Hellenic-French Bank, a joint venture of ETEBA (the erstwhile subsidiary of the National Bank of Greece) and Crédit Lyonnais of France back in 1981.

Gibson (2005) in her paper in the Economic Bulletin of the Bank of Greece presents, inter alia, an overview of the Greek banking system. The focus of the paper is to observe the effect of the three major drivers of the development in the Greek banking system (convergence, competition, and privatization) on bank profitability. The focus of Gibson's study is the period 1993-2003, which largely coincides with the period under investigation in our study. Gibson's paper comes as an addendum and update of sorts to Eichengreen and Gibson (2001), in which the terminal date of the period under consideration was Dec. 31, 1998; hence the newer paper is more complete, and more relevant to the purposes of this study, since it also covers the 1999-2003 five-year period, which was marked, among other things, by events such as the Greek stock market boom and bust of the period 1999-2000, as well as the introduction of the new European currency, the Euro, and the completion of a bout of concentration in the Greek banking sector, by way of a host of M & As taking place in the year 1999-2001. Gibson (2005) claims that "the period since 1998 has largely been one of consolidation with the result that of a downward trend in the degree of concentration in the banking sector which had begun in 1985 to be reserved somewhat." The series of mergers and acquisitions, in which Eurobank, Bank of Piraeus, Alpha Bank, and Egnatia Bank are to be found on the "predator" side constitute the cause for this consolidation and the resultant increase in concentration. This consolidation followed the reduction in the market share of the hitherto dominant firm in the Greek banking sector, namely the National Bank of Greece; this drop in market share occurred as a consequence of the structural deregulation of the Greek banking system in the course of its liberalization and deregulation. As table 2.1 shows, 1998 was a year of important restructuring in the Greek banking industry. In the years 1996-1997 some relatively small steps had been taken towards mergers and acquisitions, most notably the acquisition of Interbank by Eurobank and the merger of the two housing banks (National Mortgage Bank and National Housing Bank) of the National Bank Group.

In the table below we present the banks that ceased to exist during the period 1993-2005 examined by our study.

Table 2.5

Year of incorporation for the Greek credit institutions in our study that are not in operation anymore

Bank	Year of Incorporation	Terminal Year	Acquired by
Investment Bank	1962	2003	Emporiki Bank
Unit Bank	2002	2003	-
Hellenic Bank for Industrial Development (ETBA)	1964	2002	Piraeus Bank
National Investment Bank for Industrial Development (ETEBA)	1963	2001	National Bank of Greece
Telesis Investment Bank (originally as Dorian Bank)	1990	2001	Eurobank
Ionian Bank of Greece	1864	1999	Alpha Bank
Ergobank	1975	1999	Eurobank
Macedonia-Thrace Bank	1979	1999	Piraeus Bank
Xiosbank	1991	1999	Piraeus Bank
Cretabank	1974	1998	Eurobank
Bank of Central Greece	1980	1998	Egnatia Bank
National Mortgage Bank	1927	1997	National Bank of Greece
Bank of Athens (originally as Kardasilaris Bank)	1920	1997	Eurobank
Interbank	1990	1996	Eurobank
National Housing Bank	1930	1996	National Mortgage Bank

Note that there are three clusters of banks here too: first, we have the so-called "development" or "investment" banks founded in the 1960s, namely Investment Bank, the Hellenic Bank for Industrial Development (ETBA, after the Greek acronym), and the National Investment Bank for Industrial Development (ETEBA, also after the Greek acronym), which were absorbed either by the financial institutions that already had a controlling stake in them (Investment Bank by its parent institution, Emporiki Bank, and ETEBA by its parent institution, National Bank of Greece) or by another major player in the Greek banking landscape (ETBA by Piraeus

Bank). The acquisition of ETBA by Piraeus Bank is in the "intersection" with the second cluster here, which reflects the "shopping spree" of Eurobank, Piraeus Bank, and Alpha Bank in the late 1990s and early 2000s, in their drive to grow not only organically but also through acquisitions. Eurobank "devoured" Interbank (1996), Bank of Athens (1997), Cretabank (1997), Ergobank (1999), and Telesis Investment Bank (2001), while Piraeus Bank "gobbled up" Xiosbank (1999) and Macedonia-Thrace Bank (1999), and Alpha Bank acquired the Ionian Bank of Greece (1999). Of these, the acquisitions of Ergobank and the Ionian Bank of Greece stand out as the most important ones. To this cluster of acquisitions (at least one of them, namely that of Ergobank by Eurobank was a hostile one), we should include that of Bank of Central Greece by Egnatia Bank, which arguably did its best, given its limited heft and cash to spare compared to the likes of Eurobank and Piraeus Bank, in its quest for size.

The third cluster is that corresponding to the absorption by the National Bank of Greece of two specialized banks in which it had controlling interests, namely the National Mortgage Bank and the National Housing Bank. Finally, the opening and closure of Unit Bank, a small bank for financing buying of Toyota automobiles, should be considered negligible for our purposes and it is again a sui generis case.

According to Staikouras et al. (2006), a specific structural feature of the Greek financial system, characterizing the old banking regime, was the significant state intervention,[38] which for a long time hindered competition and created a distorted market environment. State-controlled banks accounted for the majority of deposits and credits. Indeed, in the early 1990's, the state commercial banks had around 85 per cent of total commercial banking operations. Since then, a notable trend observed in the Greek banking sector was the privatization of several banks controlled by the Greek state which contributed to the enhancement of competition in the market.

One can foresee a not-too-distant future in which only the National Bank of Greece remains in government hands. An effort to privatize this institution would

[38] Since then, emphasis is added in the government's privatization of four relatively small state-owned banks in 1998, the privatization in 1999 of the much larger Ionian Bank (which was acquired by Alpha Credit Bank) and the flotation on the Athens Stock Exchange in December of 1999 of a 30 per cent stake in ETBA (the state development bank) and in January 2001 of a 12.5 per cent stake in the Agricultural Bank (Eichengreen and Gibson, 2001).

have to overcome the opposition of the banking trade union, which fears the consequences for staffing.[39] The government has already attempted to commercialize the National Bank of Greece by installing professional management and delegating control to state-owned pension funds. But professional management is not the same as private ownership. In the process, as Gibson (2005) mentions, the largest bank in the system, National Bank of Greece, has come to a large degree (at least 40%) into non-state ownership, and may be considered to operate largely on private economy criteria; three major purely private-sector banks (Alpha Bank, Eurobank, and Bank of Piraeus) have emerged, that both each on their own, as well as in the aggregate, possess significant market power; Emporiki Bank (also known as Commercial Bank of Greece) is in the process of disentanglement of the Greek state – whose stake in the bank has fallen from 11.01% to zero – as Crédit Agricole, one of the major French banks, is obtaining a stake of 71.97% in the bank. As a positive development, the number of directly or indirectly state-controlled banks[40] has been reduced significantly from 10 in 1993 to only 2 in 2005 (Agricultural Bank and the Postal Saving Bank).

As per Eichengreen and Gibson (2001), the viability of an equilibrium in which a quarter of the market is controlled by a state-owned institution competing head-to-head with private intermediaries is questionable. Moreover, there are also strong pressures from the EU encouraging the privatization of the Greek banking system as part of a wider set of structural measures designed to improve real economic performance. The implication is that the steps already taken by the government to privatize some of the smaller public-sector banks will likely culminate in eventual privatization of the National Bank and the other banks still in public hands.

Of great significance are also the initiatives of some credit institutions aimed at building up a presence in international financial centers, such as London and New York, setting up offshore units and penetrating principally the market of the South Eastern European region (Albania, Bulgaria, Former Yugoslavia Republic of Macedonia - FYROM, Romania, Serbia-Montenegro and recently Turkey), via acquisitions or by establishing branches or joint ventures. In this region, the market

[39] On the consequences for employment of structural changes in banking, see Kanellopoulos, Tsatiris and Mitrakos (1999).

[40] The indirect control comes from the majority equity participation of public pension funds, municipalities and other funds, or from equity holdings of other state-owned or state-controlled banks.

share of is more than 20% on average, with a high 33% in FYROM and a low of somewhat less than 20% in Romania. Greek banks employ around 16,000 employees in Balkans, and a few thousand more in other countries as EU, US, Australia, and Canada.

Also, to compete in the new financial landscape and strengthen their position in the market, Greek commercial banks are transforming themselves into financial groups, adding services and subsidiaries such as insurance, brokerages, credit card companies, mutual funds, factoring companies and finance houses. Finally, some Greek banks have entered into remarkable strategic alliances with foreign banks and other financial institutions; this will allow them to import know-how and to take advantage of an international network with a strong presence in major financial centres abroad.

Gibson (2005) points out that "the increase in concentration might suggest a decline in the degree of competition. However, two factors have been countering the rise in concentration. First, the sector has moved further away from being dominated by one leader; instead a number of banks are now of sufficient size to compete with each other for market share[41]. Second, another wave of new entrants has occurred since 1998[42]."

As per Gibson, the profitability of Greek banks exhibited a rather erratic behavior during the period 1993-2003, a pattern which to a large degree should be attributed to the "huge surge in profitability" in the years of the stock market boom (1998-2000); profitability return to more typical levels thereafter. If one "zooms out" late 1990s and earlier 2000s a broader and clearer view of the whole period 1993-2005 can be illustrated. As Gibson concludes "indications of a long-term downward

[41] Alpha Bank, Eurobank, the Agricultural Bank of Greece, Emporiki Bank, and Piraeus Bank wield a sufficient degree of market power to constitute formidable opponents to the National Bank of Greece

[42] NovaBank, Probank, Omega Bank, First Business Bank, Panellinia Bank, Proton Investment Bank, Investment Bank of Greece, Aegean Baltic Bank, and Emporiki Credicom are the new players in Greek banking in the years 2000-04 (no new banks were incorporated in the years 1998-99) that are still extant (Unit Bank closed in 2003). The aforementioned banks are in descending order of total assets at the end of 2004. However, none of these has attained a market share exceeding 1 per cent of the market (measured in terms of total assets); NovaBank, the largest bank in the pack, was calculated by Gibson (2005, p. 9) to have 0.9 per cent of the market in 2003, and this same figure is produced by our calculations for this bank for the end of 2004.

trend in profitability will be observed [...] evident from the beginning of liberalization (towards the end of the 1980s) onwards."

The results of the econometric analysis in Gibson (2005) "suggest that the period of rapid structural change is perhaps coming to an end with the banking sector settling down to more normal behavior of profits." This is not implausible, given the fact that the liberalization and deregulation program, whose implementation essentially started in 1987, and whose goal was the convergence of the Greek banking system to the norms and standards of the European Community, may have been considered to have come to an end with Greece joined the EMU in 2001.

Gibson (2005) concludes that there is evidence that banks with larger market power earn higher profits, while on the other hand the impact of size on profitability was lower in the period 1998-2003 than in the period 1993-1998.

The following table is adapted from Gibson (2005, p. 9) and presents the market shares (based on total assets) and corresponding rankings for a particular set of Greek banks, for years 1993, 1998, 2000, and 2003.

Table 2.6

Market shares and corresponding for a broad subset of Greek banks, at the end of 1993, 1998, 2000, 2003 (adapted from Gibson, 2005); not adding up to exactly 100 in the cases of 2000 and 2003 is due to rounding.

BANK	1993		1998		2000		2003	
	Rank	Percentage	Rank	Percentage	Rank	Percentage	Rank	Percentage
National Bank of Greece	1	42.3	1	36.0	1	30.3	1	29.3
Alpha Bank	5	6.2	3	12.5	2	19.8	2	17.6
Eurobank	12	0.6	7	3.8	5	10.8	3	15.6
Agricultural Bank of Greece	2	12.2	2	13.1	4	10.9	4	10.6
Emporiki Bank	3	10.5	4	9.8	3	10.9	5	9.9
Piraeus Bank (including Piraeus Prime)	17	0.4	8	2.0	6	7.9	6	8.3
Geniki Bank	9	1.4	11	1.6	8	1.5	7	2.0
Egnatia Bank	22	0.2	15	0.8	9	1.2	8	1.5
Bank of Attica	21	0.3	17	0.6	12	0.9	9	1.2
Laiki Bank	24	0.1	16	0.6	13	0.8	10	1.2
Aspis Bank	25	0.1	19	0.3	15	0.4	11	1.1
Probank					18	0.02	12	0.5
Omega Bank							13	0.5
First Business Bank							14	0.4
Panellinia Bank							15	0.1
NovaBank					10	0.9	N/A	N/A
Investment Bank of Greece					16	0.1	N/A	N/A
Unitbank					17	0.02	N/A	N/A
ETBA	6	5.6	10	1.8	7	2.1		
ETEBA	13	0.6	14	1.0	11	0.9		
Telesis Bank	23	0.2	20	0.3	14	0.6		
Ionian Popular Bank	7	4.6	5	5.6				
Ergobank	8	3.1	6	5.2				
Bank of Macedonia-Thrace	11	1.0	9	1.9				
Xiosbank	14	0.5	12	1.5				
Cretabank	10	1.3	13	1.2				
Bank of Central Greece	15	0.4	18	0.5				
Crédit Lyonnais (Grèce)	18	0.4	N/A	N/A				
National Mortgage Bank	4	7.0						
Interbank	16	0.4						
National Housing Bank	19	0.3						
Bank of Athens	20	0.3						
TOTAL		100.0		100.1		100.04		99.8

According the Annual Report of the Bank of Greece for 2005, the Greek commercial banks hold a high market share, both in assets (81.2 per cent), as well as in loans (84.9 per cent) and deposits (80.5 per cent). This can be seen in Table 2.7 below.

Table 2.7

Market shares, in percentages (adapted from the Annual Report of the Bank of Greece for year 2005)

	Assets		Loans		Deposits	
	2004	**2005**	**2004**	**2005**	**2004**	**2005**
Greek Commercial Banks	81.0	81.2	85.1	84.9	81.8	80.5
Foreign Banks	10.0	10.1	8.8	8.8	8.2	9.1
Cooperative Banks	0.7	0.8	1.0	1.0	0.8	0.9
Specialized Credit Institutions	8.3	7.9	5.1	5.3	9.2	9.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

It is obvious from the table above that commercial banks incorporated in Greece have been the dominant group in the banking system. Indeed, these credit institutions hold a high market share, both in terms of assets (81%), as well as in loans (85%) and deposits (82%). On the other hand the market share of foreign-owned banks stands at 10% in terms of assets (9% and 8% for loans and deposits respectively), while the market shares of the co-operative credit institutions remain very low (less than 1% of aggregate balance sheet figures).

The series of mergers and acquisitions, in which Eurobank, Bank of Piraeus, Alpha Bank, and Egnatia Bank are to be found on the "predator" side constitute the cause for this consolidation and the resultant increase in concentration. Measured by the market share of the five largest banks, the degree of concentration of the Greek credit system increased slightly in 2005 on the basis of assets (to 65.6%, from 65% in 2004), but declined marginally in terms of loans (to 66.1%, from 66.3%) and even more in terms of deposits (to 65.5%, from 66.5%).[43] This consolidation followed the reduction in the market share of the hitherto dominant firm in the Greek banking sector, namely the National Bank of Greece.

[43] In 1997, the market share of the 5 largest credit institutions in terms of balance sheet aggregates was 57% (Bank of Greece, 1999).

The degree of concentration in the Greek banking system according the Annual Report of the Bank of Greece for the year 2005 and as provided by the simplistic measure of the market share of five largest banks is as follows for the years 2004 and 2005:

Table 2.8

Degree of concentration of the Greek banking system, as measured by market share (in percentages) of top 5 the banks (Data drawn from the Annual Report of the Bank of Greece for year 2005)

	Assets		Loans		Deposits	
	2004	**2005**	**2004**	**2005**	**2004**	**2005**
Market share of top 5 banks	65.0	65.6	66.3	66.1	66.5	65.5

The Greek banking system, according to the market share in assets of the five largest banks is considered to be highly concentrated, compared to the EU average. In particular, the average market share of the five largest banks for every EU-25 country was only 40.5 per cent in 2004, compared to the corresponding Greek figure of 65.0 per cent. However, this does not mean that the degree of concentration of Greek banking system constitutes an outlier value in the sample of all EU-25 countries. Notably, the top 5 banks in assets in Belgium maintained an 84.3 per cent market share, and the corresponding figures were 84.0 for the Netherlands and 82.7 per cent for Finland. It was also slightly lower than the average (68.6 per cent) of the EU-10 expansion countries.

It should be pointed out here that the same conclusion is reached, if that more sophisticated and "holistic" Herfindahl-Hirschman index is used for measuring concentration. According to the Annual Report of the Bank of Greece for 2006, the value of HHI for Greece for the year 2004 was 1,070 (compared to 1,097 for 2005). The value of the Herfindahl-Hirschman index for the European Union was 569, significantly lower than the corresponding value for Greece, indicating a higher than average degree of concentration in the Greek banking system. For the three aforementioned individual countries, namely Belgium, the Netherlands, and Finland, the Herfindahl-Hirschman index, just like the top 5 banks market share, was very high; 1,726 in the Netherlands and way above the perceived cut-off point of 1800 in Belgium (2,100) and Finland (an astounding 2,680!)

The Bank of Greece, in its Annual Report for 2005, argues that the h degree of concentration reflects the efforts by the most efficient banks to advantage of economies of scale and scope and does not necessarily influences competition in a negative manner[44]. It makes this argument on the grounds of a lack of "harmonized practices" (i.e. collusion) in the pricing of the various products and cites the work of Claessens and Laeven (2004) and Bikker and Haaf (2002) as corroborating this interpretation of concentration in the Greek banking industry.

Even though the Greek banking system is characterized by a relatively high degree of concentration, the five larger Greek banks (National Bank of Greece, Alpha Bank, Eurobank, Agricultural Bank of Greece, and Emporiki Bank) would be classified of mid-size ones by European standards[45]; only the two first banks are included among the top 100 European banks, while none in the top 150 credit institutions at a global level. This is principally due to the limited size of the domestic market. It is mainly through the expansion of Greek banks' activities internationally, and principally to South-eastern Europe, that chances for a further strengthening of Greek banks are provided.

[44] I.e. the Bank of Greece opts for the efficiency hypothesis in attempting to explain the degree of competition in the Greek banking system.

[45] The European Central Bank defines as medium-size banks, those banks with assets in the (0.005%, 0.5%) range of the total consolidated statement of the banks of EU countries.

CHAPTER 3

LITERATURE REVIEW

3.1 Reasons for estimating efficiency

During the last two decades, financial sectors have undergone profound changes worldwide. Deregulation of financial systems and liberalization of external transactions, as well as the application of advanced information and communications technologies have all intensified competition among institutions in local and international financial markets and paved the way for the introduction of new financial instruments and practices. Indeed, the way that banking is conducted was gradually altered and the technology of bank production was significantly modified. As a result, banking systems internationally have entered an era of restructuring and reorientation of their activities. Similar developments were also observed in the Greek banking system, as Greek banks had to adjust to the new conditions that resulted from the gradual liberalization of the domestic financial market and the completion of the European internal market and, thus, to the increasingly competitive environment in recent years. These changes in the structure of the financial system worldwide have attracted a great deal of attention in academic and policy circles. The banking system is a key element of the modern market economy.

In this regard, a frequently asked question is about the effect(s) of these changes on Greek banks and, more precisely, how Greek banks will be affected by the intensified competitive pressures. In other words, concerns raised about the long-run competitive viability of various Greek banks in the new environment that has gradually emerged. The answer to this question depends at least in part on how efficiently they are run.

Overall, the investigation of bank efficiency has fuelled a large body of literature globally, and is of vital importance from both a microeconomic and a macroeconomic point of view (Berger and Mester, 1997). From the micro perspective, the issue of banking efficiency is crucial, given the enhancement of competition due to the improvement in the institutional, regulatory and supervisory framework. From the macro perspective, the efficiency of the banking industry influences the cost of

financial intermediation and the overall stability of financial markets, as banks constitute the spinal cord of financial markets. Indeed, an improvement of banking performance indicates a better allocation of financial resources, and therefore an increase of investment that favours growth.

Although a bank may pursue many goals, profit efficiency should be its ultimate goal. Previous efficiency studies stress that cost efficiency is an important means of reaching long-run profit efficiency. There are at least three reasons for focusing on cost and profit efficiency of banks as an indication of progress (Fries and Taci, 2005). First, greater relative cost and profit efficiency may be associated with the changes in incentives and constraints in banking associated with structural and institutional reforms and with the more efficient provision of public services by the state, such as the rule of law. Second, efficiency gains reduce the resources associated with operation of payments systems and with intermediation of savings into investments. Like productivity gains in other economic sectors, greater cost and profit efficiency in banking contributes directly to overall economic development. Third, cost and profit efficiency may be associated with other dimensions of bank performance that contribute to overall development, such as the making of more productive loans, but that cannot be directly measured with available bank-level data. This association may exist if factors that contribute to greater cost and profit efficiency also promote improvement in other aspects of banking performance.

3.2 The efficiency concept

A fundamental decision in measuring efficiency is which concept to use. This, of course, depends on the question being addressed. (Berger and Mester, 1996). There are three important economic efficiency concepts that can be used: cost, standard profit, and alternative profit efficiencies. These concepts are based on economic optimization in reaction to market prices and competition.

Cost efficiency gives a measure of how close a bank's cost is to what a best practice bank's cost would be for producing the same output bundle under the same conditions. It is derived from a cost function in which variable costs depend on the prices of variable inputs, the quantities of variable outputs and any fixed inputs or outputs. The inefficiency factor incorporates both allocative inefficiencies from failing to react optimally to relative prices of inputs, and technical inefficiencies from

employing too much of the inputs to produce outputs. Cost efficiency of bank is defined as the estimated cost needed to produce bank's output vector if the bank were as efficient as the best-practice bank in the sample facing the same exogenous variables divided by the actual cost of bank b, adjusted for random error. The cost efficiency ratio may be thought of as the proportion of costs or resources that are used efficiently. For example, a bank with cost efficiency of 0.70 is 70% efficient or equivalently wastes 30% of its costs relative to a best-practice firm facing the same conditions. Cost efficiency ranges over (O, 1], and equals one for a best-practice firm within the observed data.

In applications, efficiency is generally defined relative to the best practice observed in the industry, rather than to any true minimum costs, since the underlying technology is unknown. (The usual form of the stochastic frontier measurement technique is an exception.) Fortunately, for most economic hypotheses, relative efficiency rather than absolute efficiency is the more appropriate concept.

Standard profit efficiency measures how close a bank is to producing the maximum possible profit given a particular level of input prices and output prices (and other variables). In contrast to the cost function, the standard profit function specifies variable profits in place of variable costs and takes variable output prices as given, rather than holding all output quantities statistically fixed at their observed, possibly inefficient, levels. That is, the profit dependent variable allows for consideration of revenues that can be earned by varying outputs as well as inputs. Output prices are taken as exogenous, allowing for inefficiencies in the choice of outputs when responding to these prices or to any other arguments of the profit function. Standard profit efficiency as the ratio of the predicted actual profits to the predicted maximum profits that could be earned if the bank was as efficient as the best bank in the sample, net of random error, or the proportion of maximum profits that are actually earned. Standard profit efficiency is the proportion of maximum profit that are earned , so that a standard profit ratio of 0.70 would indicate that, because of excessive costs, deficient revenues, or both, the firm is losing about 30% of the profits it could be earning. Similar to the cost efficiency ratio. The profit efficiency ratio equals one for a best-practice firm that maximizes profits for its given conditions within the observed data. Unlike cost efficiency, however, profit efficiency can be negative, since firms can throw away more than 100% of their potential profits.

Profit efficiency accounts for errors on the output side as well as those on the input side, and some prior evidence suggested that inefficiencies on the output side may be as large as or larger than those on the input side (e.g., Berger, Hancock, and Humphrey, 1993). Profit efficiency is based on the more accepted economic goal of profit maximization, which requires that the same amount of managerial attention be paid to raising a marginal dollar of revenue as to reducing a marginal dollar of costs. Profit efficiency is based on a comparison with the best-practice point of profit maximization within the data set, whereas cost efficiency evaluates performance holding output constant at its current level, which generally will not correspond to an optimum. A firm that is relatively cost efficient at its current output may or may not be cost efficient at its optimal output, which typically involves a different scale and mix of outputs. Thus, standard profit efficiency may take better account of cost inefficiency than the cost efficiency measure itself, since standard profit efficiency embodies the cost inefficiency deviations from the optimal point.

Alternative profit efficiency may be helpful when some of the assumptions underlying cost and standard profit efficiency are not met. Efficiency here is measured by how close a bank comes to earning maximum profits given its output levels rather than its output prices. The alternative profit function employs the same dependent variable as the standard profit function and the same exogenous variables as the cost function. Thus, instead of counting deviations from optimal output as inefficiency, as in the standard profit function, variable output is held constant as in the cost function while output prices are free to vary and affect profits. A few prior papers have studied standard profit efficiency at U.S. banks (Berger, Hancock, and Humphrey, 1993, DeYoung and None, 1996, Akhavein, Swamy, and Taubman, 1997, and Akhavein, Berger, and Humphrey, 1997). The measured average profit efficiencies ranged from 24% of potential profits being earned to 67%. Profit function estimation was also used to measure efficiency in terms of the risk-expected return efficient frontier as defined in the finance literature (Hughes and Moon, 1995, Hughes, Lang, Mester, and Moon, 1996a, b). A bank with too little expected profit for the amount of risk it is taking on is deemed inefficient. Average efficiency in terms of the percent of expected profit being earned for a given level of risk relative to the best practice banks was found to be around 85%. Alternative profit efficiency is the ratio of predicted actual profits to the predicted maximum profits for a best-practice bank.

The alternative profit function provides a way of controlling for unmeasured differences in output quality, since it considers the additional revenue that higher quality output can generate. If output markets are competitive and customers are willing to pay for the additional services provided by some banks, these banks should receive higher revenues that just compensate for their extra costs. Banks would be sorted into market niches that differ by service quality or intensity, with customers who need or prefer higher quality or more service paying more per dollar of their loan or deposit. Since the higher interest rates or fees received by the higher quality providers just cover their extra production costs, these banks survive in competitive equilibrium. The alternative profit function essentially replicates the cost function except that it adds revenues to the dependent variable. It accounts for the additional revenue earned by high-quality banks, allowing it to offset their additional costs of providing the higher service levels. So it does not penalize high-quality banks in terms of their efficiency measure, whereas the cost function might. Thus, if banks do not have market power, alternative profit efficiency should be thought of as a better measure of cost efficiency, rather than profit efficiency, since it does not take into account any errors in the quantities of variable outputs. Alternative profit efficiency might also prove useful if the variable outputs are not completely variable. Differences in output quality may also be partially captured in the standard profit function. However, since it holds output prices fixed, the standard profit function is less able to account for differences in revenue that compensate for differences in product quality, since these revenue differences may be partly reflected in measured prices.

The alternative profit efficiency concept may also be helpful in situations in which the firms exercise some market power in setting output prices. The standard profit function takes output prices as given and embodies the assumption that the bank can sell as much output as it wishes without having to lower its prices. Under conditions of market power, it may be appropriate to consider output levels as relatively fixed in the short run and allow for efficiency differences in the setting of prices and service quality. That is, an optimizing bank will set each of its prices at the point where the market just clears for its output and choice of service quality. Such a bank will also choose an optimizing service quality niche. Alternative profit efficiency measures the extent to which firms are able to optimize in their choices of prices and service quality, as well as their abilities to keep costs low for a given

output level. Alternative profit efficiency will also incorporate differences across firms in market power and their abilities to exploit it, which is good for the owners of the bank, but is not a social good in the same way that the other efficiencies are. Alternative profit efficiency may be viewed as a robustness check on standard profit efficiency, which takes prices as fixed and allows outputs to be totally variable. The measurement of alternative profit efficiency may also be motivated in part by inaccuracies in the output price data. If the output price vector is well measured, it should be strongly related to profits and explain a substantial portion of the variance of profits in the standard profit function. If prices are inaccurately measured, the predicted part of the standard profit function would explain less of the variance of profits and yield more error.

3.3 Basic approaches of the efficiency measurement

The literature on bank efficiency is based on two different approaches: the first measures efficiency in terms of economies of scale and scope (S-efficiency), while the second uses the efficient frontier concept, or X-inefficiency (technical and allocative efficiency). Operational efficiency requires: (1) optimization of the output mix so as to fully exploit any economies of scale and scope; and (2) optimization of the input mix so as to avoid both excessive levels of input usage (technical X-inefficiency) as well as no optimal relative proportions of inputs (allocative X-inefficiency). X-efficiency can be characterized by superior management of resources; it shows how closely the bank approaches its highest operational capability. S-efficiency can be characterized by superior choice of output levels; it shows how close the bank is to its optimal scale (Berger, 1993). In the first approach, banks are assumed to be operating on a cost function, and inefficiencies may arise either from the use of inefficient technology (associated with higher costs along all or part of the cost function), or from an inefficient scale or scope (product mix). In principle, inefficient scale or scope may be attributable either to the management of the individual bank or to the structure of the market and the number of competing banks. The bulk of academic studies have concentrated on this (output-mix efficiency) with only the most recent studies devoted to an examination of operational X-efficiency. This is in spite of studies such as those by Berger et al. (1993a, hereinafter BHT) and Bauer et al. (1993) who show that the order of magnitude of output-mix inefficiencies

is around percent for U.S. depository institutions as opposed to 20 percent for X-inefficiency measures. Berger and Humphrey (1997) survey 130 frontier efficiency studies of financial institutions from around the world. While institution type, methodologies, and data vary widely across these studies, the findings are surprisingly similar: X-inefficiencies in financial institutions are large, typically accounting for percent or more of costs, and dominate scale and scope considerations.

According to Berger and Mester (1993), scale efficiency is calculated by finding the optimum scale of production given the estimated frontier and the product mix of the firm. Then, the ratio of actual costs to costs at the optimum scale is multiplied by the ratio of actual to optimum scale output and the result of this is the scale efficiency. Berger and Mester,1997) define it as the ratio of predicted minimum average costs to actual average costs, both adjusted to be on the X-efficient frontier. Scale efficiency is distributed over the internal (0, 1], in which a score of 1 indicates that the bank is operating at optimum scale, and a score of below 1 indicates suboptimum scale. Total cost efficiency is the product of the scale and X-efficiency ratios. In their survey, they estimate the efficiency of almost 6,000 U.S. commercial banks that were in continuous existence over the six-year period 1990-95. The basic result is that, in every size class, the typical bank shows unexploited ray scale economies - i.e. that the bank's product mix could be produced at lower average cost by increasing the scale of output. The mean scale efficiencies are around 80%, suggesting that approximately equal amounts of resources are lost because of scale and X-inefficiencies. In every size class, more than 90% of firms are operating below efficient scale. The variable t* is defined as the ratio of efficient scale to actual scale. The mean t* is between 2 and 3 for each size class, suggesting that the typical bank would have to be 2 to 3 times larger in order to maximize cost scale efficiency for its product mix and input prices.[46]

In recent years, the academic research on the performance of financial institutions has increasingly focused on frontier efficiency or X-efficiency, which measures deviations in performance from that of "best practice" banks on the efficient

[46] The authors, in their effort to reconcile the differences between scale and X – efficiency and to ensure that the scale economies estimates reflect the shape of the frontier and are not simply the consequence of correlation between the X-inefficiencies and scale, reestimated the cost model using only relatively efficient banks. They got very similar results to those cited above.

frontier, holding constant a number of exogenous market factors. That is, the frontier efficiency of a bank measures how well it performs relative to the predicted performance of the "best" bank in the banking industry if these best banks were facing its same market conditions. Frontier efficiency is superior for most regulatory and other purposes to the standard financial ratios from accounting statements that are commonly employed to assess performance. This is because frontier efficiency measures use programming or statistical techniques to try to remove the effects of differences in input prices and other exogenous market factors affecting the standard performance ratios in order to obtain better estimates of the underlying performance of the managers. The financial institution efficiency literature is large (a review of 130 studies of financial institution frontier efficiency across 21 countries found that fully 116 were written or published during 1992-1997 (Berger and Humphrey, 1997). Frontier inefficiency or X-inefficiency of financial institutions has generally be found to consume a considerable portion of costs on average, to be a much greater source of performance problems than either scale or product mix inefficiencies, and to have a strong empirical association with higher probabilities of financial institutions failures over several years following the observation of substantial inefficiency.

In comparing the two approaches, Molyneux et al. (1996, p. 252) concluded that "...differences in managerial ability to control costs or maximize revenues seem to be larger than the cost effects of the choice of scale and scope of production."[47] However, the disadvantage of the frontier approach is that the method does not readily offer possible remedies for inefficient firms since, by construction, inefficiency is attributable primarily to unobservable management actions. In contrast, as Berger and Humphrey (1991, 1997) and others have argued, measures of economies of scale and scope provide a natural framework for informing bank management on possible bank branching and cost reduction strategies, and informing regulators about the efficient number of banks in the market. Altering the path of efficiency research, Berger and Humphrey (1991) showed that U.S. banks could improve their cost efficiency more

[47] Berger and Hannan (1993), Berger (1995), Goldberg and Rai (1996), Berger and Hannan (1998), Punt and van Rooij (2001) and Vennet (2002) confirmed that X-efficiency influenced banks' profit much more than scale and scope efficiency.

by reducing frontier inefficiencies than by reaching some optimal level of scale and scope economies to minimize average costs.

Previous research in Greek banking provides some contradictory evidence on scale economies. A study by Karafolas and Mantakas (1996), who used a sample of 11 Greek banks over the period 1980-89, did not find any significant total cost scale economies, although operating cost economies of scale were estimated to be statistically significant.

There is a great number of studies that deal with both scale economies and X – efficiency. Allen and Rai (1995) found that for banks in 15 countries, over the period 1988-1992, the prevalence of input X-inefficiencies far outweighs that of output inefficiencies, as measured by economies of scale and scope. Kraft and Tirtiroglou (1998) use stochastic frontier methodology to estimate X-efficiency and scale efficiency for old and new, state and private banks, in Croatia. They found evidence that new banks in Croatia is more X-inefficient and more scale inefficient than either old privatized banks or old state banks. Mertens and Urga (2001) find evidence that small banks in Ukraine operate more efficiently in cost terms but there is a substantial difference in scale economies between small and large banks. Large banks show significant diseconomies of scale while small ones show significant scale economies. Nikiel and Opiela (2002) investigate the bank efficiency in Poland and find that foreign banks servicing foreign and business customers are more cost-efficient and less profit-efficient than other banks in Poland. Additionally, evidence of cost economies and profit diseconomies of scale are found. In their paper Green et al. (2004) investigate the efficiency of banks in Central and Eastern Europe. They estimate a system of equations, consisting of an augmented translog cost function and two cost share equations. They calculate measures of economies and scale and scope on a bank-by-bank basis, and compare across countries and across ownership forms, finding that banks exhibit a reasonable degree of efficiency overall. Finally, Carvallo and Kasman (2005) use a stochastic frontier model to estimate cost inefficiency and scale and scope economies in the Latin American and Caribbean banking systems. The results suggest that there is a wide range of inefficiency levels across countries, and that very small and very large banks are significantly more inefficient than large banks.

3.4 Frontier Efficiency Methods

Many methods are available to estimate inefficiencies, and these methods often yield widely disparate results. Despite intense research efforts, there is no consensus on the best method or set of methods for measuring efficiency, and the choice of method may affect the policy conclusions that are drawn from the analyses. In the past twenty years, at least four main frontier approaches have been developed to assess firm performance relative to some empirically defined "best-practice" standard. To date there have been few attempts to link alternative measures of inefficiencies to other performance measures or to determine the relative "informativeness" of the scores produced by alternative frontier methods. Bauer et al. (1998) imposed six consistency conditions and examined the extent to which different methods meet these consistency conditions. [48] They have shown, on a large sample of US banks, not only the lack of consistency between parametric approaches and the non-parametric DEA, but also the consistency across parametric approaches.[49]

A variety of methods have been used to derive estimates of firm inefficiencies in the financial services industry (see Berger and Humphrey 1997). One set of methods is based on econometric techniques and involves the estimation of an economic function (e.g., production or cost) and the derivation of efficiency scores from either the residuals or dummy variables. These are the parametric econometric approaches. A second approach involves solving linear programs in which an

[48] There is greater similarity in bank efficiency rankings when, instead of comparing nonparametric with parametric techniques, the comparison is between different techniques within one of these categories. Bauer, Berger, and Humphrey (1993) compared two parametric techniques - SFA and TFA when both methods were used to separately identify quartiles of U.S. banks that were, respectively, most or least efficient over a 12 year period. The degree of correspondence was 38% for banks identified by each technique as being in the most efficient quartile. A somewhat higher correspondence, at 46%, was found across techniques for banks in the least efficient quartiles.

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objective function envelops the observed data; efficiency scores are derived by measuring how far an observation lies from the "envelope" or frontier. These are the nonparametric linear programming approach. The parametric and nonparametric approaches differ in the assumptions they make regarding the shape of the efficient frontier, the existence of random error, and (if random error is allowed) the distributional assumptions imposed on the inefficiencies and random error in order to disentangle one from the other. Moreover, these approaches often differ in whether the underlying concept analyzed is technological efficiency versus economic efficiency, although this difference need not occur in practice (Bauer, Berger, Ferrier and Humphrey, 1998).

According to Berger and Mester (1996), the most common efficiency estimation techniques are Data envelopment analysis (DEA), Free Disposable Hull Analysis (FDH), the Stochastic Frontier Analysis (SFA), the Thick Frontier Approach (TFA) and the Distribution-free Approach (DFA). [50] The first two of these are nonparametric techniques and the latter three are parametric methods.

Each approach has its advantages and disadvantages. The econometric approach has the virtue of allowing for noise in the measurement of inefficiency; however, it also possesses some vices, including the need to make assumptions about the particular form of the economic function being estimated and the distribution of efficiency. The programming approach has the merit that no functional or distributional forms need to be specified; however, this approach suffers from the drawback that all deviations from the frontier are attributed to inefficiency with no allowance made for noise in the standard models.[51]

Nonparametric approaches put relatively little structure on the specification of the best- practice frontier. 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 has as much or more of every output (given inputs) or as little or less of every input (given outputs). As such, DEA does not require the explicit specification of the form of the underlying production relationship. DEA, developed by Charnes, Cooper, and Rhodes (1978), was originally intended for use in

[50] See Mester (1994) for further description of these techniques.

[51] Recently, work has been undertaken to explore the "stochastic" nature of programming efficiency scores. See Grosskopf (1996) for a survey of this literature.

public sector and not-for-profit settings where typical economic behavioral objectives, such as cost minimization or profit maximization, may not apply. Thus, DEA could be used even when conventional cost and profit functions that depend on optimizing reactions to prices could not be justified. The free disposal hull approach (FDH) is a special case of the DEA model where the points on lines connecting the DEA vertices are not included in the frontier. Instead, the FDH production possibilities set is composed only of the DEA vertices and the free disposal hull points interior to these vertices. Because the FDH frontier is either congruent with or interior to the DEA frontier, FDH will typically generate larger estimates of average efficiency than DEA (Tulkens, 1993). Either approach permits efficiency to vary over time and makes no prior assumption regarding the form of the distribution of inefficiencies across observations except that undominated observations are 100% efficient.

However, a key drawback to these nonparametric approaches is that they generally assume that there is no random error. There is assumed to be: (a) no measurement error in constructing the frontier; (b) no luck that temporarily gives a decision making unit better measured performance one year from the next, and (c) no inaccuracies created by accounting rules that would make measured outputs and inputs deviate from economic outputs and inputs. Any of these errors that did appear in an inefficient unit's data may be reflected as a change in its measured efficiency. What may be more problematical is that any of these errors in one of the units on the efficient frontier may alter the measured efficiency of **all** the units that are compared to this unit or linear combinations involving this unit. In effect, Berger and Mester (1996) disentangle efficiency differences from random error by assuming that random error is zero Studies of U.S. banks that use nonparametric techniques report lower efficiency means on average than those using parametric techniques (an average of 72% versus 84%) with much greater variation (a standard deviation of 17% versus 6%), which could, in part, reflect some random error being counted as variations in measured efficiency in these studies (Berger and Humphrey, 1997)[52]. Furthermore, they cannot account for allocative inefficiency in misresponding to relative prices in choosing inputs and outputs, nor can they compare firms that tend to specialize in different inputs or outputs, because there is no way to compare one input or output with another without the benefit of relative prices. In addition, similar to the

[52] For more details see (Berger and Humphrey 1997, Table 2).

cost function, there is no way to determine whether the output being produced is optimal without value information on the outputs. Thus, the nonparametric techniques typically focus on technological optimization rather than economic optimization, and do not correspond to the cost and profit efficiency concepts.

There are three main parametric frontier approaches. The stochastic frontier approach (SFA) - sometimes also referred to as the econometric frontier approach - specifies a functional form for the cost, profit, or production relationship among inputs, outputs, and environmental factors, and allows for random error. The estimated inefficiency for any firm is taken as the conditional mean or mode of the distribution of the inefficiency term, given the observation of the composed error term. The half-normal assumption for the distribution of inefficiencies is relatively inflexible and presumes that most firms are clustered near full efficiency. In practice, however, other distributions may be more appropriate (Greene, 1990). Some financial institution studies have found that specifying the more general truncated normal distribution for inefficiency yields minor, but statistically significant, different results from the special case of the half-normal (Berger and DeYoung, 1996). A similar result using life insurance data occurred when a gamma distribution, which is also more flexible than the half-normal, was used (Yuengert, 1993). However, this method of allowing for flexibility in the assumed distribution of inefficiency may make it difficult to separate inefficiency from random error in a composed error framework, since the truncated normal and gamma distributions may be close to the symmetric normal distribution assumed for the random error.

The distribution-free approach (DFA) also specifies a functional form for the frontier, but separates the inefficiencies from random error in a different way. DFA assumes that the efficiency of each firm is stable over time, whereas random error tends to average out to zero over time. The estimate of inefficiency for each firm in a panel data set is then determined as the difference between its average residual and the average residual of the firm on the frontier, with some truncation performed to account for the failure of the random error to average out to zero fully. An alternative way to apply DFA is to use a fixed effects model. In a fixed effects model, a dummy variable is specified for each firm in a panel data set. Differences in the fixed effects estimated across firms represent firm inefficiencies (e.g., Lang and Welzel, 1996). However, Berger (1993) found that the fixed effects were confounded by the

differences in scale, which are several thousand times larger in magnitude than differences in efficiency in typical banking data sets.

Lastly, the thick frontier approach (TFA) specifies a functional form and assumes that deviations from predicted performance values within the highest and lowest performance quartiles of observations (stratified by size class) represent random error, while deviations in predicted performance between the highest and lowest quartiles represent inefficiencies. This approach imposes no distributional assumptions on either inefficiency or random error except to assume that inefficiencies differ between the highest and lowest quartiles and that random error exists within these quartiles. TFA itself does not provide exact point estimates of efficiency for individual firms but is intended instead to provide an estimate of the general level of overall efficiency. The TFA reduces the effect of extreme points in the data, as can DFA when the extreme average residuals are truncated.

The lack of agreement among researchers regarding a preferred frontier model at present boils down to a difference of opinion regarding the lesser of evils. The parametric approaches commit the sin of imposing a particular functional form that presupposes the shape of the frontier. If the functional form is misspecified, measured efficiency may be confounded with the specification errors. Usually a local approximation such as the translog is specified, which has been shown to provide poor approximations for banking data that are not near the mean scale and product mix. The translog also forces the frontier average cost curve to have a symmetric U-shape in logs. The nonparametric studies impose less structure on the frontier but commit the sin of not allowing for random error owing to luck, data problems, or other measurement errors. If random error exists, measured efficiency may be confounded with these random deviations from the true efficiency frontier. The conflict between the nonparametric and parametric approaches is important because the two types of methods tend to have different degrees of dispersion and rank the same financial institutions somewhat differently. It is not possible to determine which of the two major approaches dominates the other since the true level of efficiency is unknown. The solution, in our opinion, lies in adding more flexibility to the parametric approaches and introducing a degree of random error into the nonparametric approaches. By addressing the main limitation of each approach, the efficiency results will presumably yield efficiency estimates which are more consistent across the approaches. These processes have already begun. In the

parametric approaches, some studies have experimented with specifying more globally flexible forms. To date, this has focused on specifying a Fourier-flexible functional form which adds Fourier trigonometric terms to a standard translog function (Berger, Cummins, and Weiss, 1996; Berger and DeYoung, 1996; Berger, Leusner, and Mingo, 1996; Berger and Mester, 1997). This greatly increases the flexibility of the frontier by allowing for many inflection points and by including essentially orthogonal trigonometric terms that help fit the frontier to the data wherever it is most needed.

In the nonparametric approaches, two research agendas are being pursued. One is analytical, and seeks to provide a statistical foundation for DEA. The other is empirical, and seeks to develop and implement a stochastic version of DEA. The analytical research has demonstrated that the empirical efficiencies calculated from a DEA model provide consistent estimators for the true efficiencies, the DEA estimators can be interpreted as maximum likelihood estimators, and the asymptotic empirical distribution recovers the true distribution under the maintained assumptions. This work thus provides a theoretical foundation for statistical hypothesis testing in a DEA environment (see Banker, 1996 for a summary). However, the fundamental problem is one of specifying the distribution of efficiency across observations (Kneip and Simar, 1996; Simar, 1996). Hypothesis testing can be conducted only after the data generating process has been specified, and in a multidimensional nonparametric setting in which the inefficiencies are one-sided, this is a statistically non-trivial matter. Moreover, the sampling distribution of the DEA efficiency estimators remains unknown, and this observation motivates the second line of research. A resembling technique, such as bootstrapping, is one way of obtaining an empirical approximation to the underlying sampling distribution of DEA efficiency estimates. Once the underlying distribution is approximated, statistical inference can be conducted. This computer-intensive approach to hypothesis testing, however, requires a careful specification of the data generating process (Simar and Wilson, 1995). A different approach is to apply the techniques of chance-constrained programming to the DEA model (Land, Lovell, and Thore, 1993; Olesen and Peterson, 1995). Here inequality constraints describing the structure of the nonparametric DEA technology are converted to "chance constraints" which, due to noise in the data, are allowed to be violated by a certain proportion of the observations. If probability distributions are specified for these violations (the data generating process again), the constraints can

be converted into certainty equivalents, and a chance-constrained DEA model emerges as a nonlinear programming problem. Although the chance-constrained DEA model remains deterministic, it incorporates noise in the data (see Grosskopf, 1996, for a survey of both empirical approaches).

Stochastic Frontier Analysis was used extensively in studies of the banking industry in developed market economies. The method was applied for cases in U.S, Croatia, Poland and Czech Republic, Hungary, Norway, Spain, Ukraine, U.K., and several other countries (Mester, 1996; Maudos, 1996; Berger and DeYoung, 1996; Kraft and Tirtiroglou, 1998; Mertens and Urga ,2001; Kraft et al. ,2002; Yildirim and Philippatos ,2002; Hasan and Marton, 2003; Weill, 2003; Fries and Taci, 2005; Carvallo and Kasman, 2005); Rossi et al. ,2005; Bonin et al. ,2005). Others use Data envelopment analysis (DEA) such as Berg et al., 1993; Pastor et al., 1994; Buhk et al., 1995; Athanassopoulos, 1997; Bergendhal, 1998; Grigorian and Manole, 2002; Isik and Hassan, 2002; Jemric and Vujcic, 2002; Mercan, Reisman,Yolalan and Emel, 2003; Prior, 2003; Drake and Hull,2003; Havrylchyk, 2006. Many, also, are the studies that use Distribution Free Approach (Dietsch, 1994; Berger, 1995; Lang and Welzel, 1996; Berger and Mester, 1997; Matousek and Taci, 2002; Nikiel and Opiela, 2002) or Thick Frontier Approach (Lozano, 1995; Berg and Kim, 1996; Clark, 1996; DeYoung, 1997; Humphrey and Pulley, 1997). There are also studies that used both, parametric and non-parametric, approaches to check for the robustness of results (Lovell, 1993; Resti, 1995; Eisenbeis, Ferrier and Kwan, 1996; Mertens and Urga, 2001; Yildirim and Philippatos, 2002).

3.5 Previous research and empirical results

The roots of efficiency research originate from the institutional approach of corporate microeconomics. In the past fifteen to twenty years, the focus has shifted to the financial sector with an emphasis on researching the efficiency of banks. Most of the publications, covering the theme, study the banking system of the U.S.A. So far, the empirical literature concerned with the U.S. experience (Ferrier and Lovell, 1990; Berger et al, 1993; Clark 1996; Berger and Mester, 1997; Berger and Humphrey, 1997; Seiford and Zhu, 1999) show that overall the average cost curve is relatively flat with some evidence of scale efficiency gains for small banks. Relatively few European studies have been published on efficiency, and the analysis of the financial

systems of transition economies from an efficiency point of view has been very limited. As emphasized by Berger and Humphrey (1997), of the 122 efficiency studies, encompassing 21 countries, only roughly 5% of these study transition economies. Comparative research analyzing the efficiency of banking systems in different countries is also very scarce, possibly owing to the difficult management of problems arising from different operational environments and their impact produced on efficiency.

Berger and Humphrey (1997) survey 130 studies that apply frontier efficiency analysis to financial institutions in 21 countries. Studies, focusing on U.S. financial institutions, were the most numerous. Using both parametric and nonparametric techniques, the mean efficiency is 79 per cent with median of 83 per cent and standard deviation of 13 per cent. This result implies an average inefficiency of 27 per cent, which that only 79 per cent of the resources currently being used would be necessary to produce the same output. According to Berger and Mester (1997), the mean cost efficiency of almost 6,000 U.S. commercial banks is 86.8 per cent, over the period 1990-1995. Finally, using advanced development in DEA, Seiford and Zhu (1999) evaluated the commercial banks' efficiency. Based upon a sample of top 55 U.S. commercial banks, they report that banks experience substantial performance inefficiency.

During the last 15 years, the 10 new EU Member States, apart from Malta and Cyprus, have actively pursued a transition process. Given the ongoing process of economic integration and dynamism of the new EU member states, measuring the degree of efficiency in the banking sector over time would provide useful insights over the challenges and opportunities lying ahead. Some studies have focused their analyses at the national level, such as Hasan and Marton (2003), who examined both cost and profit efficiency in the Hungarian banking system for the period 1993-1998 using the stochastic frontier approach and found that financial institutions with no foreign involvement, reported higher inefficiency than their foreign counterparts. Nikiel and Opiela (2002) found that foreign banks in Poland are more cost efficient than other banks, thought they are less profit efficient, while Havrylchyk (2004), who also investigated the efficiency of the Polish banking system, reached the same conclusion for the period 1997-2001. Matousek and Taci (2002) observed greater efficiency in private banks in the Czech Republic for the period 1993-1998, while the study conducted by Weill (2003), which covers both the Czech Republic and Poland,

concluded that foreign banks outperform their domestic counterparts in terms of cost efficiency.

A second set of studies has focused on cross-country comparisons of inefficiency scores across Central and Eastern European banking systems, including the studies of Dimova (2004), Grigorian and Manole (2002), Yildirim and Philippatos (2002), Green et al. (2004), Rossi et al. (2004), Bonin et al. (2005), Fries and Taci (2005) and Stavarek (2005). The derived inefficiency measures appear to vary significantly across studies, while mixed results are also reported regarding the effect of bank ownership on performance. For instance, Bonin et al. (2005) investigated the influence of ownership type on cost and profit efficiency in 11 transition economies for the period 1996-2000 and found that foreign-owned banks are more cost-efficient than other banks. Fries and Taci (2005) found the same relationship between ownership type and cost efficiency for 15 East European countries over the years 1994–2001, while Dimova (2004) found that foreign privatized banks are more efficient than domestic privatized banks in 10 Central and Eastern European countries for the period 1997-2002. Similar findings are reported by Grigorian and Manole (2002), (average technological inefficiency 47%) providing evidence that foreign ownership with controlling power and enterprise restructuring enhance commercial bank efficiency in 17 transition economies for the period 1995-1998. On the other hand, Green et al. (2004) rejected the hypothesis that foreign banks are more efficient than domestic banks in nine European transition economies between 1995 and 1999.

Cross sectional studies among old and new European Union (EU) member states produced mixed rather than concrete and explicit results. Bikker (1999) studied nine old EU member countries and found that the average inefficiency is 53%. Dietsch and Weill (2000) showed that the high level of inefficiency that Bikker found is the result of the mixture of less developed European countries in the sample. Collecting data only for three countries, Dietsch and Weill estimated an average X – inefficiency of 16%. Increasing the sample to fifteen countries, Bikker (2002) concluded that the results of his present study differ from those of his previous study, but there are not poles apart. The average X – inefficiency is 30%. Kosak and Zajc (2004) tested the level of inefficiency among fifteen old and new EU member states, finding an average X – inefficiency of 16.7%. Finally, Tomova (2005) evaluate the level of efficiency, using the deterministic/ nonparametric DEA method, among twelve old and new EU member states, finding an average X – inefficiency of 55%.

A few studies did compare multiple techniques, usually applying two efficiency methods to the same data set. The studies by Bauer, Berger and Humphrey (1993), Hasan and Hunter (1997), Berger and Mester (1997) compared estimates using two or more of the parametric approaches and found that average efficiencies were comparable and reasonably consistent with competitive conditions in the banking industry.

Perhaps more interesting are the comparisons of bank efficiencies between nonparametric and parametric approaches, which are really much more dissimilar from each other than the parametric approaches are from one another. DEA and SFA were compared by Ferrier and Lovell (1990), Eisenbeis, Ferrier and Kwan (1997) and Resti (1997). These studies reported fairly close average efficiencies generated by the two approaches. However, this belies the potential problem that the levels of efficiencies under DEA may be sensitive to "self-identifiers" when there are too few observations relative to the number of constraints in DEA. Ferrier and Lovell (1990) found that the average efficiency level rose from 54% to 83% when constraints on number of branches and average account sizes were added to the model, keeping the same number of observations. Since the average efficiency for SFA was 79% and the average efficiency for DEA is somewhere between very low and relatively high, the question of whether DEA and SFA yield similar distributions of efficiency that are consistent with competitive conditions in the banking industry remains open. Resti (1997) found very high rank-order correlations between DEA and SFA of 0.73 to 0.89, and Eisenbeis, Ferrier and Kwan (1997) found fairly high rank correlations ranging between 0.44 and 0.59, but Ferrier and Lovell (1990) found rank-order correlation of only 0.02, which was not significantly different from zero. Eisenbeis, Ferrier and Kwan (1997) found that calculated programming inefficiency scores are two to three times larger than those estimated using a stochastic frontier, the patterns of the scores across banks and time are similar, and however there is a relatively high correlation of the rankings of banks' efficiencies under the two methods.

3.6 A brief survey of the literature in the Greek banking system

Up to the present the Greek banking system has not been studied adequately due to data deficiencies. Previous research in Greek banking provides some contradictory evidence on scale economies. A study by Karafolas and Mantakas

(1996), who used a sample of 11 Greek banks over the period 1980-1989, did not find any significant total cost scale economies, although operating cost economies of scale were estimated to be statistically significant. Eichengreen and Gibson (2001) investigating the profitability of 25 Greek banks over the period 1993-98 found evidence of a bell-shaped relationship between profitability and bank size, implying that profitability initially increases and then declines as bank size increases. More specifically, their results indicate that when profitability is measured by the rate of return on assets, ROA, scale economies are exhausted at around the average size of banks in their sample, which is indeed very low by European standards. On the other hand, when profitability is measured by the rate of return on equity, ROE, their estimates suggest that banks of all sizes may reap scale economies.

More recently, Athanasoglou and Brissimis (2003), comparing operational costs across banks of different size, concluded that for the period 1994-1997 economies of scale are present in the case of small and medium size banks, but diseconomies of scale exist for large banks, whereas for the period 2000-2002 economies of scale were found for all banks. On the other hand, it has been widely recognized that for a group of banks of similar size that show greater dispersion of average costs (or profits) than banks of different sizes, X-efficiency is a much more important source of cost reduction (or profit increase) than achieving an optimum size of production to minimize average costs (see Maudos *et al* 2002). To our knowledge, there have been only two previous studies on the cost efficiency of the Greek banks. Tsionas et al. (2003), using DEA, analyzed the cost efficiency and productivity features of the Greek banking system over the period 1993 – 1998. Their empirical results showed that the majority of Greek banks operate at high overall efficiency levels of over 95%, while larger institutions seem to be more efficient compared to smaller banks. This fact can be explained by the ability of the larger institutions to adopt innovative technologies. Smaller institutions are oriented towards an efficient exploitation of the market potential. Finally, over 1993- 1998, their results indicate an increase in overall efficiency of the banking system save for 1996 when a substantial drop is observed as a result of a decrease in profitability of the banking system in accounting terms. Thus, the actual performance of the banking sector towards the end of the 1990s is comparable to what it was at the beginning of the decade.

The paper by Noulas (1997) used a data envelope analysis (DEA) methodology to evaluate the relative performance of state against private banks for

1992 to conclude that (i) technical efficiency decreased for both private and state banks, and (ii) state banks experienced technical progress while private banks did not. However, his study limited the analysis to the pre-1993 period when the liberalization of the financial system was actually initiated.

Christopoulos, Lolos and Tsionas (2002) however examined the cost efficiency of Greek banks in the 1993-1998 period, using a heteroskedastic stochastic frontier approach. The beginning of the examination period coincides with the acceleration of liberalization and deregulation of the Greek financial system, in view of the country joining the EMU. The study uses a multi-input, multi-output technology and adopts a heteroscedastic frontier model instead of a commonly used homoscedastic one to measure cost efficiency in the banking system. The empirical results show that larger banks are less efficient than smaller ones.[53] The estimated efficiencies of 17 out of the 19 Greek banks exceed either 90% or 80%, depending on whether a heteroskedastic or a homoskedastic model was used. Also, it is found that economic performance, bank loans and investments are positive related to the cost efficiency of the Greek commercial banking sector.

More recently, Kamberoglou, Liapis, Simigiannis and Tzamourani (2004) use the distribution free approach to investigate cost efficiency in a panel of Greek banks over 1993-1999, a period characterized by major changes in the banking sector brought about by gradual financial deregulation. These reforms were supposed to provide an opportunity to Greek banks to improve their efficiency and to enhance their competitiveness in view of ongoing financial integration in Europe and the introduction of the euro. A fixed effects model was fitted to a panel of 18 banks. The results obtained indicate that important cost X-inefficiencies are in place. Greek banks were found to exhibit substantial cost inefficiencies[54], indicating that there is significant room for improving their competitiveness and profitability. Some evidence is provided that bank characteristics such as bank size, type of ownership and risk behavior do play a role in explaining differences in measured inefficiencies. In particular, large, public and risk adverse banks tend to be more inefficient. Scale

[53] This is a finding of their heteroskedastic model but it is not supported by the results of their homoskedastic model.

[54] The model is estimated for both an unbalanced and a balanced sample of the 18 banks, using the White heteroskedasticity consistent covariances. The results give average efficiencies of 69% and 67% for the two samples.

economies are also examined and the findings indicate that the Greek banking industry experiences economies of scale, though they have declined throughout the observed period. This suggests that competitive viability may be an important factor for further consolidation in the Greek banking industry.

Finally, Noulas and Karampasi (2006) evaluate the efficiency, in the Greek banking system, over the period 2000-2004, using the DEA method. The results indicate that the efficiency differs significantly across banks and there are big margins for improvement of efficiency. They, also, found that large banks are more efficient. Thus, the small banks will face problems for their survivor in a competitive environment. They result that the average efficiency is 84% for the period 2003-2004.

In the end of the survey of the literature in the Greek banking system, cross – country studies measure the efficiency of the Greek banking system. Weill (2003) compares the efficiency of banks from Western and Eastern European countries to assess the gap in performance between both categories of banks. He points out that among Western countries, Greece and Portugal have the least efficient banking sectors. It is noticeable that these countries are also the EU catching-up economies with the lowest per capita income among EU countries. Weill founds that the level of efficiency in Greece has increased from 54.65% in 1996 to 62.09% in 2000, an average evolution of 7.44 percentage points. In a more recent study, Weill (2004) analyzed the relationship between competition and efficiency in banking on a sample of 12 EU-member countries, including Greece, during the period 1994-1999. The most striking result is the improvement in efficiency for all countries, whilst the most significant movement of 22.77% points appeared in Greece catapulting the country from the absolute bottom (efficiency of 50.98%) to the middle part of the overall standings (efficiency of 73.75%). Finally, Stavarek (2005), employing Data Envelopment Analysis on unconsolidated data, estimates commercial banks' efficiency in three relatively homogenous groups of countries with different level of economic development and different involvement in the process of European integration. Results suggest that differences in banking efficiency exist among analyzed regions and the hierarchy corresponds with the hierarchy of regions and

countries in terms of economic development and degree of integration. From 2002 to 2003, Greece recorded growth of 17.9% (BCC model) or 6.7% (CCR model).[55]

Table 3.1 presents a brief overview of the literature. Notice that the results from different empirical research are comparable only to a limited extent. The efficiency scores are influenced by several factors: the different methods, the dissimilar sample and considered distorting factors.

Non-parametric approaches are unable to distinguish the inefficiency component from the random error term; therefore the inefficiency component can be over-calculated. The rapid development of banking sectors and integration process make the previous studies out-of-date very quickly. Therefore, it is obvious that there is a permanent need for further analysis of banking efficiency.

Table 3.1

Brief overview of the literature

Authors	Approach	Countries considered	Period	Results
U.S.A.				
Berger (1995)	DFA	U.S.A.	1980-1989	average X-inefficiency: 39%
Berger and Mester (1997)	DFA	U.S.A.	1990-1995	average X-inefficiency: 13% average profit inefficiency: 9%
Ferrier and Lovell (1990)	SFA/ DEA	U.S.A.	1984	average X-inefficiency: 26% average technological inefficiency: 21%
Among old and new EU member states				
Kosak and Zajc (2004) AT, BE, CY, CZ, DE, EE, HU, IT, LT, LV, MT, NL, PL, SI, SK.	SFA	15 old and new EU Member States	1996-2003	average X-inefficiency: 16.7%
Tomova (2005) BU, CRO, CZ, EE, FR, HU, PL, PT, RO, ES, SI, SK.	DEA	12 old and new EU Member States	1993-2002	average technological inefficiency: 55%

[55] Stavarek calculated DEA efficiency scores obtained by running separate programs for the CCR model and for the BCC model. Average efficiency in Greece with CCR was 62.49% (2002) and 66.7% (2003), while the level of efficiency with BCC was 73.14% (2002) and 86.29% (2003).

Table 3.1(continued)

Authors	Approach	Countries considered	Period	Results
Among old EU Member States				
Bikker (1999) BE, DE, CH, FR, IT, LU, NL, ES, UK	SFA	9 old EU Member States	1989-1999	average X-inefficiency: 53%
Dietsch and Weill (2000) DE, FR, IT	SFA; DFA	3 old EU Member States	1993-1997	average X-inefficiency: 16%
Bikker (2002) AT, BE, DE, DK, FI, FR, GB, GR, IE, IT, LU, NL, PT, ES, SE	SFA	15 old EU Member States	1990-1997	average X-inefficiency: 30%
Weill (2004) AT, BE, DE, DK, FI, FR, GB, GR, IT, LU, PT, ES	SFA; DFA	12 old EU Member States	1994-2000	average X-inefficiency: 35%
Transition Economies				
Hasan and Marton (2003)	SFA	Hungary	1993-1998	average X-inefficiency: 25% average profit inefficiency: 30%
Weill (2003)	SFA	Poland and Czech Republic	1997	average X-inefficiency: 26%
Havrylchyk (2006)	DEA	Poland	1997-2001	average X-inefficiency: 49%
Among Transition Economies				
Grigorian and Manole (2002) ARM, BEL, BU, CRO, CZ, EE, HU, KAZ, LV, LT, MO, PL, RO, RUS, SI, SK, UKR	DEA	17 Transition Countries	1995-1998	average technological inefficiency: 47%
Yildirim and Philippatos (2002) BU, CZ, CRO, EE, HU, KAZ, LV, LT, MAC, PL, RO, RUS, UCK, SI, SK	SFA; DFA	15 Transition Countries	1993-2000	average X-inefficiency: 24%; 36%
Bonin et al. (2005) BU, CRO, EE, CZ, HU, LV, LT, PL, RO, SK, SI	SFA	11 Transition Countries	1996-2000	average X-inefficiency: 23.3%
Rossi et al. (2005)	SFA	9 Central and Eastern European Countries	1995-2002	average X-inefficiency: 32%

Table 3.1(continued)

Authors	Approach	Countries considered	Period	Results
Greece				
Christopoulos et al. (2002)	Heteroscedastic SFA	Greece	1993-1998	average X-inefficiency: 10%; 20%
Tsionas et al. (2003)	DEA	Greece	1993-1998	average X-inefficiency: 5%
Kamberoglou et al. (2004)	DFA	Greece	1993-1999	average X-inefficiency: 31%; 33%
Noulas and Karampasi (2006)	DEA	Greece	2000-2004	average X-inefficiency: 15.9%

Notes: USA (United States of America), EU (European Union), ARM (Armenia), AT (Austria), CH (Switzerland), CRO (Croatia), CY (Cyprus), CZ (Czech Republic), BE (Belgium), BEL (Byelorussia), BU (Bulgaria), DE (Germany), DK (Denmark), EE (Estonia), ES (Spain), FR (France), FI (Finland), GB (Great Britain), GR (Greece), HU (Hungary), IE (Ireland), IT (Italy), KAZ (Kazakhstan), LT (Latvia), LU (Luxemburg), LV (Lithuania), MAC (Macedonia), MO (Moldova), MT (Malta), NL (The Netherlands), NO (Norway), PL (Poland), PT (Portugal) RO (Romania), RUS (Russia), SI (Slovenia), SK (Slovakia), SE (Sweden), TR (Turkey), UKR (Ukraine).

CHAPTER 4

DATA ANALYSIS AND VARIABLE DESCRIPTIONS

4.1 Data analysis and symmary statistics

The models specified are used to examine the cost and profit inefficiency in the Greek banking industry during the period 1993-2005. All the bank-specific data are taken from the Balance Sheet Accounts and Income Statements published annually by the Greek banking firms included in the sample.

The beginning of the examination period coincides with the acceleration of liberalization and deregulation of the Greek financial system, in view of the country joining the European Monetary Union (EMU). Also, the examined period captures the new conditions appeared in the banking industry in terms of organization. In particular, it seems that the model that tends to prevail internationally is that of a financial conglomerate, with specialized subsidiaries providing the entire spectrum of financial services efficiently and flexibly, also taking advantage of the various synergies (Bank of Greece, 1999). Under these circumstances, the Greek credit institutions were called to decide whether they would move towards the above model or instead they would retain a purely local character and specialize in certain segments of the market, especially in retail banking, a sector which would be more sheltered from competition in the single European area. Indeed, as it has been extensively discussed (Chapter 2), over the second half of the 1990s, Greek banks started to reconsider their strategies and extensive restructuring in terms of mergers and acquisitions took place, in view of Greece entering the Euro-zone in 2001. The observed mergers and acquisitions, mostly between smaller banks over the reviewed period, may be attributed to two main factors. The first is related to a wave of privatization initiated by direct government action, in line with EU developments. The second factor directing acquisitions has been market discipline, that is to obtain cost and efficiency gains.

We include the Greek commercial banks in operation during the period 1993-2005 in our data set (see Table 4.1 below).

Table 4.1: Greek Banks included in our data set

Bank	Years in Operation
National Bank of Greece	1993-2005
Alpha Bank	1993-2005
Eurobank	1993-2005
Agricultural Bank of Greece	1993-2005
Emporiki Bank (aka Commercial Bank of Greece)	1993-2005
Piraeus Bank	1993-2005
Geniki Bank (aka General Bank of Greece)	1993-2005
Egnatia Bank	1993-2005
Bank of Attica	1993-2005
Laiki Bank (formerly European Popular Bank)	1993-2005
Aspis Bank	1993-2005
NovaBank	2001-2005
Probank	2002-2005
Omega Bank	2001-2005
Marfin Bank (formerly Crédit Lyonnais (Grèce), Piraeus Prime)	1993-2005
Panellinia Bank	2002-2005
Telesis Bank (formerly Dorian Bank)	1993-2000
Ergobank	1993-1999
Ionian Popular Bank	1993-1999
Bank of Macedonia-Thrace	1993-1999
Xiosbank	1993-1999
Cretabank	1993-1998
Bank of Central Greece	1993-1998
National Mortgage Bank	1993-1997
Bank of Athens	1993-1997
Interbank	1993-1996
Bank of Cyprus	1993-2005
National Housing Bank	1993-1996

We believe that the assessment and quantification of cost and profit efficiency of the Greek banking system starting from the liberalization period is necessary for the evaluation of its performance and future prospects within the EMU framework. The conclusions drawn could prove useful for further analysis of the cost structure of the Greek banking sector.

Adding Bank of Cyprus to the above, for reasons to be explained later, we have $N = 28$ firms in the cross-sectional dimension; at the same time there are $T = 13$ years in the time dimension. Since, some banks in our panel ceased to exist during the examined time period, while some other came into play after 1993, we have an unbalanced panel; that is. So after reviewing the data for reporting errors and other inconsistencies, we result in an unbalanced panel of 259 observations. In particular, we do not have $NT = 28 \times 13 = 364$ observations for bank-specific variables. Actually, the precise number of such observations for our panel data is $13 \times 13 + 1 \times 8 + 4 \times 7 + 2 \times 6 + 4 \times 5 + 4 \times 4 + 2 \times 3 = 259$. This panel comprises a large portion of banks mainly in importance based on the balance sheet aggregates. In all examined years, banks included in the sample accounted for a significant proportion of total banking assets (around 80 per cent).

Long-term credit banks, namely ETBA and ETEBA, are excluded from our analysis, since they were not "ordinary banks" and their operations differed substantially from those of the mainstream commercial banks. The smaller cooperative institutions were also excluded, since beyond them having a different legal form than regular commercial banks (they do not operate as corporations, but rather as "credit cooperative", more importantly they generally operate in small areas; the loan market of cooperative banks are segregated either by prefecture (e.g. it is hard to see how the Cooperative Bank of Lamia would do business outside the corresponding prefecture of Fthiotis), or at most by geographical district (for instance, the largest cooperative credit institution, the Pan-Cretan bank, has an extensive branch network in Crete, but is hardly present in other geographical regions). It seems plausible to assert that, owing to this segregation, each cooperative bank tends to maintain a monopoly in its prefecture or wider region of operation, for the particular sub-market of cooperative banks. Owing to these idiosyncrasies however, the analysis of these institutions may require a different methodology than the one applied in this thesis, and could be interesting as a topic of future study.

Obviously, we exclude the central bank, namely the Bank of Greece, from our set of banks, since, although it maintain the legal form of a bank, performs operations and activities that radically depart from those of a commercial bank. In the same vein, we left out the two so-called "specialized credit institutions", namely the Greek Postal Savings Bank, and the Deposit and Loans Fund, since, although they did actually perform some banking operations, they were not even stand-alone corporations but

rather administrative branches of certain ministries (Greek Postal Savings Bank of the Ministry of Transport and Communications, and the Deposit and Loans Fund of the Ministry of Economy). The recent incorporation and current flotation of the Greek Postal Savings Bank, means that it may have to be included in corresponding data sets in future studies.

In addition, we also omit from the data set the investment banks, which belong to a different market altogether. Those banks left out owing to this line of reasoning are Investment Bank of Greece, Proton Investment Bank, and Investment Bank. Those institutions focusing their operations in corporate banking, namely First Business Bank, Emporiki Credicom, Aegean Baltic Bank, and Citibank Shipping (the latter two with a specialized emphasis to shipping industry), as well as a small bank specialized in the niche of automobile purchase financial, namely Unit Bank, were also excluded from our data set, since they fail the meet the criterion of being a well-rounded commercial banking institution.

There could be valid arguments made against excluded such banks, since the large commercial institutions also have investment banking and corporate banking arms, and the financial results are indeed taken into account in our data. However, we chose to follow the approach that is most typically followed in the literature.

Branches of foreign banks are excluded from our data set, at least for the practical reason of unavailability of interest expense data (with the exception of the Bank of Cyprus, which chooses to publish full accounting data, although legally not mandated to do so, and which we include in our data set). For a more detailed analysis of the situation with foreign banks and why they have to be excluded, the interested reader is referred to the appendix.

Table 4.2 shows the main variables employed in the frontier efficiency estimations. In particular, they present some summary statistics for our outputs, inputs, input prices, fixed netputs and other bank-specific variables.

Table 4.2 :Descriptive statistics from 1993 to 2005 (1993-1999 shown here; for 1999-2005, see next page)

Variable	1993	1994	1995	1996	1997	1998	1999
Cost and outputs							
Cost to assets	13.70	14.05	12.12	11.72	10.27	9.98	7.88
Loans to assets	23.78	25.17	28.06	31.53	31.90	36.27	36.58
Other earning assets and securities to assets	53.57	45.38	40.15	35.77	36.35	36.30	38.99
Inputs and input prices							
Interest expense to assets	9.59	10.53	8.58	7.89	6.66	6.82	5.17
Staff expense to assets	2.00	2.19	2.09	2.17	2.18	1.82	1.49
Price of funds	12.63	13.80	12.26	11.20	9.53	8.93	7.36
Price of labor	2.00	2.19	2.09	2.17	2.18	1.82	1.49
Price of capital	73.19	70.51	78.50	81.20	87.18	87.16	95.85
Fixed netputs							
Physical capital to assets	2.01	2.31	2.09	2.03	1.83	1.67	1.34
Equity to assets	4.55	4.87	4.84	4.47	5.10	5.98	9.89
Bank size							
Total assets	2.43	2.55	3.05	3.33	3.99	4.88	7.16
Bank-specific variables							
Cash to assets	8.81	10.61	11.30	13.30	12.25	13.08	15.00
Loan loss provisions to assets	0.34	0.38	0.23	0.52	0.62	0.52	0.64
Bank deposits to funds	20.30	18.48	28.46	29.31	25.63	18.83	25.22
ROA	1.06	1.31	1.26	0.79	0.99	1.20	3.04

Tables 4.2 present the data employed, in a rounded form. Each row represents the average bank in our set of banks for a particular year. All of the variables expressed in monetary units are in real terms; 1993 is used as the base year. The total cost was calculated as the total operating expense, given by the following expression: (Total Operating Expense) = (Interest Expense) + (Fees & Commissions Expense) + (Personnel Expense) + (Admin. Expense) + (Depreciation) + (Other Operating Expense)

Table 4.2 (continued): Descriptive statistics from 1993 to 2005 (1999-2005 shown here; for 1993-1999, see previous page)

Variable	2000	2001	2002	2003	2004	2005
Cost and outputs						
Cost to assets	7.78	10.50	5.55	5.04	4.79	4.31
Loans to assets	43.79	47.67	52.46	56.98	62.70	55.30
Other earning assets and securities to assets	32.80	44.39	35.15	30.62	26.97	25.10
Inputs and input prices						
Interest expense to assets	5.09	3.76	2.35	2.10	2.03	2.08
Staff expense to assets	1.45	1.65	1.57	1.43	1.44	1.26
Price of funds	7.51	6.56	3.01	2.68	2.61	2.91
Price of labour	1.45	1.65	1.57	1.43	1.44	1.26
Price of capital	77.04	80.91	68.14	72.83	87.46	96.84
Fixed netputs						
Physical capital to assets	1.90	2.12	2.43	2.12	1.76	1.54
Equity to assets	8.94	9.28	6.61	6.84	6.70	8.40
Bank size						
Total assets	9.92	11.02	9.65	10.25	10.55	14.03
Bank-specific variables						
Cash to assets	9.87	5.63	3.34	4.25	4.28	3.47
Loan loss provisions to assets	0.37	0.33	0.39	0.49	0.60	0.60
Bank deposits to funds	28.18	17.32	12.97	13.13	11.74	19.19
ROA	1.86	1.39	0.66	0.87	0.70	0.90

Source: Balance Sheet Accounts and Income Statements and own estimations

Note: Figures are means (in millions of euros for total assets and percentage for all other variables) over the period 1993-2005.Further descriptive statistics can be provided upon requested. The ROA is the ratio of income before taxes to total assets.

As we can see, total assets increased significantly during the examined period from 2, 43 million euros in 1993 to 14.03 million euros in 2005. Total cost also as a percent of total assets declined significantly over the sample period from 13.70% in 1993 to 4.31% in 2005. More specifically, a marked reduction in the cost/asset ratio in 2002, because the absolute amount of cost fell in 2002 following a reduction in official rates and, as a result, in the total amount of 'interest paid' (Interest expense as a percent of total assets also declined from 3.76% in 2001 to 2.35% in 2002). Cost

ratios differed significantly among banks at the beginning of the sample period but these differences gradually narrowed.

The profitability ratio improved during the period of 1993-1999 (from 1.06% in 1993 to 3.04% in 1999) and declined during the period of 1999-2005 (from 3.04% to 0.90%). The data indicate significant and persistent divergences in bank profitability during the period of analysis, with the ROA exhibiting greater dispersion than cost ratios not only through time but also across banks.

As far as the output of banks in the sample, the loan to assets ratio increased from 23.78 per cent in 1993 to 55.30 per cent in 2005, while significant differences existed among individual institutions. As with the cost ratio, differences among banks diminished mainly as a result of mergers. Other earning assets and securities to total assets declined from 53.57 per cent in 1993 to 25.10 per cent in 2005.

Other variables included in the cost function are the unit cost of loan able funds, the unit cost of labor and the unit cost of physical capital. The cost of loanable funds is calculated by dividing total interest expense by total funds and is obviously closely linked to developments in interest rates. Indeed, the main characteristic of the period of analysis is the drastic reduction in bank interest rates. As a result, the price of loanable funds for the sampling banks declined from 12.63 per cent in 1993 to 2.91 per cent in 2005. The price of labor (personnel expenses over the total assets) reduced from 2.00 per cent in 1993 to 1.26 per cent in 2005. If we exclude certain outliers connected with a small bank, differences in the price of labor among banks in the sample look persistent and there is no indication that they diminished with the passage of time. The price of physical capital, which is calculated by dividing, depreciation, administration and other expenses by the amount of fixed assets exhibits the largest variability among banks in the sample. This is hardly surprising since the sample includes on the one hand the big and long established banks and on the other a set of new and fast expanding institutions. The price of capital for the sampling banks increased from 73.19 per cent in 1993 to 96.84 per cent in 2005.

Finally, the average ratio of cash to total assets reduced from 8.81 per cent in 1993 to 3.47 per cent in 2005.

Table 4.3 reports sample means and standard deviations for the overall sample for the dependent and explanatory variables.[56]

Table 4.3

Descriptive statistics (1993-2005)

VARIABLE	Description	Mean	Std. Dev
Total costs, outputs and input prices			
Total costs to total assets	cost ratio	9.24	4.091
Total loans to total assets	output ratio	49.11	15.821
Other earning assets to total assets	output ratio	37.70	15.336
Personnel expenses to total assets	price of labour	1.78	0.883
Interest expenses to total funds	price of funds	8.37	5.531
Fixed netputs			
Equity to assets	equity ratio	8.36	5.364
Fixed assets to total assets	physical capital ratio	1.93	1.111
BANK SPECIFIC VARIABLES			
Loan loss provisions to loans	loan quality	1.12	1.333
Bank deposits to total funds	funding mix	20.70	38.860
Cash to assets	liquidity risk	9.30	6.316
Return on assets	financial performance	0.87	1.520
Herfindahl-Hirschman Index	concentration	1,624.15	142.054
Bank size			
Total assets	size	6,537,685.38	10,673,477.698

As we can see, average cost ratio stands at 9.24%. Weill (2003) compares the efficiency of banks from developed Western European countries (Greece among others) and developing Eastern European countries to assess the gap in performance between both categories of banks. The results clearly support the out performance of Western banks compared to Eastern banks: in 2000, the median of average cost ratios for Western banks is 5.78%, while it is 8.73% for Eastern banks. In our study, we find an average cost ratio (9.24%), higher than that of Western banks according to Weill. However, the results are not comparable. First of all, the periods under investigation differ significantly. Moreover, in comparison to cost ratios, the cost efficiency measures derived from the application of efficiency frontiers provide more

[56] Figures are means (in thousand of euros for total assets, and percentage for all other variables) for the data used in our analysis, over the period 1993-2005. The Herfindahl-Hirschman Index (HHI) is the sum of the squared market shares of the individual banks, in terms of total assets, and table 5.2 depicts its mean value.

sophisticated information on the bank performance and give a more relevant view on this issue.

Table 4.3, also, shows that total loans (gross) account for almost fifty per cent (49.1%) of the total assets, reflecting in someway the rapid expansion of credit. However, the standard deviation (15.8%) indicates the instability of the Greek banking system, mainly during the period of deregulation and liberalization (mid-1990s). Bank of Greece (1998), reports: "Benefiting from the more favorable growth prospects generated by the introduction of the euro and macroeconomic stability, lending activities are also expected to increase, though not to a large degree, owing to the expected further disintermediation." And in the Annual Report of the Bank of Greece for the year 2005, we read: "The growth rate to households remained high during 2005, standing at 30.3% in the last quarter of the year (fourth quarter 2004: 30%) and accelerating to 31.4% at the end of the first two months of 2006. In particular, the growth rate of housing loans accelerated, more notably towards the end of the year, and rose to 31.3% in the last quarter (fourth quarter 2004: 26.9%). This development is attributed to increased transactions in the housing market. At the same time, the growth rate of consumer loans, though decelerating, remained at a high level during 2005 (fourth quarter 2005: 29.9%, fourth quarter 2004: 37.9%), while the falling trend continued into this year (February 2006: 28.4%).

The ratio of other earning assets to assets turns to be 37.7% on average, with a standard deviation of 15.3%. The average price of labor is 1.78% with a negligible standard deviation of 0.9%, indicating high concentration around the mean. The price of funds stands at 8.37%, much higher than that observed in the European Union (2.57%, ECB, 2005).

Equity ratio stands at an average of about 8.36%, very close to the European average. The reasons behind this rational financial leverage are the structural changes over the 1990s, the relatively high credit expansion and the fact that the financing of this credit expansion relied more than in the past on the issuance of bank bonds and other debt securities, as well as on the interbank money market. The latter is reflected in the average value of the bank deposits to total funds ratio (20.7%), which consists a measure of the funding mix. However, the standard measure of the relative sources of funding, exhibits significantly more variability across the sample (38.86%) than do other variables. The ratio of loan loss provisions to total loans controls for the output quality has a mean value of 1.12% with a low standard deviation of 1.33%, indicating

reliability of the sample mean. As regards the liquidity, table 5.2 presents a satisfactory average ratio of cash to assets (9.3%). Turning to a financial performance measure, the mean rate of return on assets (ROA) is 0.87% with a low coefficient of variation (1.52%). Last, the average value of bank assets, measured in euros, is over six billions and the coefficient of variation is more than ten. Physical capital represents on average almost only 2% of the total assets.

All the bank-specific data were taken from publicly available balance sheets and income statements of the particular banking institutions. Greek monthly financial magazine "Epilogi" proved to be a very handy source, since it publishes annually a special issue, namely "Epilogi Isologismon" (isologismos means balance sheet in Greek), which contains the balance sheets and income statements of most banks (among other firms); for the balance sheets and income statements of banks that were harder to find in published media, we resorted to what is actually the last resort, that is the National Printing Office, where all corporations (including banks that possess the corporate form) all required by law to published their annual financial statements.

There are two "schools of thought" in compiling panels of banks for research purposes. The one is to follow the all-encompassing approach, as in Gibson (2005), or in Repousis (2005), who even includes the branch operations of foreign banks in Greece in his study of concentration of the Greek banking system. This approach ignores the distinction between commercial, investment, and corporate banking markets and subsumes in a common banking market all operating banks (possibly including foreign ones). The other approach, which is the one followed in our econometric work, was to include only those banks that we deemed as belonging in the commercial banking market. We felt that this was a "cleaner" approach. Foreign banks were excluded for data availability purposes, among other reasons, with a single exception. Of course, it is a valid arguments that many "commercial" banks (the National Bank of Greece, Alpha Bank, Eurobank, to name a few examples) also had significant corporate and investment banking arms, and by included those in our study, but excluding the purely corporate or investment banks, we have the worst of both worlds; neither the complete banking market, not a pure commercial banking one[57].

[57] For the "trichotomy" between retail, corporate, and financial market services in determining the banking (sub-) market to be examine, see, for instance, Adamidis (2005)

The corresponding table, based on our data, with market share and corresponding ranking for every year is as follows:

Table 4.4: Bank concentration and ranking from 1993 to 2005, inclusive (1993-1998 shown here; for 1999-2005, see next pages);banks highlighted in grey are included in our sample

YEAR	1993		1994		1995		1996		1997		1998	
BANK NAME	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**
National Bank of Greece	1	36.3	1	33.2	1	33.0	1	31.0	1	31.3	1	35.9
Alpha Bank	5	6.8	5	7.6	4	8.2	4	10.2	3	11.0	3	12.5
Eurobank	12	0.7	12	1.0	12	1.0	12	1.1	8	2.2	7	3.8
Agricultural Bank of Greece	2	13.5	2	14.0	2	13.9	2	14.0	2	13.3	2	13.1
Emporiki Bank	3	11.6	3	11.4	3	10.6	3	11.0	4	10.5	4	9.8
Piraeus Bank	18	0.4	16	0.5	16	0.6	15	0.7	14	1.0	8	2.0
Greek Postal Savings Bank												
Geniki Bank	9	1.5	10	1.3	9	1.3	10	1.4	12	1.3	11	1.6
Egnatia Bank	23	0.2	22	0.3	21	0.4	19	0.4	19	0.4	15	0.8
Laiki Bank	24	0.1	23	0.2	23	0.3	17	0.5	16	0.6	16	0.6
Bank of Attica	22	0.3	21	0.4	20	0.4	22	0.4	18	0.4	17	0.6
Aspis Bank	25	0.1	25	0.1	25	0.1	25	0.1	23	0.2	19	0.3
NovaBank												
Probank												
Omega Bank												
First Business Bank												
Marfin Bank (formerly Piraeus Prime / Credit Lyonnais)	19	0.4	19	0.4	15	0.6	20	0.4	21	0.2	22	0.1
Panellinia Bank												
Investment Bank of Greece												
Proton Investment Bank												
Emporiki Credicom												
Aegean Baltic Bank												
Citibank Shipping	26	0.1	26	0.1	26	0.1	26	0.1	24	0.1		
Investment Bank	27	0.1	27	0.04	27	0.02	27	0.02	25	0.02	21	0.00
ETBA	6	6.2	6	6.4	7	5.7	8	2.7	9	2.1	10	1.8
Unit Bank												
ETEBA	14	0.6	15	0.5	22	0.4	23	0.4	15	0.6	14	1.0
Telesis Bank (formerly Dorian Bank)	24	0.2	24	0.2	24	0.1	24	0.2	22	0.2	10	0.3
Ergobank	8	3.5	8	3.8	8	4.0	7	4.1	7	4.5	6	5.1
Ionian Popular Bank	7	5.1	7	5.5	6	6.2	6	6.7	6	7.1	5	5.6
Bank of Macedonia-Thrace	11	1.1	11	1.3	10	1.3	9	1.6	10	1.6	9	1.9
Xiosbank	15	0.5	13	0.8	13	0.8	13	0.9	13	1.1	12	1.5
Cretabank	10	1.4	9	1.3	11	1.2	11	1.4	11	1.3	13	1.2
Bank of Central Greece	16	0.5	17	0.5	17	0.5	16	0.5	17	0.5	18	0.5
National Mortgage Bank	4	7.7	4	7.6	5	8.0	5	8.5	5	8.0		
Bank of Athens	21	0.3	18	0.5	18	0.4	21	0.4	20	0.4		
Interbank	17	0.4	14	0.7	14	0.6	14	0.7				
National Housing Bank	20	0.4	20	0.4	19	0.4	18	0.5				
TOTAL		100.0		100.0		100.0		100.0		100.0		100.0

Table 4.4 (continued): Bank concentration and ranking from 1993 to 2005, inclusive (1999-2004 shown here; for 1993-1998, see previous page and for 2005, see next page); banks highlighted in grey are included in our sample

YEAR	1999		2000		2001		2002		2003		2004	
BANK NAME	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**
National Bank of Greece	1	31.4	1	30.9	1	31.1	1	30.3	1	27.2	1	25.0
Alpha Bank	2	14.3	2	20.1	2	18.2	2	16.8	2	16.4	2	16.6
Eurobank	5	6.2	5	11.0	3	11.8	3	14.4	3	14.6	3	15.4
Agricultural Bank of Greece	3	11.7	4	11.1	5	10.7	4	10.3	4	9.9	4	9.9
Emporiki Bank	4	11.0	3	11.2	4	11.5	5	10.2	5	9.3	5	9.3
Piraeus Bank	8	3.7	6	7.7	6	7.6	6	7.7	6	7.8	6	8.2
Greek Postal Savings Bank									7	5.6	7	5.5
Geniki Bank	12	1.6	8	1.5	8	1.7	7	1.8	8	1.9	8	1.8
Egnatia Bank	13	1.3	9	1.3	9	1.4	9	1.5	9	1.4	9	1.5
Laiki Bank	15	0.7	11	0.8	11	0.9	10	1.1	11	1.1	10	1.3
Bank of Attica	14	0.8	10	0.9	10	1.3	11	1.1	10	1.1	11	1.2
Aspis Bank	16	0.5	13	0.4	13	0.8	12	1.0	12	1.0	12	1.0
NovaBank					12	0.9	13	0.8	13	0.8	13	0.9
Probank							15	0.3	14	0.5	14	0.7
Omega Bank					15	0.1	16	0.3	15	0.5	15	0.5
First Business Bank							14	0.4	16	0.4	16	0.5
Marfin Bank (formerly Piraeus Prime / Credit Lyonnais)	18	0.2	14	0.3	18	0.1	17	0.2	17	0.3	17	0.4
Panellinia Bank							19	0.1	18	0.1	18	0.2
Investment Bank of Greece					17	0.1	20	0.1	21	0.1	19	0.1
Proton Investment Bank							22	0.05	19	0.1	20	0.1
Emporiki Credicom											21	0.1
Aegean Baltic Bank									22	0.02	22	0.04
Citibank Shipping Investment Bank	19	0.02	15	0.02	14	0.1	18	0.1	20	0.1		
ETBA	9	2.2	7	2.1	7	1.7	8	1.7				
Unit Bank			17	0.00	16	0.1	21	0.1				
ETEBA	20	0.00	16	0.00	19	0.00						
Telesis Bank (formerly Dorian Bank)	17	0.5	12	0.6								
Ergobank	6	5.3										
Ionian Popular Bank	7	4.8										
Bank of Macedonia-Thrace	10	2.0										
Xiosbank	11	1.6										
Cretabank												
Bank of Central Greece												
National Mortgage Bank												
Bank of Athens												
Interbank												
National Housing Bank												
TOTAL		100.0		100.0		100.0		100.0		100.0		100.0

Table 4.4 (continued): Bank concentration and ranking from 1993 to 2005, inclusive (2005 shown here; for 1993-2004, see previous pages); banks highlighted in grey are included in our sample

YEAR	2005	
BANK NAME	**Rank**	**%**
National Bank of Greece	1	21.7
Alpha Bank	2	17.0
Eurobank	3	16.9
Agricultural Bank of Greece	4	8.61
Emporiki Bank	6	7.8
Piraeus Bank	5	8.3
Greek Postal Savings Bank	8	4.31
Geniki Bank	9	1.4
Egnatia Bank	10	1.3
Laiki Bank	11	1.2
Bank of Attica	13	1.0
Aspis Bank	14	0.81
NovaBank	12	1.16
Probank	7	6.69
Omega Bank	15	0.45
First Business Bank	17	0.35
Marfin Bank (formerly Piraeus Prime / Credit Lyonnais)	16	0.51
Panellinia Bank	18	0.19
Investment Bank of Greece	19	0.07
Proton Investment Bank	20	0.06
Emporiki Credicom	21	0.04
Aegean Baltic Bank	22	0.035
Citibank Shipping Investment Bank		
ETBA		
Unit Bank		
ETEBA		
Telesis Bank (formerly Dorian Bank)		
Ergobank		
Ionian Popular Bank		
Bank of Macedonia-Thrace		
Xiosbank		
Cretabank		
Bank of Central Greece		
National Mortgage Bank		
Bank of Athens		
Interbank		
National Housing Bank		
TOTAL		100.0

Table 4.5: Herfindahl-Hirschman index for period 1993-2005, both for full set of Greek banks as well as for the considered subset of commercial banks

Year	Herfindahl-Hirschman Index On Full Set Of Operating Greek Banks	Herfindahl-Hirschman Index On Subset Of Commercial Greek Banks
1993	1821	1782
1994	1635	1594
1995	1621	1589
1996	1535	1528
1997	1545	1540
1998	1805	1800
1999	1571	1566
2000	1800	1796
2001	1756	1753
2002	1687	1684
2003	1507	1476
2004	1431	1400
2005	1400	1342

Table 4.6: Concentration in the Greek banking system as given by the Top-3 and Top-5 measures, etc. (years 1993-1998 shown; for years 1999-2005, see next page)

YEAR	1993		1994		1995		1996		1997		1998	
BANK	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
National Bank of Greece	1	36.3	1	33.2	1	33.0	1	31.0	1	31.3	1	35.9
Alpha Bank	5	6.8	5	7.6	4	8.2	4	10.2	3	11.0	3	12.5
Eurobank												
Agricultural Bank of Greece	2	13.5	2	14.0	2	13.9	2	14.0	2	13.3	2	13.1
Emporiki Bank	3	11.6	3	11.4	3	10.6	3	11.0	4	10.5	4	9.8
Ionian Popular Bank											5	5.6
National Mortgage Bank	4	7.7	4	7.6	5	8.0	5	8.5	5	8.0		
%												
Top-3		61.3		66.1		57.5		56.0		55.6		61.5
Top-5		75.8		73.8		73.6		74.7		74.2		76.8
Contribution To Herfindahl-Hirschman Index												
Top-3		1632		1425		1395		1280		1280		1616
Top-5		1737		1541		1526		1455		1456		1744
Percent Contribution To Herfindahl-Hirschman Index On Full Set Of Greek Banks												
Top-3		89.6		87.2		86.1		83.4		82.9		89.6
Top-5		95.4		94.3		94.1		94.8		94.3		96.6
Herfindahl-Hirschman Index		1821		1635		1621		1535		1545		1805
Percent Contribution To Herfindahl-Hirschman Index On Subset Of Greek Commercial Banks												
Top-3		91.6		89.4		87.8		83.8		83.1		89.8
Top-5		97.5		96.7		96.0		95.3		94.5		96.9
Herfindahl-Hirschman Index		1782		1594		1589		1528		1540		1800

Table 4.6 (continued): Concentration in the Greek banking system as given by the Top-3 and Top-5 measures, etc. (years 1999-2004 shown; for years 1993-1998, see previous page)

YEAR	1999		2000		2001		2002		2003		2004	
BANK	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
National Bank of Greece	1	31.4	1	30.9	1	31.1	1	30.3	1	27.2	1	25.0
Alpha Bank	2	14.3	2	20.1	2	18.2	2	16.8	2	16.4	2	16.6
Eurobank	5	6.2	5	11.0	3	11.8	3	14.4	3	14.6	3	15.4
Agricultural Bank of Greece	3	11.7	4	11.1	5	10.7	4	10.3	4	9.9	4	9.9
Emporiki Bank	4	11.0	3	11.2	4	11.5	5	10.2	5	9.3	5	9.3
Ionian Popular Bank												
National Mortgage Bank												
%												
Top-3		57.4		62.2		61.1		61.5		58.2		57.0
Top-5		74.7		84.3		83.4		82.0		77.3		76.2
Contribution To Herfindahl-Hirschman Index												
Top-3		1329		1486		1439		1405		1222		1138
Top-5		1489		1730		1687		1616		1405		1322
Percent Contribution To Herfindahl-Hirschman Index On Full Set Of Greek Banks												
Top-3		84.58		82.54		81.95		83.26		81.08		79.56
Top-5		94.75		96.11		96.06		95.74		93.26		92.43
Herfindahl-Hirschman Index		1571		1800		1756		1687		1507		1431
Percent Contribution To Herfindahl-Hirschman Index On Subset Of Greek Commercial Banks												
Top-3		84.85		82.74		82.08		83.41		82.80		81.28
Top-5		95.05		96.35		96.22		95.91		95.23		94.43
Herfindahl-Hirschman Index		1566		1796		1753		1684		1476		1400

Table 4.6 (continued): Concentration in the Greek banking system as given by the Top-3 and Top-5 measures, etc. (year 2005 shown; for years 1993-1998, see previous page)

YEAR	2005	
BANK	Rank	%
National Bank of Greece	1	21.68
Alpha Bank	2	17.03
Eurobank	3	16.98
Agricultural Bank of Greece	4	8.61
Emporiki Bank	5	7.77
Ionian Popular Bank		
National Mortgage Bank		
%		
Top-3		55.69
Top-5		72.07

Our tables have been based on the published balance sheets and income statements of banks. For the years that we can compare with Gibson, we find some differences between our data and her data. For instance, we calculate a 36.3 per cent market share for the National Bank of Greece in 1993, whereas Gibson computes 42.3 per cent. In general, our main differences concern year 1993.

From the values of the Herfindahl-Hirschman index we computed[58], just as from the very elucidating charts in Gibson (2005, p. 10)[59], one may observe that concentration was steadily falling from its 1993 level, reaching its lowest level in year 1996. One could argue that this marks the completion of the first stage of structural deregulation of the Greek banking system, with a host of new banks (Egnatia Bank, Laiki Bank, Aspis Bank, Eurobank, Xiosbank, Interbank) getting established in the early 1990s are leading to a de-concentration in the banking system. From 1996 the trend starts to reverse and in 1998 concentration reached 1993 levels, plunging in 1999 and re-reaching those high levels in 2000. Essentially, what we see here is a situation, where after National Bank of Greece, Emporiki Bank. Agricultural Bank of Greece, National Bank of Greece, ETBA, and Ionian-Popular Bank, all directly or indirectly state-owned[60] started to lose their grip in the banking system, in the process of deregulation., with a sleuth of new private-sector banks coming into play, resulting in de-concentration, the stronger private-sector banks (Alpha Bank, Eurobank, Piraeus Bank) proceed into acquisitions of smaller players, both private-sector ones (Ergobank, Xiosbank, Interbank) and public-sector ones (ETBA, Ionian Popular Bank) resulting in a re-consolidation of the banking sector, but this time in the hands of mainly the three aforementioned private-sector banks, alongside the still strong public-sector big-3 (NBG, Emporiki, Agricultural). The increase of HHI in 1998 is also due to the absorption of National Mortgage Bank by NBG, which however should not have produced any decrease in competition, since the National Mortgage Bank was a bank of the NBG group[61]. In the years 2000-03 we have a steady decrease

[58] We computed the Herfindahl-Hirschman index on market shares computed on total assets, a la Gibson. However, it needs to be stress that the U.S. antitrust authorities, such as the Dept. of Justice, compute market shares in terms of *deposits*.

[59] Which cover a time span much broader than our study, reaching actually back to the early 1980s.

[60] Note how, in years 1993-95 they made up 6 of the 7 largest banks in assets, with Alpha Bank the only private-sector bank in the top 7.

[61] This illustrates the limitations of treating as independent players entities that belong to the same financial group.

in concentration, particularly owing to the NBG losing market share and some new, small banks coming into play.

Table 4.7: Total Assets (in millions of euros)

Credit Institution	Dec 31, 2005		Dec 31, 1993	
	Total Assets	Rank	Total Assets	Rank
National Bank of Greece (NBG)	53,278.93	1	21,147.48	1
Alpha Bank	41,849.24	2	3,987.17	5
Eurobank	41,724.00	3	379.83	12
Agricultural Bank of Greece	20,408.41	4	7,866.11	2
Piraeus Bank	21,154.10	5	249.85	17
Emporiki Bank	19,087.51	6	6,748.84	3
Probank	16,454.59	7	-	-
Greek Postal Savings Bank	10,586.35	8	Not yet incorporated as a société anonyme	
Geniki Bank	3,510.11	9	870.61	9
Egnatia Bank	3,284.15	10	126.00	22
Laiki Bank	2,936.29	11	85.54	24
NovaBank	2,861.04	12	-	-
Bank of Attica	2,468.84	13	198.22	21
Aspis Bank	1,987.05	14	80.10	25
Marfin Bank (Crédit Lyonnais in 1993)	1,257.22	15	222.55	18
Omega Bank	1,102.59	16	-	-
First Business Bank	871.08	17	-	-
Panellinia Bank	456.18	18	-	-
Investment Bank of Greece	172.15	19	-	-
Proton Investment Bank	148.24	20	-	-
Emporiki Credicom	99.66	21	-	-
Aegean Baltic Bank	84.90	22	-	-
National Mortgage Bank (Ktimatiki)	To NBG	-	4,462.76	4
ETBA	To Piraeus Bank	-	3,607.71	6
Ionian and Popular Bank	To Alpha Bank	-	2,945.88	7
Ergobank	To Eurobank	-	2,013.49	8
Cretabank	To Eurobank	-	809.36	10
Macedonia-Thrace Bank	To Piraeus Bank	-	660.80	11
ETEBA	To NBG	-	365.96	13
Xiosbank	To Piraeus Bank	-	319.96	14
Bank of Central Greece	To Egnatia Bank	-	282.84	15
Interbank	To Eurobank	-	253.17	16
National Housing Bank (Stegastiki)	To Ktimatiki	-	205.71	19
Bank of Athens	To Eurobank	-	200.35	20
Telesis Investment Bank	To Eurobank	-	105.86	23
Citibank Shipping	Under liquidation	-	63.29	26
Investment Bank	To Emporiki	-	44.30	27
TOTAL	245,782.63		58,303.74	

Table 4.8: Total Assets (as proportion of aggregate assets for all Greek banks – "concentration")

Credit Institution	Dec 31, 2005		Dec 31, 1993	
	Total Assets	Rank	Total Assets	Rank
National Bank of Greece (NBG)	21.68%	1	36.27%	1
Alpha Bank	17.03%	2	6.84%	5
Eurobank	16.98%	3	0.65%	12
Piraeus Bank	8.61%	4	0.43%	17
Agricultural Bank of Greece	8.30%	5	13.49%	2
Emporiki Bank	7.77%	6	11.58%	3
Probank	6.69%	7	-	-
Greek Postal Savings Bank	4.31%	8	Not yet incorporated as a société anonyme	
Geniki Bank	1.43%	9	1.49%	9
Egnatia Bank	1.34%	10	0.22%	22
Laiki Bank	1.19%	11	0.15%	24
NovaBank	1.16%	12	-	-
Bank of Attica	1.00%	13	0.34%	21
Aspis Bank	0.81%	14	0.14%	25
Marfin Bank	0.51%	15	0.38%	18
Omega Bank	0.45%	16	-	-
First Business Bank	0.35%	17	-	-
Panellinia Bank	0.19%	18	-	-
Investment Bank of Greece	0.07%	19	-	-
Proton Investment Bank	0.06%	20	-	-
Emporiki Credicom	0.04%	21	-	-
Aegean Baltic Bank	0.035%	22	-	-
National Mortgage Bank (Ktimatiki)	To NBG	-	7.65%	4
ETBA	To Piraeus Bank	-	6.19%	6
Ionian and Popular Bank	To Alpha Bank	-	5.05%	7
Ergobank	To Eurobank	-	3.45%	8
Cretabank	To Eurobank	-	1.39%	10
Macedonia-Thrace Bank	To Piraeus Bank	-	1.13%	11
ETEBA	To NBG	-	0.63%	13
Xiosbank	To Piraeus Bank	-	0.55%	14
Bank of Central Greece	To Egnatia Bank	-	0.49%	15
Interbank	To Eurobank	-	0.43%	16
National Housing Bank (Stegastiki)	To Ktimatiki	-	0.35%	19
Bank of Athens	To Eurobank	-	0.34%	20
Telesis Investment Bank	To Eurobank	-	0.18%	23
Citibank Shipping	Under liquidation	-	0.11%	26
Investment Bank	To Emporiki	-	0.08%	27
TOTAL	100%		100%	

The above two tables isolate the starting and ending year of our study, to make the differences in the structure of the Greek banking system between 1993 and 2005 clearer. All amounts are nominal.

4.2 Variable definitions for estimations of efficiency frontier

Selection of proper variables to define and to measure technical efficiency is always an extremely important decision. It is especially so in using SFA and DEA methodology for such measurements as different outcomes may result rfrom different set of variables used on the very same set of institutions. Despite the large body of literature there is no general consensus on how to define inputs and outputs of multi-product banks. The two main issues are related to the role of deposits and whether inputs and outputs should be measured in physical or monetary units. Traditionally, deposits are regarded as the main ingredients for loan production and the acquisition of other earning assets. On the other hand, high value-added deposit products, like integrated savings and checking accounts, investment trusts and foreign currency deposit accounts tend to highlight the output characteristics of deposits. Indeed, high value-added deposit services are an important source of commissions and fee revenues for specialized commercial banks such as trust and private banks. In the context of these specialized institutions, one cannot afford to ignore the output nature of deposits. Extending this argument further, one might contend that the classification of deposits should therefore depend on the structure and characteristics of banks in the representative sample and viewed in the regulatory context of the country in question.

The following five are the most used approaches in the literature, which have been developed to define the input-output relationship in financial institution behavior in the literature.[62]

- The **production approach**, being more concerned with the technical efficiency of financial institutions, defines the bank activity as production of services. Deposits are counted as output and interests

[62] Also, three other but less used approaches have been proposed in the literature, modified production approach. Yet, there is little agreement among economists on the explicit definition of banking outputs and inputs, mainly as a result of the nature and functions of financial intermediaries (see Berger and Humphrey (1992) and Maggi and Rossi (2003)).

paid on deposits are not included in bank total costs (Ferrier and Lovell, 1990). According to this approach input and output are measured in physical quantity. (Number of accounts, transactions processed, etc.). The production approach (Sherman and Gold, 1985) views financial institutions as producers of deposit and loan accounts, defining output as the number of such accounts or transactions.

- The **intermediation approach** (Sealey and Lindley, 1977) views banks as institutions that collect and allocate funds in loans and other assets; deposits are included among the inputs and interests in the total costs. This approach stems directly from the traditional role of financial institutions as intermediaries that convert financial assets from surplus units into deficit units.
- The **asset approach** is a variant of the intermediation approach where liabilities are considered as inputs and assets as output. This approach recognizes the primary role of financial institutions as creators of loans. In essence, this stream of thought defines outputs as the stock of loan and investment assets (Favero and Papi, 1995).
- The **value-added approach** identifies any balance sheet item as output if it absorbs a relevant share of capital and labor, otherwise it is considered as an input or non relevant output; according to this approach deposits are considered as an output since they imply the creation of value added.
- Finally, the **user cost approach** that it is the net contribution to the bank revenue that defines inputs and outputs; in this case deposits are counted as outputs.

Thus, the choice of a particular approach and consequently the definition used for the inputs and outputs are likely to affect the results of the efficiency estimates (Favero and Papi, 1995; Hunter and Timme, 1995; Resti, 1997). The researcher's choice is often a pragmatic compromise between theoretical considerations and data availability. Even today, there is no all-encompassing theory of the banking firm and no agreement on the explicit definition and measurement of banks' inputs and outputs. The "intermediation approach" asserts that banks collect deposits and purchase funds from other financial institutions, and use them as inputs to grant loans

and to purchase other financial assets and securities, such as bonds and shares (Benston *et al* (1982)). Accordingly, the amounts of loans and securities are used as a measure of a bank's output and interest costs on deposits and purchased funds are included, along with operating costs, in the measurement of total costs. As the "intermediation approach" is more inclusive of the total costs of banking, it is preferred if the objective is to evaluate the economic viability of banks, given that interest costs and operational costs are functionally the same from bank managers' point of view. Accordingly, the "production approach" is preferred when more emphasis is placed on investigating banks' operational efficiency and productivity. The "intermediation approach" is a more general concept than operational efficiency and hence is more appropriate when the purpose is to evaluate the implications of the deregulation of the banking system and the liberalization of financial transactions in an economic environment characterized by the gradual integration of the European financial systems and markets. It is also more useful for analyzing the efficiency of bank mergers.

The outputs and inputs chosen are fairly basic and standard, although there is considerable variation within the literature, and many studies add other bank outputs (e.g. off-balance sheet activities), other inputs (e.g. financial equity capital), other bank characteristics (e.g. nonperforming loans), and environmental factors (e.g. state income growth) to the models (see the following table).

Table 4.9: Summary of the literature on definition of the variables (inputs and outputs)

Authors	Approach	Outputs	Inputs	Input prices	Fixed Netputs
Allen and Rai (1996)	Intermediation approach	1.Traditional banking assets 2.Investment assets	1.Labor 2.Capital 3.Borrowed Funds	1.Staff expences/ total number of employees 2.Capital equipment and occupancy expenses/fixed assets 3.Total interest expenses/total interest bearing liabilities	
Berger and Mester (1997)	Intermediation or asset approach	1.Consumer loans 2.Business loans 3.Securities	1.Purchased funds 2.Core deposits 3.Labor	1.Interest rates on purchased funds 2.Interest rates on core deposits 3.Price of labor	1.Off-balance sheet guarantees 2.Physical capital 3.Financial equity capital
Casu and Molyneux (1999)	Intermediation approach	1.Total loans 2.Other earning assets		1.Total Costs (interest expenses, non-interest expenses, personnel expenses) 2.Total deposits	1.Equity Capital

Table 4.9: Summary of the literature on definition of the variables (inputs and outputs) (continued)

Authors	Approach	Outputs	Inputs	Input prices	Fixed Netputs
Christopoulos, Lolos and Tsionas (2002)	Intermediation approach	1. Loans and advances 2.Investment 3.Liquid assets	1.Capital 2.Deposits 3.Labor	1.Capital expenses/ Fixed assets 2.Interest expenses/ total deposits 3.Personnel expenses/ total labor	
Maggi and Rossie (2002)	Intermediation approach (European commercial banks)	1.Deposits 2.Loans 3.Services	1.Capital 2.Labor 3.Deposits	1.Capital cost/ fixed assets net of depreciation 2. Personnel expenses/ total number of employees 3. Interest expenses/ total deposits	
	Value-added approach (U.S. banks)		1.Capital 2.Labor		
Hasan and Marton (2003)	Intermediation approach	1.Total loans 2.Total investments 3.Non-interest or fee related income 4.Total interest bearing borrowed funds	1.Labor 2.BorrowedFunds	1.Non-interest expenses/number of full-time equivalent workers 2. Total interest expenses/total interest borrowed funds	1.Equity Capital
Kamberoglu, Liapis, Simigiannis and Tzamourani (2004)	Intermediation approach	1. Loans 2.Other income (fees) 3.Securities	1.Labor 2.Physical Capital 3.Loanable funds	1. Personnel expenses/ total number of employees 2.Depreciation/ fixed assets 3.Interest expenses/ Total value of deposits and repos	1.Equity Capital
Carvallo and Kasman (2005)	Value-added approach	1.Loans 2.Deposits 3.Other earning assets	1.Labor 2.Physical Capital 3.Funds	1.Personnel expenses/ total assets 2.Operating costs net of personnel expenses/ total assets 3.Total interest expenses/ total deposits	1.Equity to total assets
Fries and Taci (2005)	Intermediation approach	1.Loans to customers 2. Deposits	1.Labor 2.Physical Capital	Total non-interest expenses/ total assets (price for labor and physical capital)	1.Equity to total assets
Staikouras et al. (2006)	Intermediation approach	1.Loans 2.Other earning assets	1.Labor 2.Borrowed funds	1.Operating expenses/ assets 2.Interest paid on funds	1.Level of equity

Berger and Humphrey (1997) pointed out that, although there is no 'perfect approach', the *intermediation approach* may be more appropriate for evaluating entire financial institutions because this approach is inclusive of interest expenses, which often account for one-half to two-thirds of total costs. Moreover, the *intermediation approach* may be superior for evaluating the importance of frontier efficiency to the profitability of financial institutions, since the minimization of total costs, not just production costs, is needed to maximize profits.

For the definition of inputs and outputs in the stochastic frontier model, we adopt the intermediation approach proposed by Sealey and Lindley (1977), which is preferred in many studies, because it captures the varied nature of modern banking firms. We specify two outputs: loans, and other earning assets. The latter comprise of investment assets (i.e. marketable securities, as stocks and bonds, and participating interests in other firms) and other assets (claims on credit institutions and treasury bills). Labor and total funds are the input variables, whereas the costs associated with those inputs are total personnel expenses and total interest on funds, respectively. The price of funds is computed by dividing total interest expenses by the total amount of funds, while the price of labor is defined as the ratio of personnel expenses to total assets.[63] Total cost is defined as the sum of interest expenses, fee expenses, commission expenses, and operational expenses (administrative expenses, depreciation and other expenses). In the case of the profit function, the dependent variable is defined as profit before taxes. We, also, specify physical capital and equity as fixed netputs. The treatment of physical capital as a fixed input is relatively standard in efficiency estimation (Berger and Mester, 1997).

Physical capital is defined as fixed assets, including tangible fixed assets (land, lots, buildings and installations, furniture, office equipment, etc., less depreciation), as well as intangible fixed assets (goodwill, software, restructuring expenses, research and development expenses, minority interests, formation expenses, underwriting expenses, etc). Moreover, following Hughes and Mester (1993) and Mester (1996) the level of equity capital is included so as to account for different risk preferences[64] and to control for bank's insolvency risk, which affects bank cost and profit via the risk

[63] Following Altunbas et al. (2000), the price of labor is measured by the ratio of personnel expenses to total assets, as data on the number of employees are not available for the whole period.

[64] Hughes, Lang, Mester, and Moon (1995, 1996) and Hughes and Moon (1995) provide evidence against risk neutrality in the banking industry.

premium the bank pays for uninsured debt, and through the intensity of risk management activities the bank undertakes (Berger and Mester, 1997). If managers from one bank are more risk-averse than the managers from other banks, they can hold a higher level of equity than the cost-minimizing level. Consequently, by omitting the level of equity, we may consider a bank as inefficient even if it behaves optimally, given the risk preferences of its managers. The cost and alternative profit efficiency concepts take as given that banks are risk neutral. If, for instance, bank managers of foreign-owned banks were more risk-averse than the managers of domestic-owned banks, their performance would be underestimated if equity were not controlled in the cost efficiency model. Hughes, Lang, Mester, and Moon (1995, 1996) and Hughes and Moon (1995) tested and rejected the assumption of risk neutrality for banks. We therefore include the level of equity to take the differences in risk preferences into account. Berger and Mester (1997), provide another reason to include the level of equity in the estimation of the cost and profit efficiency model. This reason is based upon the fact that equity constitutes an alternative funding source for loans for banks. Even if deposits imply financial costs while equity does not, raising equity involves higher costs than raising deposits. As a result, omitting equity may favor the banks that rely more on equity for the funding of loans if equity is more costly than deposits.

The table 4.10, below, summarizes the variables used in the estimation of the cost and profit function, in the case we use the **Stochastic Frontier Approach** (SFA), to measure cost and profit inefficiency:

Table 4.10 (SFA)

Variables used in the cost and profit function

Variable		Description
Total cost	TC	financial + operational expenses (interest expenses + fees + commissions) + (personnel expenses + administrative expenses + depreciation + other expenses)
Total profit	Alt-Pr	profit before taxes
Outputs		
Loans	Y_1	total gross loans (short-term and long-term loans & advances to industry and customers)
Other earning assets	Y_2	investment assets + other assets (marketable securities + participating interests in other firms) + (claims on credit institutions + treasury bills)
Inputs		
Labour	X_1	total assets as a proxy of the number of employees
Funds	X_2	total borrowed funds (bank bonds and sight, saving, time and restricted deposits of the private and the public sector)
Input prices		
Price of labour	P_1	personnel expenses / total assets
Price of funds	P_2	interest expenses / total funds
Netputs		
Equity	Z_1	controls for the level of equity
Physical capital	Z_2	controls for the physical capital
Time trend	t	controls for the differences across years

For the definition of inputs and outputs in the DEA (Data Envelopment Analysis) model, following the modern empirical literature [see, among others, Molyneux *et al.* (1996); Mester (1996)], we use the *intermediation approach*, likewise the SFA methodology. Under the non-parametric approach which will be implemented in our empirical analysis, increasing the number of variables reduces the number of technically inefficient observations [see Coelli et al. (1998)]. Therefore, in order to minimize this possible drawback of the methodology, we restricted our choice of variables to a three-input, two-output model. We specify two outputs: Y1= total loans, Y2 = other earning assets; and three inputs variables: X1 = labor, X_2 = total funds and X_3 = physical capital. As above, in the SFA method, total cost is defined as the sum of interest expenses, fee expenses, commission expenses, and operational expenses (administrative expenses, depreciation and other expenses the price of funds is computed by dividing total interest expenses by the total amount of

funds, while the price of labor is defined as the ratio of personnel expenses to total assets. Finally, the price of physical capital is calculated by dividing other operational expenses (administrative expenses + depreciation + other expenses) by the total amount of fixed assets. In order to compare the efficiency estimations, which resulted by the parametric (SFA) and non-parametric methodology, it is appropriate to employ a second approach of the stochastic frontier approach method with the latter structure of the variables (inputs and outputs), to measure cost inefficiency.

Given these considerations, the variables selected to conduct the cost efficiency analysis, using both SFA and DEA methodology, are the following:

Table 4.11 (SFA and DEA)

Variables used in the cost efficiency analysis

Variable		**Description**
Total cost	TC	financial + operational expenses (interest expenses + fees + commissions) + (personnel expenses + administrative expenses + depreciation + other expenses)
Outputs		
Loans	Y_1	total gross loans (short-term and long-term loans & advances to industry and customers)
Other earning assets	Y_2	investment assets + other assets (marketable securities + participating interests in other firms) + (claims on credit institutions + treasury bills)
Inputs		
Labour	X_1	total assets as a proxy of the number of employees
Funds	X_2	total borrowed funds
Physical capital	X_3	total fixed assets
Input prices		
Price of labour	P_1	personnel expenses / total assets
Price of funds	P_2	interest expenses / total funds
Price of physical capital	P_3	other operational expenses/ total fixed assets
Time trend	t	controls for the differences across years

Consequently, the choice of input and output variables would necessarily depend on the nature and the thrust areas of banking in the country concerned as the role played by the banking system is dictated by the needs of the society and the state of the economy and the expectations of the Governments. The choice of the input-output variables in the present study is primarily guided by these considerations.

4.3 The efficiency correlates

In the first stage common parameters were estimated to explain differences in cost and profit inefficiency associated with input prices, output quantities and bank-specific variables. The unexplained portions of differences in inefficiency across banks were attributed to core cost inefficiency. At a second stage, to explain inefficiency differences across banks, some authors regress inefficiency estimates on several independent variables.[65] We therefore regress the X-inefficiency values against various firm-specific characteristics. The second stage regression assumes the following specification:[66]

$$\text{Ln Cost Inefficiency}_{it} = \alpha + \beta \ln IV_{it} + \varepsilon_{it}$$

$$\text{Ln Alternative Profit Inefficiency}_{it} = \alpha + \beta \ln IV_{it} + \varepsilon_{it}$$

where CI_{it} are the cost inefficiencies of the ith bank in period t obtained in the first stage of the analysis. IV_{it} is the set of the independent variables included in the model.

Some econometric issues make such analyses suggestive but not conclusive. First, the dependent variables in the regressions, cost and profit efficiency, is an estimate, but the standard error of this estimate is not accounted for in the subsequent regression or correlation analysis. Second, none of the variables used in the regression is completely exogenous, and the endogeneity of any regressor can bias the coefficient estimates on all the regressors. Endogeneity makes the conclusions about causations problematic. As an alternative to reggression analysis, simple correlations are provided in some papers to underscore the fact that causation may run in both directions. The potential correlates used in the second stage regressions also vary substantially across studies.

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[65] We should note, though, that this analysis has some drawbacks, such as the possible endogeneity of most of the regressors, which can bias the coefficient estimates on all the regressors, and the fact that the dependent variable is an estimate, but its standard error is not accounted for in the regression analysis. See Berger and Mester (1997) for a more detailed analysis.

[66] The regressions are usually linear, but Mester (1993, 1996) used the logistic functional form, as the stochastic frontier inefficiency estimates varied between zero and one.

In this study, the independent variables included in the model are defined as follows. The firm-characteristics used in the regressions are: performance (ROA = net income before taxes/total assets), portfolio composition and funding mix respectively (TL/TA = total loans/total assets and DEP/TA = bank deposits/total funds); and size (lnTA = the natural logarithm of total assets). Other independent variables are: cash to assets, which measures liquidity risk of the banks, PLL/L = provision for loan losses/total loans, which is included to account for output quality, the equity to assets ratio to capture the financial capital ratio, the equity to assets ratio (E/A), which measures banks' capitalization and the Herfindahl Index, which captures the concentration of the banking system.

CHAPTER 5

METHODOLOGIES

5.1 "Methodological Crosschecking"

The reason for calculating (in) efficiency scores is to assess the relative performance of economic agents, information that can then be used by decision makers (e.g., the agents themselves, managers, shareholders, regulators, etc.). If the efficiency scores are to be useful to decision makers, then they must be "informative" or "valuable." Bauer et al. (1998) proposes six consistency conditions that efficiency measures would ideally meet if they are to be "useful" to decision makers. Many methods are available to estimate inefficiencies, and these methods often yield widely disparate results. To date there have been few attempts to link alternative measures of inefficiencies to other performance measures or to determine the relative "informativeness" of the scores produced by alternative frontier methods.[67] Given the large-scale changes in banking markets and banking regulations that have occurred during the past decade (see Berger, Kashyap, and Scalise 1995), the usefulness of efficiency scores in the banking industry is especially interesting. One set of methods is based on econometric techniques and involves the estimation of an economic function (e.g., production or cost) and the derivation of efficiency scores from either the residuals or dummy variables. A second approach involves solving linear programs in which an objective function envelops the observed data; efficiency scores are derived by measuring how far an observation lies from the "envelope" or frontier.

The rationale for using two different methods is twofold. First, there is the opportunity to examine the robustness of our findings. Charnes, Cooper, and Sueyoshi (1988) advocate the use of "methodological crosschecking" whenever important policy decisions are to be based on results that may depend upon the methodology selected to perform the study. Second, you can examine the relative informativeness

[67] Exceptions include Siems (1992), Barr, Seiford, and Siems (1994), Wheelock and Wilson (1995) and Bauer, et al. (1998).

of the efficiency scores obtained using the stochastic and programming methodologies. One need not choose one method over the other; rather, both methods could be used, at relatively low cost, to obtain information about performance. The relevant question is not which is the "better" method but how to weight the information the alternative approaches provide.

As a result, one basic reason for using more than one approach to derive efficiency measures is based on the fact that efficiency scores are used for a variety of purposes. It is important to know how informative efficiency scores are prior to using them in decision making. To the extent that the efficiency scores from different techniques contain different information, multiple sets of efficiency scores might be used as the basis for decision making. The efficiency scores derived from different methods could be assigned different weights based on how much information they convey to the decision maker. This possibility is the basic idea of the informativeness principle. As noted by Bauer et al. (1998), efficiency scores that meet certain consistency conditions are likely to be more useful to decision makers than scores that do not. Among the factors they discuss are the consistencies of efficiency scores with market conditions and traditional measures of firm performance. It could be argued that efficiency scores that satisfy these consistency conditions are more "informative" than those that do not. After deriving and examining the inefficiencies themselves, their informativeness will be investigated by examining the relationship between the inefficiency scores and other measures of bank performance.

To examine efficiency over time and its potential usefulness to decision makers, we estimate the X-efficiencies of a sample of 28 Greek banks over the period 1993 to 2005 using two very different methods—the stochastic frontier approach (SFA) with a composed error term (Aigner, Lovell, and Schmidt 1977) and a linear programming cost frontier (DEA) (Färe, Grosskopf, and Lovell 1985). The two approaches differ in many ways, but the essential differences, and the sources of the advantages of one approach or the other, boil down to two characteristics.

1. The econometric approach is stochastic, and so attempts to distinguish the effects of noise from the effects of inefficiency. The programming approach is no stochastic, and lumps noise and inefficiency together and calls the combination inefficiency.
2. The econometric approach is parametric, and confounds the effects of misspecification of functional form (of both technology and

inefficiency) with inefficiency. The programming approach is nonparametric and less prone to this type of specification error.

5.2 Stochastic Frontier Approach (SFA)

5.2.1 Cost and Profit Efficiency Frontier

The literature on frontier production and cost (and profit) functions and the calculation of efficiency measures begins with Farrel (1957). He suggested that we could usefully analyse technical efficiency in terms of realised deviations from an idealized, frontier isoquant. This approach falls naturally into an econometric approach in which the inefficiency is identified with disturbances in a regression model.

In the banking literature, econometric measurement of inefficiency has been undertaken mainly through estimating a cost function.[68] The estimation of a cost function is relatively easy, but it allows an examination of only input inefficiencies, i.e., the cost effects of wrong levels or mixes of inputs. Berger et al. (1995) argued in favor of using a profit function to examine banking inefficiency. They identify three advantages of estimating a profit function over a cost function. First, the profit function allows an examination of output inefficiencies by incorporating the revenue effects of producing incorrect levels or mixes of outputs. Second, when there is unmeasured variance in the quality of an output, higher quality may be erroneously identified as lower efficiency under cost function estimation since more inputs are needed usually to produce the higher quality. The profit function is much less affected by this problem since higher quality brings additional revenues that tend to offset the additional costs. Finally, an identification of technical and allocative inefficiencies on both the input and output sides can be useful in analyzing the effects of mergers and branching regulations since consolidations change the distribution of inputs and outputs toward banks that may be more or less technically efficient and they also change the allocative mixes of inputs and output within the consolidating banks.

On the other hand, the implementation of the profit function approach is rather difficult due to chronic data problems. Since the profit function specifies both inputs

[68] Data envelopment analysis, a nonparametric method, also provides measurements of efficiency.

and outputs, the number of parameters is significantly higher than that for a cost function. Thus, degrees of freedom become a more severe constraint. More importantly, the profit function requires price data for outputs, and this is not very easy to construct. We choose to use the cost and profit function approach.

Cost efficiency gives a measure of how close a bank's cost is to what a best practice bank's cost would be for producing the same output bundle under the same conditions. Alternative profit efficiency here is measured by how close a bank comes to earning maximum profits given its output levels rather than its output prices. The efficient frontier is determined by two conditions, technical efficiency (minimum use of inputs) and allocative efficiency (optimal mix of inputs given relative factor prices). The absence of either technical or allocative efficiency (or both) necessarily leads to a departure from cost minimization or profit maximization and creates inefficiency. Berger and Mester (1997) argue that nonparametric methods could take into account technical inefficiency, but due to the exclusion of input and output prices, they are not capable of disentangling allocative inefficiency. But since cost or profit functions are not known or directly observable, inefficiencies must be measured relative to an efficient cost or profit frontier that is estimated from data. Therefore, the measurement of inefficiency is based on deviations from the minimal costs (or maximum profits) observed in the data rather than from a technologically feasible efficient frontier. Bank cost inefficiency is defined as the difference between observed costs and predicted minimum costs for a given scale and mix of outputs, factor prices and other country-level variables. Respectively, bank profit inefficiency is defined as the difference between observed profits and predicted maximum profits for a given scale and mix of outputs, factor prices and other country-level variables. In other words, each bank in the sample is benchmarked against the "best" bank in the sample.

5.2.2 The cost and profit function

The SFA, as developed by Aigner et al. (1977) and applied to banks by Ferrier and Lovell (1990),[69] specifies a particular form for the cost function, usually a translog form, and allows for random errors. It assumes that these errors consist of

[69] Recent econometric developments are summarized in Kumbhakar and Lovell (2000) and Kumbhakar et al. (2001); Berger and Mester (1997) discuss applications to banking.

inefficiencies, which follow an asymmetric distribution, usually a truncated or half normal distribution, and random errors that follow a symmetric distribution, usually the standard normal distribution. The reason for this particular structure of the composite error term is that, by definition, inefficiencies cannot be negative. Both the inefficiencies and random errors are assumed to be orthogonal to the input prices, outputs and country-level or bank-specific variables specified in the estimating equation. SFA starts with a standard cost function and estimates the minimum cost frontier for the entire sample from balance sheet data. The efficiency measure for a specific bank observation is its distance from the frontier.

The main advantages of stochastic frontier approach, as it has been already discussed, is the allowance for measurement error, and the generation of firm-specific efficiency estimates, which are important for the bank managers to improve their operational efficiency. According to the SFA, total cost assumes the following specification:

$$TC_{it} = f(P_{it}, Y_{it}, Z_{it}) + v_{it} + u_{it} \qquad (1)$$

where TC_{it} denotes observed operating and financial cost for bank i at year t, P is a vector of input prices, Y is a vector of outputs of the firm, and Z stands for a set of control variables (fixed netputs). This approach disentangles the error term in two components.

The first one, v_i, corresponds to the random fluctuations and is assumed to follow a symmetric normal distribution around the frontier ($v_i \sim N(0,\sigma_\varepsilon^2)$) and captures a phenomenon beyond the control of management. The second one, u_i, accounts for the firm's inefficiency - e.g. factors that affect technical or allocative efficiency, which could de controlled by management – and is assumed to follow a truncated normal distribution.[70] The stochastic frontier approach assumes that the inefficiency component of the error term is positive; that is, higher bank inefficiency is associated with higher cost.

[70] The rationale is that inefficiency cannot diminish cost and thus must have an asymmetric distribution, whereas random error can add or subtract cost and then have a symmetric distribution.

The stochastic cost frontier methodology, based on a translog cost function.[71] , is adopted to calculate cost efficiency scores for the 28 banks in our sample. To this end, we employ the following flexible translog transformation of the underlying cost function: [72]

$$\ln TC = \alpha_{i0} + \sum_i \alpha_i \ln P_i + \sum_i \beta_i \ln Y_i + \tfrac{1}{2} \sum_i \sum_j \alpha_{ij} \ln P_i \ln P_j + \tfrac{1}{2} \sum_i \sum_j \beta_{ij} \ln Y_i \ln Y_j + \sum_i \sum_j \delta_{ij} \ln P_i \ln Y_j + \sum_i \phi_i \ln Z_i + 1/2 \sum_i \sum_j \phi_{ij} \ln Z_i \ln Z_j + \sum_i \sum_j \eta_{ij} \ln Z_i \ln Y_j + \sum_i \lambda_{ij} \ln Z_i \ln P_j + vT + u_i + \varepsilon_i \quad (2)$$

where TC is variable costs, P is a vector of input prices, Y is a vector of variable outputs, Z is a vector of fixed netputs. All variables are expressed in natural logs. T is a time trend, which is assumed to be closely related to technical progress and thus is included in the equation to control for the effects of technical progress on bank costs.[73] To ensure that the estimated cost frontier is well behaved, standard homogeneity and symmetry restrictions are imposed, thus $\alpha_{im} = \alpha_{mi}$ and $\alpha_{jk} = \alpha_{kj}$, $\forall i, j, k, m$, u is bank-specific inefficiency, assumed to be half-normally distributed u~iid $N^{+}(\mu,\sigma^2_u)$, and ε is the random error assumed to be independently and identically distributed according to standard normal distribution, $N(0,\sigma^2_\varepsilon)$.

We also employ an alternative profit function specification that follows similar specification as above, whilst the dependent variable is defined as:

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[71] We prefer the translog specification compared with the alternative Fourier-flexible functional form, since the latter application requires additional truncations of data (Hasan and Marton, 2003). Moreover, Berger and Mester (1997) report that mean efficiency estimates between the two procedures is very small.

[72] Some papers (Mitchell and Onruval, 1996; Berger et al., 1997a; DeYoung and Hasan, 1998) have found that the Fourier-flexible form, that combines a standard translog functional form with the nonparametric Fourier functional form, provide a better fit. Berger and Mester (1997) however report that means efficiency estimates between the two procedures was very small. Moreover, Fourier application requires additional truncations of data and given the limitation of our sample (244 observations), we estimate a translog function.

[73] Because of sample size limitations, the time trend indicator t is not specified to interact with the outputs Yi and input prices Pj variables. Accordingly, only the impact of the neutral technical change on the cost function is considered in the paper, whereas the relevant impact, if any, of the non-neutral technical change is not identified.

$$\ln(\pi+\theta+1), \qquad (3)$$

where θ indicates the absolute value of the minimum value of profit (π) over all banks in the sample and is added to every firm's dependent variable in the profit function. This transformation allows us to take natural log of profits, given that they can take negative values. Also for measuring the efficiency under the profit function the composite error term is now defined as $\varepsilon_i - u_i$.

The general procedure for estimating cost inefficiency from Equation (2) is to estimate equation coefficients and the error term $v_i = u_i + \varepsilon_i$, and to calculate efficiency for each observation in the sample. The cost frontier can be approximated by maximum likelihood, and efficiency levels are estimated using the regression errors. Jondrow et al. (1982) show that the variability, σ, can be used to measure a firm's mean efficiency, where $\sigma^2 = \sigma_u^2 + \sigma_\varepsilon^2$. Bank-specific estimates of inefficiency terms can be calculated by using the distribution of the inefficiency term conditional to the estimate of the composite error term.

A formal definition of bank-specific relative cost and profit inefficiency is given as:

$$C-eff. = \frac{\exp(f(P,Y,Z))\exp(\ln(u^c_{\min}))}{\exp(f(P,Y,Z))\exp(\ln u^c_i)} = \frac{u^c_{\min}}{u^c_i} \qquad (4)$$

$$Alt-\Pr-eff. = \frac{\{\exp[\hat{f}(P,Y,Z)] \times \exp[\ln \hat{u}_{a\pi}]\}-\theta}{\{\exp[\hat{f}(P,Y,Z)] \times \exp[\ln \hat{u}^{\max}_{a\pi}]\}-\theta} \qquad (5)$$

where u_i is the average regression residual for bank i and u^c_{min} is the smallest value for all banks, i.e., the ''best cost-practice'' bank, equation 4. In the case of the alternative profit function, equation 5, $\hat{u}^{\max}_{a\pi}$ is the largest value for all banks, i.e., the "best profit practice". Thus, each bank is benchmarked against the ''best'' bank in the sample.

5.3 Data Envelopment Analysis (DEA)

5.3.1 Methodological issues

DEA is a linear programming formulation that defines a nonparametric relationship between multiple outputs and multiple inputs (Charnes et al., 1978). It basically identifies an efficient frontier, which consists of the most efficient decision making units (DMUs) such as banks. Efficient banks are those for which no other banks or linear combination of banks can generate at least the same amount of each output (given inputs). Readers interested in details of DEA frontier estimation methodology are encouraged to consult the works done by Charnes et al. (1994), Chebat et al. (1994), and Seiford and Zhu (1999).

Data Envelopment Analysis (DEA) is a mathematical programming approach for the construction of production frontiers and the measurement of efficiency relative to the constructed frontiers. DEA is based on a concept of efficiency very similar to the microeconomic one; the main difference is that the DEA production frontier is not determined by some specific functional form, as discussed above, but it is generated from the actual data for the evaluated firms. In other words, the DEA frontier is formed as the piecewise linear combination that connects the set of 'best-practice observations' in the data set under analysis, yielding a convex Production Possibility Set (PPS). As a consequence, the DEA efficiency score for a specific Decision-Making Unit (DMU) is not defined by an absolute standard, but it is defined relative to the other DMUs in the specific data set under consideration. This benchmark is a linear combination of banks included in the sample. Intuitively, an efficiency score of 0.6 indicates that if bank under review were producing on the frontier instead of at its current location, it would require only 60% of current inputs to produce the same level of output. This feature differentiates DEA from the parametric approaches, which require a specific pre-specified functional form of the modeled production or cost function.

Each bank is evaluated against a hypothetical bank with an identical output mix that is constructed as a combination of efficient banks. DEA identifies the most efficient banks in a population and provides a measure of inefficiency for all others. The most efficient banks are rated to have an efficiency score of one, while the less efficient institutions score between zero and one. Though DEA does not give a

measure of optimal efficiency, it however differentiates the least efficient banks from the set of all banks. Thus, the efficient institutions calculated using DEA establish the best practice frontier" (Siems and Thomas, 1992). Brown and Gardner (1995), in their exploratory analysis of European banking strategies, have used the DEA approach to provide another relative efficiency measure which is also referred to as "competitive advantage" or "cost/revenue efficiency". A well-known advantage of DEA is that there is no need to specify a particular functional form for the production frontier, while the drawback of a non-parametric deterministic method is to assume that there is no random error. Deterministic models do not distinguish between inefficiency and random noise, assuming that all deviations from the estimated frontier represent inefficiency.

In their original paper, Charnes, Cooper and Rhodes (1978) proposed a model that had an input orientation and assumed constant returns to scale (CRS). Later studies have considered alternative sets of assumptions. The assumption of variable returns to scale (VRS) was first introduced by Banker, Charnes and Cooper (1984). The CRS assumption is only appropriate when all DMUs are operating at an optimal scale. However, factors like imperfect competition and constraints on finance may cause a DMU not to be operating at optimal scale. As a result, the use of the CRS specification when some DMUs are not operating at optimal scale will result in measures of technical efficiency (TE) which are confounded by scale efficiencies (SE). The VRS specification has been the most commonly used specification in the 1990's [see Coelli et al. (1998)]. For the above reasons, we employ the DEA method assuming variable returns to scale (VRS).[74]

In the input-orientated models, the DEA method seeks to identify technical inefficiency as a proportional reduction in input usage. It is also possible to measure technical inefficiency as a proportional increase in output production. These two measures provide the same value under CRS, but do not equate when VRS is assumed. The choice of orientation has both practical and theoretical implications.[75] Many studies have tended to select input-orientated measures because the input

[74] In applying DEA, we followed procedures outlined in Fare, Grosskopf, and Lovell (1994). Variable returns to scale were permitted through use of a side summation restriction in the linear programming.

[75] In some applications, the choice of the orientation is clear; for example, in industries where the emphasis is on cost-control, the 'natural' choice would be an input-orientation [Ferrier and Valdmanis (1996)].

quantities appear to be the primary decision variables, although this argument may not be valid in all industries. However, some research has pointed out that restricting attention to a particular orientation may neglect major sources of technical efficiency in the other direction [Berger et al. (1993)]. To date, the theoretical literature is inconclusive as to the best choice among the alternative orientations of measurement. It is necessary to point out that output- and input-orientated models will estimate exactly the same frontier and, therefore, by definition, identify the same set of efficient DMUs. It is only the efficiency measures associated with the inefficient DMUs that may differ between the two methods. In our survey, we evaluate cost inefficiency as a proportional reduction in input usage (input-orientation).

Although the basic DEA models (CRS and VRS) have been improved in a number of ways in recent years [see Lovell (1993) and Seiford (1996)], one of the main criticisms faced by researchers using non-parametric methods is the difficulty of drawing statistical inference. The more recent literature, however, has been fairly successful in finding ways to overcome this problem [see Grosskopf (1996)]. One of the first tools employed to this end was regression analysis. The basic idea of what has become known as the "Two-Step" procedure is to treat the efficiency scores as data or indices and use linear regression to explain the variation of these efficiency scores. The first improvement to this model has come with the attempt to account for the fact that efficiency scores are censored [Lovell, Walters and Wood (1995)]; as a result, a model that accounted for the fact that the dependent variable was limited became preferred to OLS. Another criticism that is sometimes leveled against this approach is that it only considers radial inefficiency and ignores the slacks. A possible solution to this has been proposed by Fried, Schmidt and Yaisawarng (1995) and involves estimating a SUR (Seemingly Unrelated Regression) system of equations for the slacks. Bhattacharyya et al. (1997) pointed out that when employing regression analysis in the second step to explain the variation of the efficiency scores, it is likely that the included explanatory variables fail to explain the entire variation in the calculated efficiencies and the unexplained variation mixes with the regression residuals, adversely affecting statistical inference. They propose the use of a stochastic frontier regression model, which allows for the decomposition of the variation of the calculated efficiencies into a systematic component and a random component.

5.3.2 Envelopment Model with Variable Returns to Scale (VRS)

The following DEA model is an input-oriented model where the inputs are minimized and the outputs are kept at the current levels.

$\theta^* = \min \theta$

subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io} \qquad i = 1,2,\ldots,m;$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad r = 1,2,\ldots,s;$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0 \qquad j = 1,2,\ldots,n.$$

where DMU_0 represents one of the n DMUs under evaluation, and x_{io} and y_{ro} are the ith input and rth output for DMU_0, respectively.

Since $\theta = 1$ is a feasible solution to (1.2), the optimal value to (1.2), $\theta^* \leq 1$. If $\theta^* = 1$, then the current input levels cannot be reduced (proportionally), indicating that DMU_0 is on the frontier. Otherwise, if $\theta^* < 1$, then DMU_0 is dominated by the frontier. θ^* represents the (input-oriented) efficiency score of DMU_0.

Consider a simple numerical example, where we have five DMUs. Within a week, each DMU generates the same profit of 2,000 euro with a different combination of cost and response time, as shown in table below:

DMU	Cost	Response time	Profit
1	1	5	2
2	2	2	2
3	4	1	2
4	6	1	2
5	4	4	2

Chart 5.1, below, presents the five DMUs and the piecewise linear frontier, DMUs 1, 2, 3 and 4 are on the frontier. If we calculate model (1.2) for DMU5, we obtain a set of unique optimal solutions of $\theta^* = 0.5$, $\lambda_2^* = 1$ and $\lambda_j^* = 0$ ($j \neq 2$), indicating that DMU2 is the benchmark for DMU5, and DMU5 should reduce its cost and response time to the amounts used by DMU2.

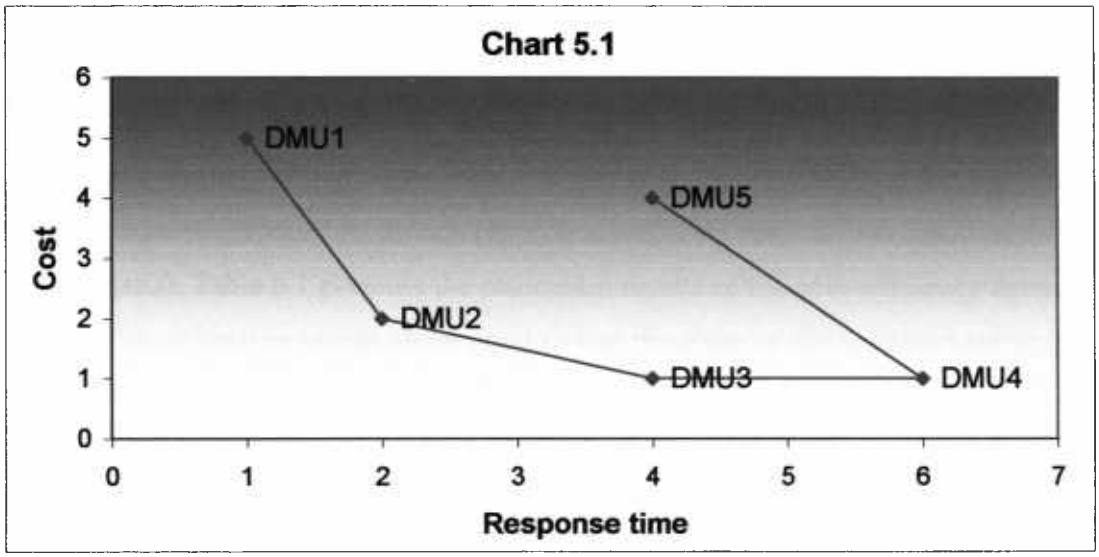


Chart 5.1: Five DMU

CHAPTER 6

EMPIRICAL RESULTS

6.1 Stochastic Frontier Approach (SFA) – Approach with two outputs, two inputs and two netputs

6.1.1 Cost and alternative profit estimates

In this section, we report the empirical findings of cost efficiency frontier based on the Stochastic Frontier Approach (approach with two outputs, two inputs and two fixed netputs). Table 6.1 presents the estimation results of the cost efficiency frontier. Overall, the estimation results show good fit and the signs of the variables are in line with the theory.

Regarding the estimations of the cost function parameters, the coefficients of both the input prices and the outputs are statistically significant. In particular, the coefficient estimate of the price of labour is positive and statistically significant at the 5 per cent level of significance, insinuating that a 1% increase in personnel expenses will raise total cost by 0.57%. Moreover, the coefficient of the price of funds is also positive and statistically significant at the 10 per cent level of significance, indicating that a 1% increase in interest expenses will lead total cost in an increase of 0.43%. With respect to the elasticity of total cost to the two outputs, the estimated coefficient of the total loans is positive and statistically significant at the 5 per cent level of significance, while estimated coefficient of the other earning assets is negative and statistically significant at the 10 per cent level of significance. The latter result is an important caveat, since the expenses associated with the credit origination and loan monitoring are quite substantial, increasing bank's total costs. The coefficient on the cross-output term between loans and other earning assets is negative as expected, but not statistically significant, while the same applies for the cross-price term.

Finally, as regards the elasticity of total costs to the two netputs, the coefficient estimates are around 0.7% .In particular, the coefficient estimates of the level of equity (fixed netput Z_1) and physical capital are positive and statistically significant at the 1 per cent level of significance. By this way, equity is proved to be an expensive source of funding, since an increase in the equity capital of one percentage point is

associated with a corresponding increase in costs of 0.74%. Fixed assets remain costly to handle as expected, as they involve not only depreciation but also additional expenses for maintenance and repairing.

Table 6.1

Parameter estimates-Cost inefficiency

Variable	Coefficient	St.Err.	z-statistic	P-value
Ln(p1)	0.5679868**	0.2345756	2.42	0.015
Ln(p2)	0.4320132*	0.2345756	1.84	0.066
Ln(y1)	0.5170141**	0.2551618	2.03	0.043
Ln(y2)	-0.3173889*	0.1910122	-1.66	0.097
Ln(p1²)	0.0202771	0.0498592	0.41	0.684
Ln(p2²)	0.0202771	0.0498592	0.41	0.684
Ln(p1)ln(p2)	-0.0202771	0.0498592	-0.41	0.684
Ln(y1²)	0.0748872*	0.0425953	1.76	0.079
Ln(y2²)	0.2453575***	0.039596	6.20	0.000
Ln(y1)ln(y2)	-0.0225305	0.036904	-0.61	0.542
Ln(y1)ln(p1)	0.0896127**	0.0361226	2.48	0.013
Ln(y1)ln(p2)	-0.0896127**	0.0361226	-2.48	0.013
Ln(y2)ln(p1)	-0.0391479	0.0393551	-0.99	0.320
Ln(y2)ln(p2)	0.0391479	0.0393551	0.99	0.320
Ln(z1)	0.7445166***	0.2708212	2.75	0.006
Ln(z2)	0.6634287***	0.2336898	2.84	0.005
Ln(z1²)	-0.0563975	0.0343766	-1.64	0.101
Ln(z2²)	0.0097862	0.057491	0.17	0.865
Ln(z1)ln(z2)	0.1275471***	0.0454263	2.81	0.005
Ln(y1)ln(z1)	-0.0786488**	0.0366174	-2.15	0.032
Ln(y1)ln(z2)	0.0263659	0.0425664	0.62	0.536
Ln(y2)ln(z1)	-0.0225157	0.0427574	-0.53	0.598
Ln(y2)ln(z2)	-0.1954895***	0.0371962	-5.26	0.000
Ln(p1)ln(z1)	0.0088239	0.0476299	0.19	0.853
Ln(p1)ln(z2)	-0.0894916**	0.0381851	-2.34	0.019
Ln(p2)ln(z1)	-0.0088239	0.0476299	-0.19	0.853
Ln(p2)ln(z2)	0.0894916**	0.0381851	2.34	0.019
Time trend	-0.0015568	0.0032556	-0.48	0.633
Constant	-5.353706***	100.937	-5.30	0.000

Number of observations: 244
Log likelihood function: 75.54992
Wald $x^2(21)=15634.12$
Prob> $x^2=0.00000$

Variances: $\sigma^2(v)=0.015791$
$\sigma^2(u)= 0.045449$
$\sigma(v) = 0.126605$
$\sigma(u) = 0.2131869$
$\sigma=[(\sigma^2(u)+\sigma^2(v)]=0.0612392$
$\lambda= \sigma(u)/ \sigma(v)=1.696656$

Note: The table reports the estimated coefficients of Equation (2). The dependent variable is the natural log of total cost. P_1 stands for the price of labour, P_2 is the price of funds, Y_1 stands for total loans, and Y_2 for other earning assets, Z1 stands for equity, and Z_2 is physical capital. ***, ** and * indicate 1 per cent, 5 per cent, and 10 per cent significance levels, respectively.

At this point, we report the empirical findings of profit inefficiency based on the Stochastic Frontier Approach. Table 6.2 presents the estimation results of the profit efficiency frontier. Overall, as above, the estimation results show good fit and the signs of the variables are in line with the theory.

Regarding the profit inefficiency results, the coefficient estimate of the price of funds is positive and statistically significant at the 10 per cent level of significance, insinuating that a 1 per cent increase in interest expenses will raise total cost by 1.6 per cent. On the other hand, the coefficient of the price of labour is not significant. With respect to the elasticity of total cost to the two outputs, the estimated coefficients are both not statistically significant. The coefficient on the cross-output term between loans and other earning assets is positive but not statistically significant, while the cross-price term between price of labour and price of funds is negative but, like the cross output term, not statistically significant. Finally, as regards the elasticity of total costs to the two netputs, the estimated coefficients of equity and physical capital are both not statistically significant.

Table 6.2

Parameter estimates-Profit inefficiency

Variable	Coefficient	St. Err.	z-statistic	P-value
Ln(p1)	-0.601462	0.9452485	-0.64	0.525
Ln(p2)	1.601462*	0.9452485	1.69	0.090
Ln(y1)	-0.1945137	1.047892	-0.19	0.853
Ln(y2)	0.1258757	0.9820709	0.13	0.898
Ln(p1²)	0.0156502	0.2307657	0.07	0.946
Ln(p2²)	0.0156502	0.2307657	0.07	0.946
Ln(p1)ln(p2)	-0.0156502	0.2307657	-0.07	0.946
Ln(y1²)	0.0371777	0.197728	0.19	0.851
Ln(y2²)	-0.0325072	0.1750226	-0.19	0.853
Ln(y1)ln(y2)	0.0977523	0.1719846	0.57	0.570
Ln(y1)ln(p1)	0.0147184	0.1489058	0.10	0.921
Ln(y1)ln(p2)	-0.0147184	0.1489058	-0.10	0.921
Ln(y2)ln(p1)	0.208609	0.1803571	1.16	0.247
Ln(y2)ln(p2)	-0.208609	0.1803571	- 1.16	0.247
Ln(z1)	-0.6830552	1.180994	-0.58	0.563
Ln(z2)	-0.5239498	1.088991	-0.48	0.630
Ln(z1²)	0.0904947	0.1514245	0.60	0.550
Ln(z2²)	0.0153288	0.2571625	0.06	0.952
Ln(z1)ln(z2)	0.1027483	0.193811	0.53	0.596
Ln(y1)ln(z1)	-0.1060854	0.1716956	- 0.62	0.537
Ln(y1)ln(z2)	-0.0200618	0.1748771	-0.11	0.909
Ln(y2)ln(z1)	0.0556816	0.187806	0.30	0.767
Ln(y2)ln(z2)	-0.1164818	0.1725103	- 0.68	0.500
Ln(p1)ln(z1)	0.1906641	0.2086912	0.91	0.361
Ln(p1)ln(z2)	-0.3865835**	0.1674771	-2.31	0.021
Ln(p2)ln(z1)	-0.1906641	0.2086912	- 0.91	0.361
Ln(p2)ln(z2)	0.3865835**	0.1674771	2.31	0.021
Time trend	0.0169125	0.0153657	1.10	0.271
Constant	14.75743***	4.99364	2.96	0.003

Number of observations: 244
Log likelihood function: -292.5189
Wald $x^2(21)$= 226.38
Prob> x^2 =0.00000

Variances: $\sigma^2(v)$=0.591047
$\sigma^2(u)$= 0.0990901
$\sigma(v)$ = 0.76879581
$\sigma(u)$ = 0.3147858
σ=[($\sigma^2(u)$+$\sigma^2(v)$]=0.6901372

Note: The table reports the estimated coefficients of Equation (2). The dependent variable is the natural log of total cost. P_1 stands for the price of labour, P_2 is the price of funds, Y_1 stands for total loans, and Y_2 for other earning assets, Z_1 stands for equity, and Z_2 is physical capital. ***, ** and * indicate 1 per cent, 5 per cent, and 10 per cent significance levels, respectively.

6.1.2 Cost and alternative profit inefficiencies by year and bank

Cost and alternative profit inefficiency scores have been obtained from stochastic translog cost and profit, respectively, functions which include output levels, input prices and fixed netputs. In this section, we report the empirical findings of bank inefficiency averaged for each of the 28 banks in the sample using the panel estimation reported above. We have to notice that we truncated the extreme values from the estimated inefficiencies, in order to avoid biases resulted of estimation errors (according to Maudos et al, 2002). The results report substantial levels of inefficiency in the banking industry. Those high inefficiency values, obtained from both the cost and the alternative profit efficiency function, insinuate that banks do not operate close to the efficient frontier.

In detail, the results show that the average cost inefficiency score is 0.1664, indicating that the average bank in the sample could reduce its cost by 16.6%, if it was to match its performance with the best-practice bank. Comparing the inefficiency scores obtained from the cost and profit estimates, banks in Greece seem to be more efficient in controlling costs than in generating profits, as profit inefficiency scores are far above the levels of cost inefficiency. In particular, we can observe that the average value indicates that banks produce with 0.553 of profit inefficiency, indicating that the average bank in the sample could increase its profits by 55.3% to meet the performance of the best-practice bank.

The observed higher level of profit inefficiency, compared to cost inefficiency is justified by the fairly low intermediation depth compared with other EU countries, and the high demand for financial services. Thus, banks' efforts to expand their activities appear to have absorbed many resources that have only partly paid off over the sample period, leaving profit efficiencies trailing behind cost efficiencies. Moreover, as interest margins have been relatively high, though declining in recent years, and banks earn substantial profits, they face less pressure to further increase profitability, thus shifting their attention to keep their costs under control.

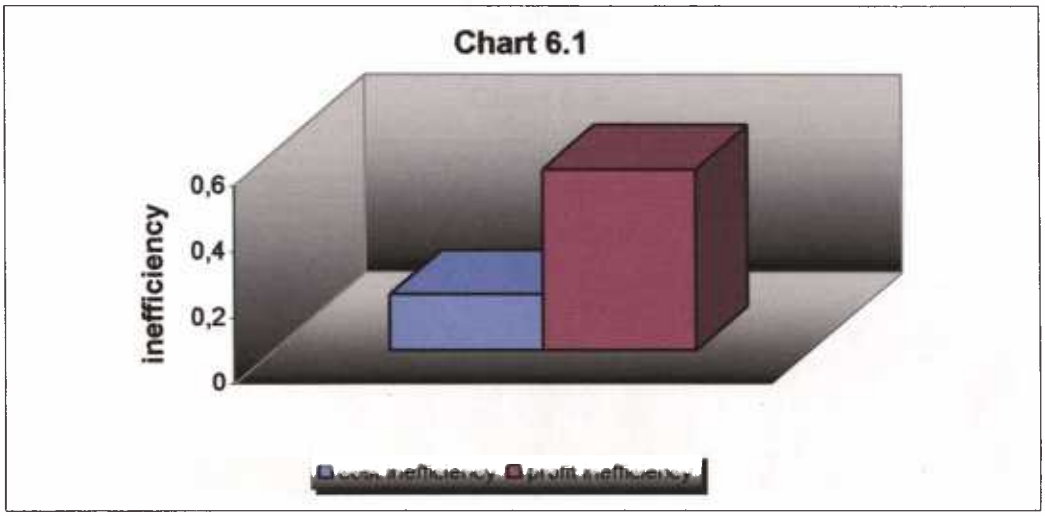


Chart 6.1: Comparison of cost and alternative profit inefficiency.

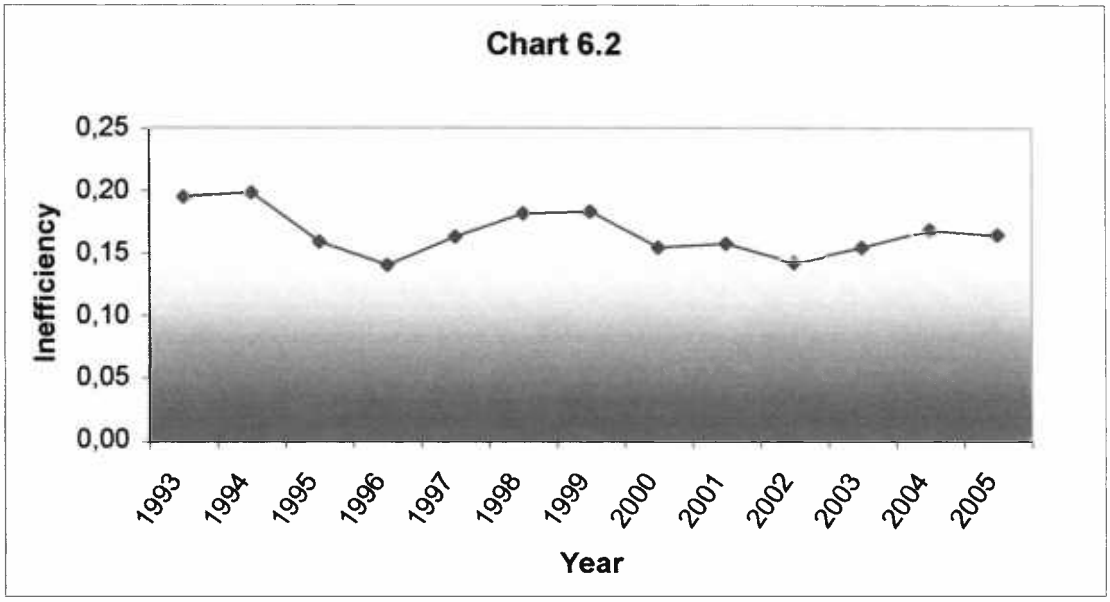
Table 6.3 and the chart 6.2 report cost inefficiency estimates respectively over the period 1993-2005. The table reports the cost inefficiency scores as derived from a common stochastic frontier. It is also reports the mean, minimum, maximum, standard deviation and the number of observations for each year. The results of cost inefficiency scores over the examined period reveal that efficiency levels do not vary considerably, but they indicate an improvement, simultaneously. Cost inefficiency values range from the lowest 0.140 in 1996 to 0.198 in 1998. Finally, the results indicate, as shown in chart 6.2, a fluctuation during the examined period.

Table 6.3

Average Cost Inefficiency Estimates

Year	Mean	Std. Dev.	Min	Max	Obs
1993	0.194	0.113	0.045	0.477	22
1994	0.198	0.140	0.046	0.566	23
1995	0.159	0.077	0.047	0.323	22
1996	0.140	0.064	0.043	0.327	23
1997	0.163	0.145	0.052	0.746	22
1998	0.182	0.124	0.074	0.583	20
1999	0.183	0.106	0.038	0.440	18
2000	0.155	0.083	0.056	0.383	14
2001	0.158	0.085	0.033	0.385	14
2002	0.143	0.070	0.076	0.378	17
2003	0.155	0.067	0.082	0.374	17
2004	0.169	0.063	0.104	0.318	16
2005	0.165	0.084	0.053	0.366	16
Period 1993-2005	0,164	0,094	0.033	0.746	244

Chart 6.2 helps us to observe the existing fluctuation during the period 1993-2005.



We observe that cost inefficiency declined from 19.4% in 1993 to 14% in 1996, while it increased to 18.3% in 1999 and fell to 16.5% in 2005. The beginning of the examination period coincides with the acceleration of liberalization of interest rates and the deregulation of the Greek financial system, which started in the mid-1980s, and consequently the decline in cost inefficiency from its highest values, 19.5% in 1993 and 19.8% in 1994, was reasonable. After the abolition of the requirement on commercial banks to invest part of their deposits in Treasury bills and of the administratively determined minimum interest rate on saving deposits, banks were in a position to allocate their liquid assets and determine their lending and deposit rates freely. At the same time, after the almost complete deregulation of the credit system, banks obtained the option to extend credit to almost every branch or sector of activity at freely negotiable interest rates and on their own terms. Reflecting on our mind the opportunities that the new regulation system provided, we conclude that the downward trend of inefficiency score was absolutely justified. The increase which follows is also sensible because of the conditions in stock market in 1999. Since 1997, major reforms and new institutions were introduced, that expanded credit institutions' field of activity and strengthened competition. Responding to the new global conditions, Greek commercial banks moved towards the required structure, by entering into a series of mergers and acquisitions or into remarkable strategic alliances. As an important consequence of the necessary investments in infrastructure

upgrades, the average cost inefficiency began an upward trend reaching in 1999 the level of 0.183. More recently, inefficiency has returned to more "normal" levels and indications of a long- term stable trend are evident from 2000, with average inefficiency ranging from 0.143 in 2002 to 0.169 in 2004.

The results of cost and alternative profit inefficiency scores across banks reveal that efficiency levels do not vary considerably. Table 6.4 reports cost inefficiency estimates for each bank, over the period 1993-2005. It is also reports the mean, minimum, maximum, standard deviation and the number of observations for each bank, as well as for the whole banking system.

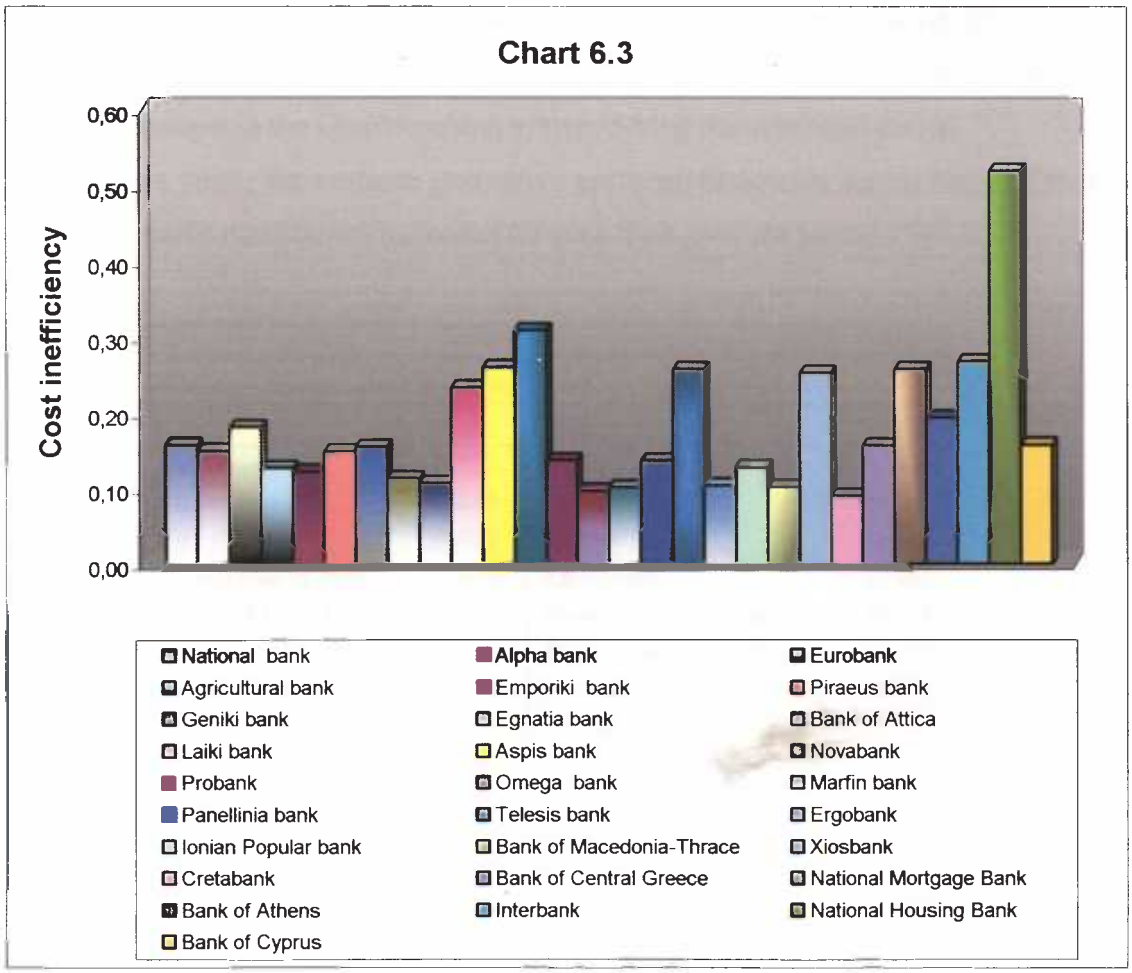
Table 6.4

Average Alternative Profit Inefficiency Estimates

Bank Name	Year	Mean	Std. Dev.	Min	Max	Obs
National Bank	1993-2005	13	0,158	0,040	0,097	0,221
Alpha Bank	1993-2005	13	0,151	0,052	0,053	0,281
Eurobank	1993-2005	13	0,181	0,043	0,087	0,252
Agricultural Bank	1993-2005	13	0,127	0,045	0,082	0,244
Emporiki Bank	1993-2005	13	0,123	0,046	0,077	0,222
Piraeus Bank	1993-2005	13	0,150	0,041	0,087	0,240
Geniki Bank	1993-2005	13	0,156	0,032	0,116	0,223
Egnatia Bank	1993-2005	13	0,114	0,027	0,075	0,155
Bank of Attica	1993-2005	13	0,109	0,028	0,070	0,167
Laiki Bank	1993-2005	13	0,235	0,107	0,060	0,398
Aspis Bank	1993-2006	13	0,261	0,098	0,151	0,440
NovaBank	2001-2005	5	0,309	0,105	0,143	0,385
Probank	2002-2005	4	0,137	0,0342	0,111	0,176
Omega Bank	2001-2005	5	0,097	0,0184	0,076	0,119
Marfin Bank	1993-2005	13	0,101	0,079	0,033	0,308
Panellinia Bank	2002-2005	4	0,137	0,042	0,095	0,180
Telesis Bank	1993-2000	8	0,259	0,269	0,046	0,746
Ergobank	1993-1999	7	0,104	0,016	0,090	0,131
Ionian Popular Bank	1993-1999	7	0,128	0,026	0,089	0,169
Bank of Macedonia-Thrace	1993-1999	7	0,104	0,014	0,080	0,123
Xiosbank	1993-1999	7	0,254	0,093	0,111	0,407
Cretabank	1993-1998	6	0,090	0,015	0,074	0,101
Bank of Central Greece	1993-1998	6	0,157	0,058	0,106	0,258
National Mortgage Bank	1993-1997	5	0,259	0,067	0,174	0,327
Bank of Athens	1993-1997	5	0,194	0,031	0,145	0,225
Interbank	1993-1996	4	0,269	0,062	0,205	0,346
National Housing Bank	1993-1996	4	0,521	0,061	0,477	0,564
Bank of Cyprus	1993-2005	13	0,158	0,133	0,067	0,566

Cost inefficiency values range from the lowest 0.09 for Cretabank to 0.520 for National Housing bank. The variations in cost inefficiency scores across banks may be associated with a set of factors that affect incentives and managerial selection at the bank level.

Chart 6.3 offers a graphic presentation of the relative results.



Bank specific results reveal a wide range of cost inefficiency measures across banks. Of the 28 banks, 16 have inefficiency levels above 15%. The banks with the lower average level of cost inefficiency are Cretabnk, Ergobank, Bank of Macedonia-Thrace, Marfin bank and Bank of Attica, which means that these banks operate close to the efficient frontier. In particular, Cretabank has the lowest level of cost inefficiency, followed by Omega Bank. On the contrary, National Housing Bank reports the highest average inefficiency score in the sample, followed by Novabank. Aspis Bank and Interbank stand somewhat in the middle of the frame with cost

inefficiency scores 26.1% and 26.9%, respectively. Finally, it is noteworthy that some large banks, which are National Bank of Greece, Alpha Bank, Piraeus Bank and Geniki Bank strongly, compete with each other standing at 15.8%, 15.1%, 15.0% and 15.6%, respectively. On the other hand, Agricultural Bank and Emporiki Bank enjoy a better position, indicating an average cost inefficiency of 12.7% and 12.3%, respectively, while Eurobank seems to be the most inefficient bank among the other large banks with cost inefficiency of about 18.1%. The findings, however, should be treated with caution, since we analyse an unbalanced sample due to the major structural changes in the Greek banking system during the examined period.

At this point, we evaluate alternative profit inefficiencies across banks. Table 6.5 reports profit inefficiency estimates for each bank over the period 1993-2005.

Table 6.5

Average Alternative Profit Inefficiency Estimates

Bank	Mean	Bank	Mean
National bank	0.525	***Marfin bank***	0.645
Alpha bank	0.285	***Panellinia bank***	0.301
Eurobank	0.461	***Telesis bank***	0.540
Agriculturak bank	0.794	***Ergobank***	0.352
Emporiki bank	0.931	***Ionian popular bank***	0.807
Piraeus	0.629	***Bank of Maced-Thrace***	0.680
Geniki bank	0.948	***Xiosbank***	0.475
Egnatia bank	0.480	***Cretabank***	0.684
Bank of Attica	0.733	***Bank of Central Greece***	0.733
Laiki bank	0.309	***National Mortgage Bank***	0.366
Aspis bank	0.356	***Bank of Athens***	0.725
Novabnk	0.594	***Interbank***	0.420
Probank	0.350	***National Housing bank***	0.543
Omega bank	0.271	***Bank of Cyprus***	0.206

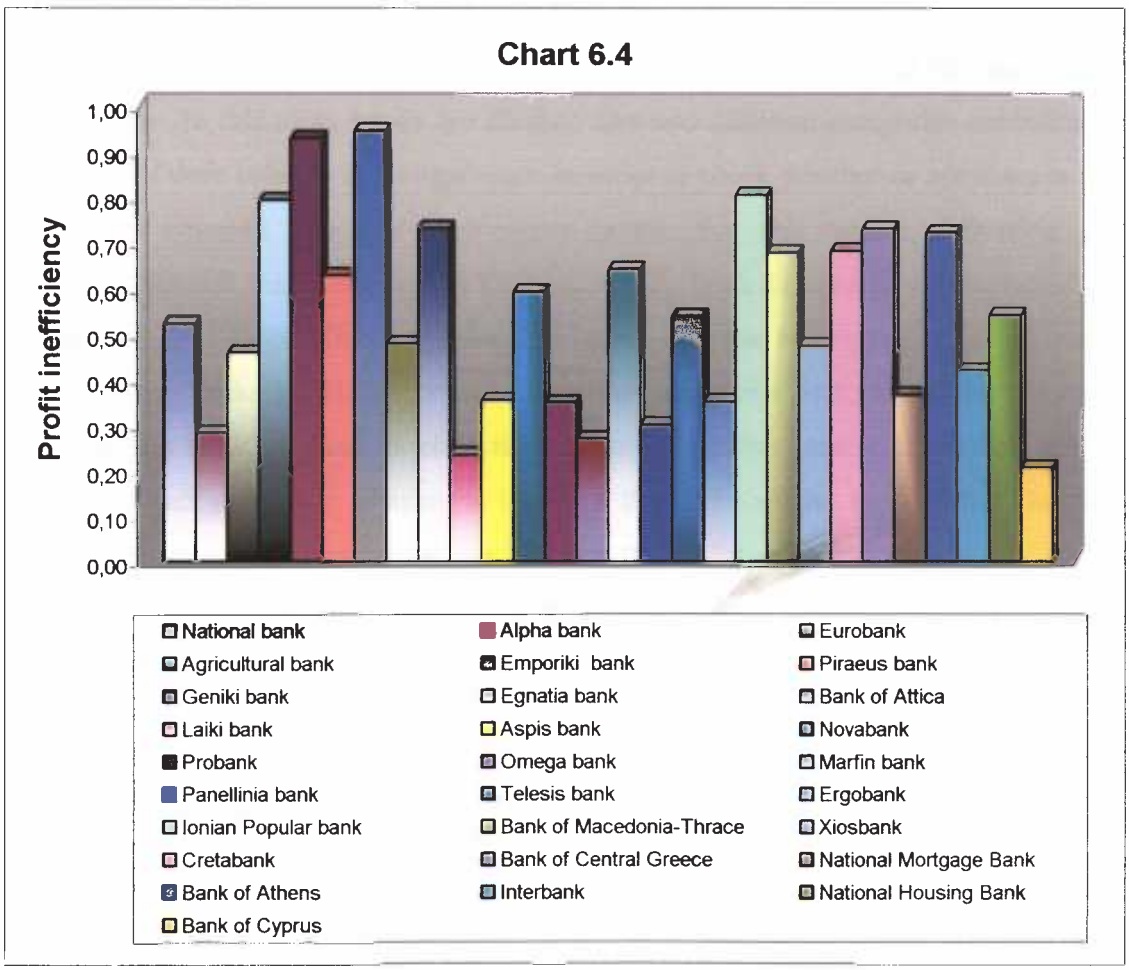
Variable	*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
Alternative Profit Inefficiency	0.554	0.216	0.206	0.948	244

(average alternative profit for the banking sector over the period 1993-2005)

The bank ranking differs for profit inefficiency scores, as low cost efficiencies appear to offset high profit efficiencies. This seems to imply that banks with relatively high cost inefficiencies offer better service quality and, thus, they are able to generate higher profits. Overall, profit inefficiency scores range between 20.6% for Bank of Cyprus to 94.8% for Geniki bank. It is noteworthy that there are big differences in

profit inefficiency scores, across banks. The banks with the lower average level of profit inefficiency are Bank of Cyprus and Omega bank with profit inefficiency scores 20.6% and 27.1%, respectively. On the contrary, Geniki Bank reports the highest average alternative profit inefficiency score in the sample, followed by Emporiki bank. National Bank and Telesis bank stand somewhat in the middle of the frame with profit inefficiency scores 52.5% and 54.3%, respectively. Alpha Bank enjoys a better position in relation to large banks, indicating an average profit inefficiency of 28.5%, while Emporiki bank seems to be the most profit inefficient bank among the other large banks with alternative profit inefficiency of 93.1%.

Chart 6.4 offers a graphic presentation of the above relative results.



Overall, our findings, based on the stochastic cost and alternative profit functions, show a generally high level of cost and profit inefficiency for banks in the Greek banking industry. Over the sample period, banks exhibit a higher level of cost efficiency compared to profit efficiency.

The reasons for high level of cost and even higher level of profit inefficiency of the Greek banking sector are both endogenous and exogenous. The most significant exogenous factors are the legislature and the macroeconomic environment, which have had an adverse impact on the banking system in the past. Regarding the endogenous factors, the skills of bank managers and the inappropriate system of corporate governance present an additional obstacle for improving efficiency and profitability of the banks. These findings highlight the challenges ahead in terms of financial, and in particular, banking integration within the EU.

6.1.3 Cost and alternative profit inefficiencies by firm size and ownership structure

Table 6.6 reports the average cost and profit inefficiency results for banks of different size. In this term, banks are divided into two different categories according to the size of their balance sheet aggregate, in order to check whether or not there is a relationship between size and inefficiency levels. For this reason, following a different approach from that, which dominates the Greek literature, we distinguish between the five larger Greek commercial banks and the remaining banks of our sample. Large banks are National bank of Greece, Emporiki bank, Eurobank, Alpha bank, Piraeus bank. A bank is classified as large if it has total assets above €20 million the last year. Our decision is based to the fact that the most of the Greek commercial banks are extremely small from the point of view of international comparisons and one of the general long-term directions of changes in the industry structure is integration and mergers of banks.

Table 6.6

Average cost and profit inefficiency levels

	Mean	Std. Dev.	Min	Max	Obs
Cost inefficiency					
Bank size					
Large*	0.153	0.021	0.053	0.281	65
Small and medium-sized	0.173	0.113	0.033	0.746	179
Ownership structure					
Government* (state owned)	0.152	0.086	0.074	0.564	68
Domestic private	0.173	0.104	0.033	0.746	176
All banks	0.164	0.100	0.033	0.746	244
Profit inefficiency					
Bank size					
Large	0.566	0.239	0.285	0.931	65
Small and medium-sized	0.535	0.204	0.206	0.948	179
Ownership structure					
Government (state owned)	0.674	0.172	0.366	0.931	68
Domestic private	0.478	0.194	0.206	0.948	176
All banks	0.553	0.216	0.206	0.948	244

Note: The table reports the average inefficiency scores by bank size and ownership structure.
*Large banks: National bank of Greece, Emporiki bank, Eurobank, Alpha bank, Piraeus bank.
**Banks that are controlled by government (state-owned):Agricultural bank, Bank of Central Greece, National Bank, Emporiki bank, National Mortgage bank, National Housing bank, Cretabank, Bank of Macedonia-Thrace, Ionian Popular Bank.

The results suggest that large-sized banks are the most cost efficient in the sample, with an average inefficiency score of 0.153. The remaining banks follow with an average inefficiency score of 0.173. Thus, these estimates show a positive relationship between size and cost efficiency, as small banks could further exploit economies of scales so as to gain in terms of cost efficiency. The results from our study echo these of Tsionas et al. (2003). Specifically, Tsionas et al(2003), employing DEA, showed that the Greek banking system operates at high overall efficiency levels, and that larger banks are more efficient than smaller banks. When DEA methodology is employed (Tsionas, Lolos and Christopoulos, 2003), the empirical results show that the Greek banking system operates at high overall efficiency levels, and that larger banks are more efficient than smaller banks. Similar findings are reported by Spathis, Kosmidou and Doumpos (2002) and Halkos and Salamouris (2004). Specifically, Spathis, Kosmidou and Doumpos (2002) use multicriteria decision aid methods (M.H.DIS and UTADIS) to identify the financial ratios that affect the classification of banks according to their size. The evidence suggests that

for the period 1990-1999, large banks are more efficient than small ones, and that this superiority in efficiency mainly originates from the presence of economies of scale. Halkos and Salamouris (2004) apply the DEA methodology for the period 1997-1999 and also report a strong positive correlation between size and efficiency, thus suggesting that M&As lead to a continuous increase of average efficiency In contrast, Christopoulos et al (2002) showed that larger banks are less efficient than smaller ones, or that there is not substantial difference between large and small banks, over the period 1993-1998. In particular, they use a heteroskedasticity frontier model to measure cost efficiency over the same sample period and conclude that small and medium sized banks are almost fully efficient, while larger banks suffer from low cost efficiency.

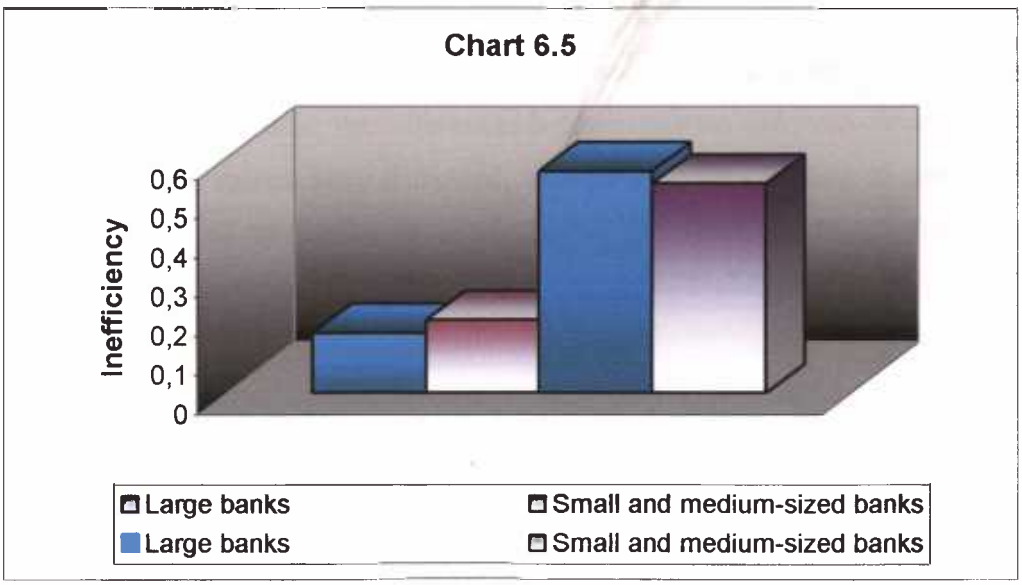
The most common way for banks to get an adequate size so as to take advantage of economies of scale is through mergers and acquisitions (M&As). During the 1990s, there was an impressive level of activity in mergers and acquisitions in the Greek banking sector. This activity was particularly intense in the period 1995-1999, and the majority of M&As mainly involved large banks. M&As can help to improve efficiency and simultaneously strengthen a bank's monopoly power as they lead to greater concentration in the market. A bank is technologically efficient if it acquires the optimum size and produces the best possible combination of services with given prices for the productive factors it uses. As economies of scale and scope of services provided depend on technology and also on factors such as the preferences of bank customers or the regulatory framework within which the bank operates, it is only reasonable to expect changes in the size of the bank and the structure of its assets in order for it to benefit fully from these economies. One of the ways that this can be achieved is through M&As.

However, many researchers agree that M&As between banks had a limited impact on cost. In particular, most findings from research on cost efficiency covering the 1980s and the early 1990s ranged from negative to positive, but were insignificant (see Berger and Humphrey, 1992). By contrast, studies covering recent years, which were also based on an analysis of indicators, lend support to the belief that a

remarkable improvement is evident in cost efficiency, not only in small banks (see Berger, 1998) but also in large banks.[76]

However, a look at table 6.4 shows that the above picture is reversed in the case of profit efficiencies. Small and medium-sized banks appear to be the most profit efficient, with an average inefficiency score of 0.535, closely followed by large-sized banks. Thus, small banks appear to receive more profit despite having relatively high costs. One explanation for this finding is that small banks may find it easier to engage in relationship lending than large banks, as this type of lending may require less knowledge of clients' financial needs, which is more accessible in small banks. Furthermore, small banks may undertake risky loans with high returns in contrast with large banks which avoid undertaking this type of loans.

Chart 6.5 summarizes "graphically" the average cost and profit inefficiency levels by different size:

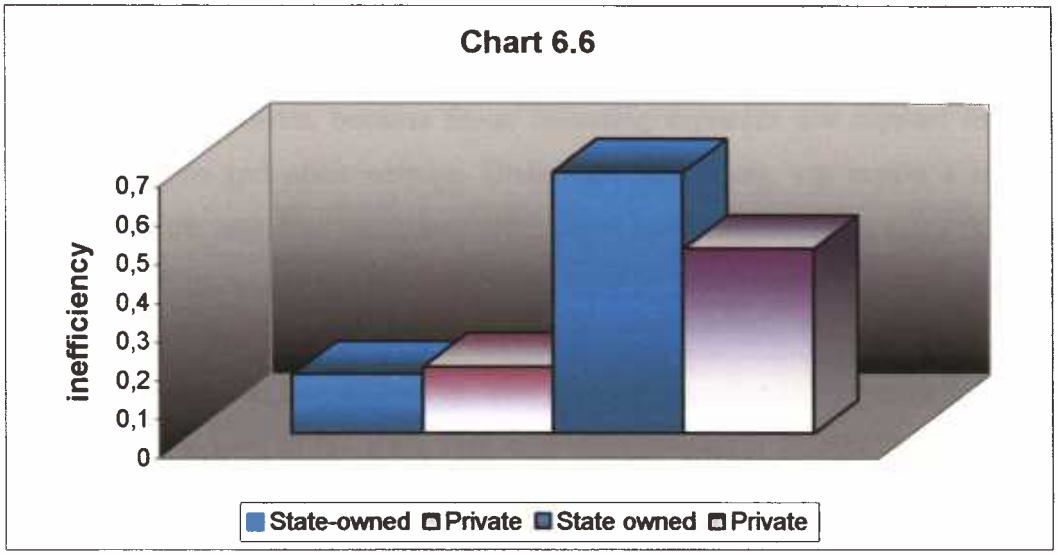


We can observe, by the graph, that there is a big distance between cost and profit inefficiencies. Small and medium-sized banks are more profit efficient, but less cost efficient than larger banks.

[76] This is not always the case. Rhoades (1998) in his study out of a total of 9 M&As which were examined, improved cost efficiency was observed in only four cases. The greatest cost reductions were due to staff cuts.

Finally, in table 6.6, we also report average cost and profit inefficiency scores for banks with different ownership structure, namely state-owned and private banks. Banks that are controlled by government (state-owned) are: Agricultural bank, Bank of Central Greece, National Bank, Emporiki bank, National Mortgage bank, National Housing bank, Cretabank, Bank of Macedonia-Thrace, Ionian Popular Bank. Eichengreen and Gibson (2001) mention that public banks are different from private banks. They face softer budget constraints. Their management is protected from hostile takeovers. Their loan portfolios, staffing, and technical efficiency differ. However, the authors report also that private banks control their size more efficiently, manage their assets more efficiently, and raise staff productivity. The results indicate that private banks are associated with higher cost but lower profit inefficiency, a finding that seems to be controversial in the literature. Thus, private banks are more cost but less profit inefficient than banks which are controlled by state, with an average inefficiency score of 0.173 and 0.478, respectively. Consequently, profit efficiency estimates reverse the ranking observed for cost efficiency. State-owned banks appear to be less profit efficient. In a more recent study, Gibson (2005) concludes that on the whole, the differences between private and state-owned banks in the Greek banking system have narrowed, with public banks tending to converge on the characteristics of private banks. According to the structure of cost, state-owned banks have smaller operating costs, although relatively higher staff costs. In the last few years, private banks' operating costs have been declining and are now at almost the same level as those of state-owned banks. This suggests that ownership is less important for bank behavior and perhaps results from the greater independence which publicly-owned banks acquired in the second half of the 1990s, due to the various administrative changes that have accompanied the liberalization of the financial system. The low cost efficiency of private banks raises questions about the wisdom of initial liberalization policies. Certainly, some of the new private banks are good. But these banks might well have entered even if licensing standards had been much tougher.

Chart 6.6 summarizes "graphically" the average cost and profit inefficiency levels by different size:



Overall, our results regarding firm size and ownership structure are mixed. Large-sized banks are the most cost efficient in the sample, while small banks appear to be the most profit efficient. Finally, private banks are less cost and more profit efficient than banks which are controlled by state.

6.1.4 The efficiency correlates

Table 6.7 and 6.8 present the parameter estimates of the second stage regression. Overall, the estimation results show good fit. The coefficient of determination for the cost regression is 0.1667, which means that the 16.67% of the variability of the dependent variable is explained by the above factors, while the respective coefficient of determination fro the profit regression is a bit lower, that is 0.1156.

6.1.4.1 Cost inefficiency

Regarding the cost inefficiency regression, the coefficient of loan loss provision to assets is negative and statistically significant at the 1 per cent level of significance, consistent with the "skimping hypothesis". The results suggest that consistent with the skimping hypothesis, nonperforming loans may be associated with low costs from choosing to put less effort into loan monitoring and control. Under the "skimping" hypothesis (Berger and DeYoung, 1997) there is a trade-off between short-term

operating costs and future loan performance problems, in that, banks that devote less resources on credit underwriting and loan monitoring may appear to be more cost efficient in the short-run, because fewer operating expenses can support the same quantity of loans and other outputs. Under this hypothesis, we expect a negative coefficient of the loan loss provisions ratio, since banks which spend more resources on loan screening, would have less problem loans at the expense of higher operating costs (Mester 1996).

In addition, the deposit mix variable presents the expected negative sign and is statistically significant at the 5 per cent level of significance. It is consistent with the theory, since bank deposits are less costly to service than retail deposits, the coefficient of the ratio of bank deposits to total funding is expected to be negative. The equity ratio reports a significantly negative coefficient, which is consistent with the 'moral hazard' hypothesis; the higher the capital shareholders have at risk, the stronger are their incentives to monitor management and assure that the institution operates efficiently. Turning now to liquidity risk, the coefficient of the fraction of cash in the asset portfolio is positive and statistically significant at the 1 per cent level of significance, suggesting that the cash could be invested in other ways and increase revenues, profits, and thus the efficiency instead be unexploited in the banks. On the contrary, neither the profitability ratios nor portfolio composition are statistically significant.

Table 6.7

Second stage regression

Variable	Coefficient	St. Err.	t-statistic	P>|t|
Loan loss provisions to loans	-0.159***	0.060	-2.64	0.009
Equity to assets	-0.159**	0.072	-2.21	0.028
Bank deposits to total funds	-0.067**	0.032	-2.06	0.041
Loans to assets	-0.066	0.109	-0.60	0.546
Cash to assets	0.170***	0.046	3.70	0.000
Return on assets	0.019	0.028	0.69	0.490
Total assets	-0.034	0.023	-1.48	0.139
Herfindahl	-0.115	0.424	0.27	0.786
Constant	4.011	3.273	1.23	0.222
R-squared	0.1667			
Observations	209			
F (8,200)	4.58			
Prob>F	0.0000			

Note: The table reports the second stage regression results. The dependent variable is the inefficiency score provided from the estimation of Equation (2). To avoid collinearity problems with the selected variables, we first analyze the correlations of all selected variables. We observe that there is no significant correlation between the explanatory variables. ***, ** and * indicate 1 per cent, 5 per cent, and 10 per cent significance levels, respectively.

6.1.4.2 Profit inefficiency

Regarding the profit inefficiency regression, the deposit mix variable, as in the cost inefficiency case, is negative and statistically significant at the 1 per cent level of significance, assuring the theory, again. In addition, the coefficient of the fraction of cash in the asset portfolio is positive and statistically significant at the 5 per cent level of significance, suggesting that the cash could be invested in other ways and increase revenues, profits, and thus the efficiency of banks. We also observe a positive and statistically significant coefficient for the total assets variable, which indicates that banks with more total assets exhibit higher level of inefficiency. The coefficient of the equity to assets variable is positive and statistically significant at the 5 per cent level of significance, which indicates that raising equity typically involves higher costs (than raising deposits), and that the 'moral hazard' hypothesis is less strong in the case of profit efficiency. On the contrary, and consistent with the results in cost inefficiency, neither the profitability ratios nor portfolio composition are statistically significant.

Table 6.8

Second stage regression

Variable	Coefficient	St. Err.	t-statistic	P>|t|
Loan loss provisions to loans	-0.004	0.049	-0.08	0.938
Equity to assets	0.179**	0.072	2.49	0.014
Bank deposits to total funds	-0.074***	0.027	-2.76	0.006
Loans to assets	-0.077	0.114	0.68	0.497
Cash to assets	0.122**	0.053	2.31	0.022
Return on assets	-0.019	0.034	-0.56	0.574
Total assets	0.050**	0.023	2.17	0.031
Herfindahl	0.253	0.511	0.50	0.621
Constant	1.557	0.398	0.39	0.696
R-squared	0.1156			
Observations	209			
F (8,200)	4.32			
Prob>F	0.0001			

Note: The table reports the second stage regression results. The dependent variable is the inefficiency score provided from the estimation of Equation (3). To avoid collinearity problems with the selected variables, we first analyze the correlations of all selected variables. We observe that there is no significant correlation between the explanatory variables. ***, ** and * indicate 1 per cent, 5 per cent, and 10 per cent significance levels, respectively.

6.2 Stochastic Frontier Approach (SFA) – Approach with two outputs and three inputs

In this section, we report the empirical findings of cost efficiency frontier based on the Stochastic Frontier Approach (approach with two outputs and three inputs), which employed in order to compare its results with these of DEA methodology. We employ this second approach of SFA in order to exist consistency in the variables between the two methodologies (SFA and DEA).

6.2.1 Cost inefficiency by year and bank

Cost inefficiency scores have been obtained from stochastic translog cost functions which include output levels and input prices. In this section, we report the empirical findings of bank inefficiency averaged for each of the 28 banks in the sample using the panel estimation reported above. The results are analogous with these of the above approach of SFA model. The results report substantial levels of inefficiency in the banking industry, higher than these of the previous approach. These high inefficiency values insinuate and assure the result that banks do not operate close to the efficient frontier.

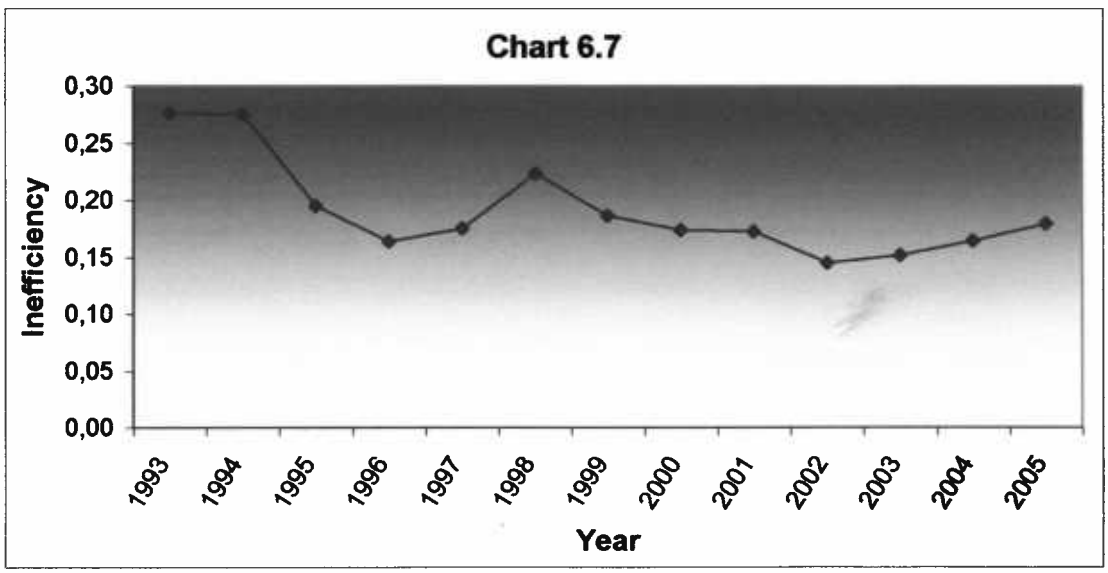
In detail, the results show that the average cost inefficiency score is 0.19, indicating that the average bank in the sample could reduce its cost by 19%, if it was to match its performance with the best-practice bank. Table 6.9 and the chart 6.7 report cost inefficiency estimates respectively over the period 1993-2005. Table 6.9 also shows the mean, minimum, maximum, standard deviation and the number of observations for each year are reported, as well as for the whole period 1993-2005. The results of cost inefficiency scores over the examined period reveal, as resulted both here and above, that efficiency levels do not vary considerably, but they indicate an improvement, simultaneously. Cost inefficiency values range from the lowest 0.145 in 2002 to 0.276 in 1993. Finally, the results indicate, as shown in chart 6.3 a fluctuation during the examined period.

Table 6.9

Average Cost Inefficiency Estimates

Year	Mean	Std. Dev.	Min	Max	Obs
1993	0.276	0.247	0.032	0.897	22
1994	0.275	0.301	0.025	1.000	23
1995	0.195	0.166	0.029	0.549	22
1996	0.163	0.138	0.053	0.530	23
1997	0.175	0.222	0.052	1.000	22
1998	0.223	0.217	0.052	0.872	20
1999	0.186	0.177	0.030	0.650	18
2000	0.173	0.167	0.041	0.559	14
2001	0.172	0.179	0.040	0.749	14
2002	0.145	0.142	0.039	0.653	17
2003	0.151	0.105	0.043	0.519	17
2004	0.164	0.106	0.060	0.388	16
2005	0.179	0.161	0.034	0.532	16
Period 1993-2005	0.191	0.056	0.025	1.000	244

Chart 6.7 helps us to observe the existing fluctuation during the period 1993-2005.



We observe that cost inefficiency declined from 27.6% in 1993 to 16.3% in 1996, while it increased to 22.3% in 1998 and fell to 17.9% in 2005. As discussed above, the beginning of the examination period coincides with the acceleration of liberalization of interest rates and the deregulation of the Greek financial system, which started in the mid-1980s, and consequently the decline in cost inefficiency from its highest values, 27.6% in 1993 and 27.5% in 1994, was reasonable. Reflecting on our mind the opportunities that the new regulation system provided, we conclude that

the downward trend of inefficiency score was absolutely justified. The increase which follows is also sensible because of the conditions in stock market in 1999. Since 1997, major reforms and new institutions were introduced, that expanded credit institutions' field of activity and strengthened competition. As an important consequence of the necessary investments in infrastructure upgrades, the average cost inefficiency began an upward trend reaching in 1999 the level of 18.6%. More recently, inefficiency has returned to more "normal" levels and indications of a long- term stable trend are evident from 2000, with average inefficiency ranging from 14.5% in 2002 to 17.9% in 2005.

The results of cost inefficiency scores across banks reveal that efficiency levels do not vary considerably. Table 6.10 reports cost inefficiency estimates for each bank over the period 1993-2005. The variations in inefficiency scores across banks may be associated with a set of factors that affect incentives and managerial selection at the bank level. Chart 6.8 offers a graphic presentation of the relative results.

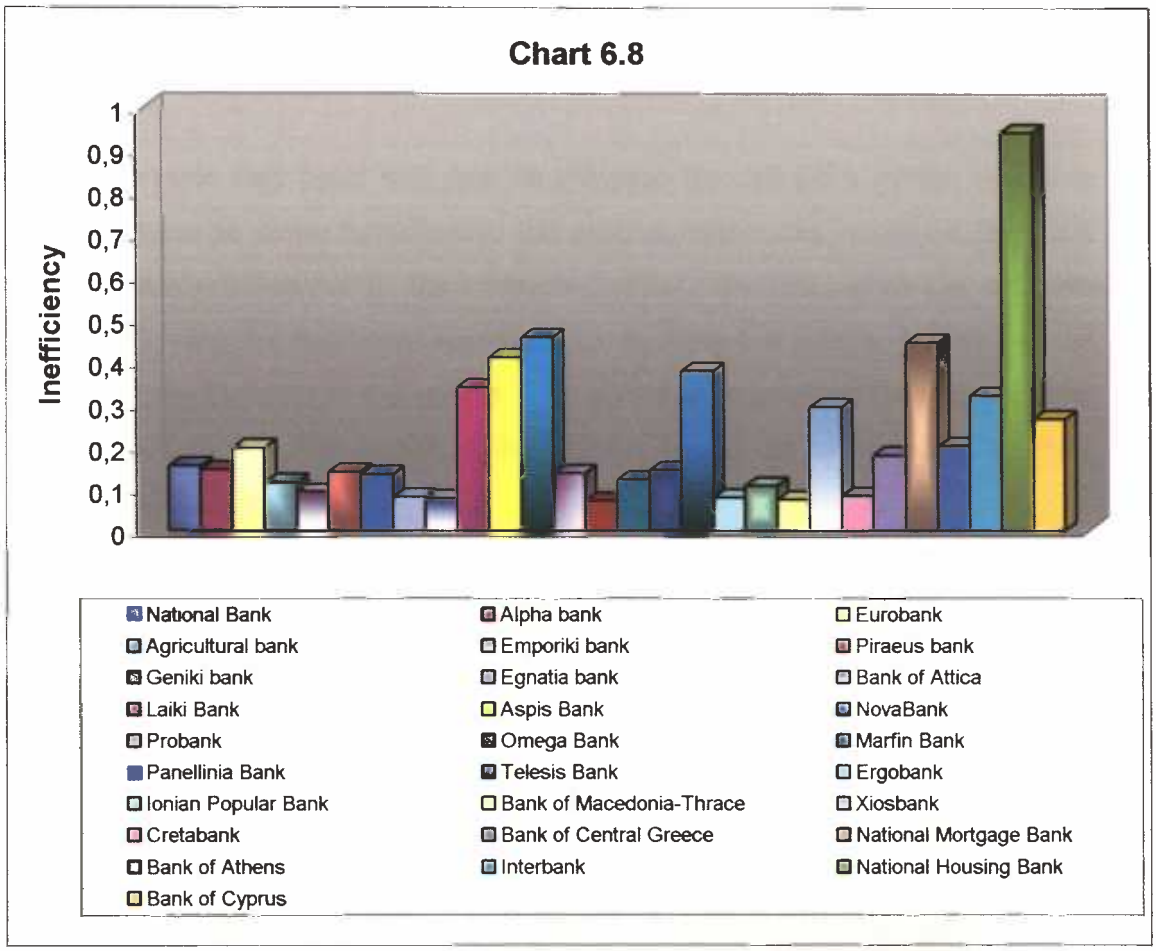
Table 6.10

Average Cost Inefficiency Estimates

BANK NAME	YEARS	OBS	MEAN	STDEV	MIN	MAX
National Bank	1993-2005	13	0,154	0,088	0,068	0,374
Alpha Bank	1993-2005	13	0,144	0,080	0,034	0,352
Eurobank	1993-2005	13	0,197	0,100	0,036	0,403
Agricultural Bank	1993-2005	13	0,115	0,090	0,041	0,354
Emporiki Bank	1993-2005	13	0,093	0,069	0,041	0,276
Piraeus Bank	1993-2005	13	0,140	0,050	0,071	0,254
Geniki Bank	1993-2005	13	0,134	0,045	0,066	0,208
Egnatia Bank	1993-2005	13	0,080	0,035	0,041	0,140
Bank of Attica	1993-2005	13	0,078	0,042	0,039	0,162
Laiki Bank	1993-2005	13	0,340	0,173	0,042	0,593
Aspis Bank	1993-2006	13	0,411	0,236	0,102	0,780
NovaBank	2001-2005	5	0,459	0,267	0,116	0,749
Probank	2002-2005	4	0,136	0,114	0,060	0,267
Omega Bank	2001-2005	5	0,070	0,006	0,064	0,078
Marfin Bank	1993-2005	13	0,122	0,146	0,025	0,532
Panellinia Bank	2002-2005	4	0,144	0,062	0,084	0,213
Telesis Bank	1993-2000	8	0,379	0,387	0,027	1,000
Ergobank	1993-1999	7	0,078	0,030	0,058	0,132
Ionian Popular Bank	1993-1999	7	0,106	0,046	0,054	0,198
Bank of Macedonia-Thrace	1993-1999	7	0,073	0,023	0,039	0,109
Xiosbank	1993-1999	7	0,294	0,120	0,115	0,455
Cretabank	1993-1998	6	0,083	0,031	0,052	0,114
Bank of Central Greece	1993-1998	6	0,178	0,121	0,076	0,385
National Mortgage Bank	1993-1997	5	0,447	0,081	0,340	0,549
Bank of Athens	1993-1997	5	0,201	0,060	0,131	0,267
Interbank	1993-1996	4	0,320	0,085	0,218	0,398
National Housing Bank	1993-1996	4	0,943	0,065	0,897	0,989
Bank of Cyprus	1993-2005	13	0,264	0,331	0,034	1,000

Cost inefficiency values range from the lowest 0.07 for Omega bank to 0.943 for National Housing bank. The variations in cost inefficiency scores across banks may be associated with a set of factors that affect incentives and managerial selection at the bank level.

Chart 6.8 offers a graphic presentation of the relative results.



Bank specific results reveal a wide range of cost inefficiency measures across banks, a finding which is consistent with this of previous approach. Of the 28 banks, 10 have inefficiency levels above 20%. The banks with the lower average level of cost inefficiency are Emporiki bank, Bank of Athens, Omega Bank, Egnatia, Bank of Macedonia-Thrace and Bank of Attica, which means that these banks operate close to the efficient frontier. In particular, Omegabank has the lowest level of cost inefficiency, followed by Bank of Macedonia-Thrace. On the contrary, National Housing Bank reports the highest average inefficiency score in the sample, followed by Novabank, while Eurobank and Bank of Athens stand somewhat in the middle of the frame with cost inefficiency scores 19.7% and 20.1%, respectively. Finally, it is noteworthy that National Bank of Greece, Alpha Bank, Piraeus Bank and Geniki Bank strongly compete with each other standing at 15.4%, 14.4%, 14.0% and 13.4%, respectively. On the other hand, Agricultural Bank and Emporiki Bank enjoy a better position, indicating an average cost inefficiency of 11.5% and 9.3%, respectively,

while Eurobank seems to be the most inefficient bank among the other large banks with cost inefficiency of about 19.7%.

6.3 Data Envelopment Analysis (DEA)

The same data panel will now be analyzed through DEA model, imposing variable returns to scale. Specifically, this section reports the results of the DEA efficiency analysis relative to the common frontier. We first define the common frontier following the traditional approach, i.e. building the frontier by pooling the data set for the 28 banks in the sample. This allows us to compare the banks against the same benchmark. The results of the exercise turned out to be robust to slight changes in the sample.[77]

Table 6.11 below illustrates the average inefficiency scores relative to the whole sample, over the period 1993-2005. Observing the cost inefficiency trend over the sample years, we notice a significant improvement. The average inefficiency score declined from 0.38 in 1993 to 0.10 in 2005. The findings reveal an average inefficiency score of 0.373 across all banks, over the examined period, indicating that the average bank in the sample could reduce its cost by 37.3% matching its performance with the best-practice bank.

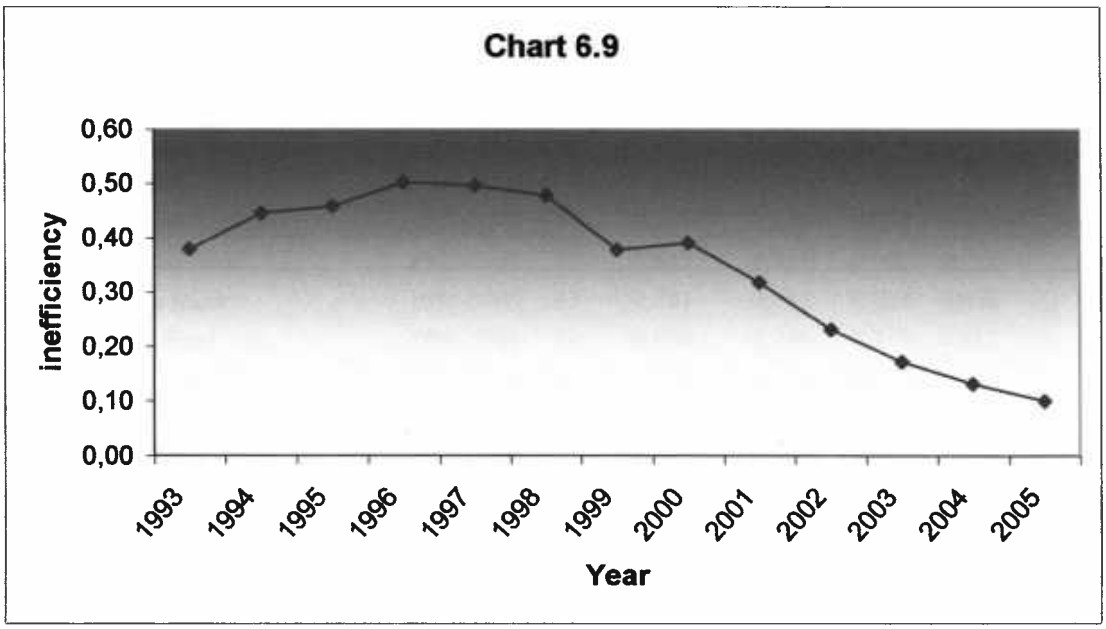
Table 6.11

Average Cost Inefficiency Estimates

Year	Mean	Std. Dev.	Min	Max	Obs
1993	0,380	0,285	0,000	0,764	22
1994	0,447	0,259	0,000	0,811	23
1995	0,459	0,273	0,000	0,799	22
1996	0,503	0,263	0,000	0,812	23
1997	0,498	0,248	0,000	0,793	22
1998	0,478	0,215	0,171	0,791	20
1999	0,380	0,228	0,000	0,749	18
2000	0,392	0,210	0,000	0,742	14
2001	0,319	0,144	0,000	0,541	14
2002	0,231	0,152	0,000	0,539	17
2003	0,172	0,139	0,000	0,391	17
2004	0,132	0,124	0,000	0,356	16
2005	0,100	0,132	0,000	0,356	16
Period 1993-2005	0,373	0,254	0,000	0,812	244

[77] DEA is a deterministic technique and therefore is very sensitive to outliers. Hence, it is fundamental to check that solutions are stable, and do not vary dramatically when some units are excluded from the sample.

Chart 6.9 helps us to observe the existing fluctuation during the period 1993-2005.



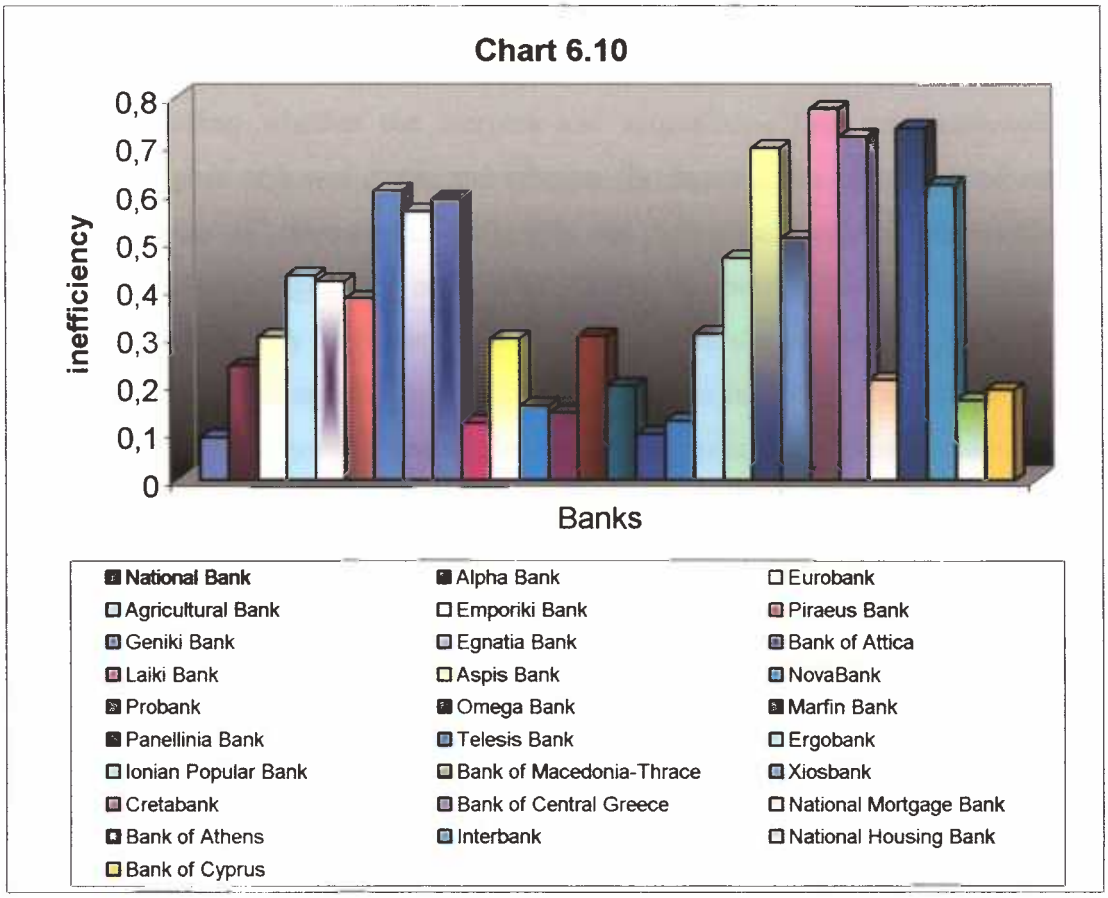
Overall, the results show relatively high average inefficiency scores. Simple averages of DEA cost inefficiency values were calculated and their behavior examined over time to study the commercial Greek banking sector's general inefficiency. These averages over the sample years indicate a significant improvement. An increasing trend in inefficiency observed over the period 1993-1997, while the average cost inefficiency followed a downward trend between 1997 and 2005. This trend of inefficiency values can be explained by the process of deregulation. Reflecting on our mind the opportunities that the new regulation system provided, we conclude that the downward trend of inefficiency score was absolutely justified.

At this point, we assess the cost inefficiency results relative to the differences in the bank level. Table 6.12 reports cost inefficiency estimates for each bank over the period 1993-2005. Chart 6.10 offers a graphic presentation of the relative results.

Table 6.12

Average Cost Inefficiency Estimates

Bank Name	Years	Obs	Mean	St.Dev	Min	Max
National Bank	1993-2005	13	0,089	0,105	0,000	0,326
Alpha Bank	1993-2005	13	0,239	0,147	0,000	0,505
Eurobank	1993-2005	13	0,300	0,191	0,000	0,744
Agricultural Bank	1993-2005	13	0,429	0,219	0,000	0,607
Emporiki Bank	1993-2005	13	0,417	0,251	0,000	0,733
Piraeus Bank	1993-2005	13	0,381	0,252	0,007	0,696
Geniki Bank	1993-2005	13	0,606	0,246	0,113	0,812
Egnatia Bank	1993-2005	13	0,563	0,195	0,280	0,811
Bank of Attica	1993-2005	13	0,589	0,189	0,254	0,771
Laiki Bank	1993-2005	13	0,119	0,133	0,000	0,369
Aspis Bank	1993-2006	13	0,298	0,148	0,000	0,518
NovaBank	2001-2005	5	0,157	0,131	0,000	0,303
Probank	2002-2005	4	0,142	0,071	0,061	0,195
Omega Bank	2001-2005	5	0,302	0,070	0,215	0,370
Marfin Bank	1993-2005	13	0,196	0,209	0,000	0,567
Panellinia Bank	2002-2005	4	0,095	0,071	0,000	0,172
Telesis Bank	1993-2000	8	0,123	0,138	0,000	0,327
Ergobank	1993-1999	7	0,308	0,065	0,218	0,417
Ionian Popular Bank	1993-1999	7	0,466	0,075	0,360	0,581
Bank of Macedonia-Thrace	1993-1999	7	0,696	0,091	0,504	0,774
Xiosbank	1993-1999	7	0,507	0,174	0,146	0,665
Cretabank	1993-1998	6	0,777	0,013	0,764	0,791
Bank of Central Greece	1993-1998	6	0,719	0,016	0,697	0,737
National Mortgage Bank	1993-1997	5	0,209	0,196	0,000	0,397
Bank of Athens	1993-1997	5	0,736	0,033	0,681	0,766
Interbank	1993-1996	4	0,618	0,059	0,540	0,681
National Housing Bank	1993-1996	4	0,166	0,096	0,098	0,234
Bank of Cyprus	1993-2005	13	0,188	0,131	0,000	0,431



Bank specific results reveal a wide range of cost inefficiency measures across banks. Of the 28 banks, 11 have inefficiency levels above 25%. National bank of Greece has the lowest level of cost inefficiency (0.089), followed by Panellinia bank (0.095). On the contrary, Cretabank reports the highest average inefficiency score in the sample (0.777), followed by Bank of Athens (0.736), while Aspis Bank and Eurobank stand somewhat in the middle of the frame with cost inefficiency scores of 0.298 and 0.300 respectively. Interestingly, three pairs of banks share the same levels of inefficiency: Finally, Alpha Bank, Aspis Bank and Eurobank compete with each other standing at 0.239, 0.298 and 0.300, respectively. On the other hand, Agricultural Bank and Emporiki Bank seem to be in the worst position among the other large banks (0.427, 0.417), while National Bank of Greece enjoy a better position (0.089).

6.4 Comparison of frontier efficiency methods (SFA and DEA)

To make informed policy decisions regarding financial institutions, regulators need to have accurate information about the likely effects of their decisions on the

performance of the institutions they supervise.[78] Specifically, the regulators of commercial banks should have some expert knowledge based on rigorous empirical research regarding whether the mergers and acquisitions they are petitioned to approve in higher or lower costs, and whether the increases in equity capital ratios they may require will raise costs significantly and reduce the supply of intermediaries services. Similarly, regulatory authorities should be aware whether the observed managerial inefficiency they may observe could raise the probability of financial institution failure substantially, and so could be used to reallocate scarce supervisory resources to where they are most needed. In recent years, the academic research on the performance of financial institutions has increasingly focused on frontier efficiency or X-efficiency, which measures deviations in performance from that of "best-practice" firms on the efficient frontier, holding constant a number of exogenous market factors such as the prices faced in local markets. Despite intense research efforts, there is no consensus on the best method or set of methods for measuring frontier efficiency, and the choice of method may affect the policy conclusions that are drawn from the analyses.

As discussed above, many methods are available to estimate inefficiencies, and these methods often yield widely disparate results. To date there have been few attempts to link alternative measures of inefficiencies to other performance measures or to determine the relative "informativeness" of the scores produced by alternative frontier methods. Given the large-scale changes in banking markets and banking regulations that have occurred during the past decade (see Berger, Kashyap, and Scalise 1995), the usefulness of efficiency scores in the banking industry is especially interesting.

Bauer et al. (1998) argue that it is not necessary to have a consensus on which is the single best frontier approach for measuring efficiency for the efficiencies to be useful for regulatory analysis. Instead, they propose a set of consistency conditions that efficiency measures derived from the various approaches should meet to be most useful for regulators or other decision makers. The efficiency estimates derived from the different approaches should be consistent in their efficiency levels, rankings, and identification of best and worst firms, consistent over time and with competitive

[78] For convenience, we simply use the term "regulators" to refer to all lawmakers, supervisory agencies, antitrust authorities, etc. that exercise any regulatory or supervisory authority over financial institutions.

conditions in the market, and consistent with standard nonfrontier measures of performance. For evaluating consistency, it is necessary to apply multiple efficiency methods to the same data set.

There are a few studies that applied two or more methods to the same data set and the results are quite mixed across studies. To examine efficiency over time and its potential usefulness to decision makers, we estimate the X-efficiencies of a sample of 28 Greek banks over the period 1993 to 2005 using two very different methods—a stochastic cost frontier with a composed error term (Aigner, Lovell, and Schmidt 1977) and a linear programming cost frontier (Färe, Grosskopf, and Lovell 1985).

To be sure that the applications are comparable, the two techniques (SFA and DEA) use the same efficiency concept (cost inefficiency-technical inefficiency), the same sample of banks, the same time interval and the same specification of inputs and outputs. To be sure that the results do not depend upon any one particular economic environment of the banking industry or any peculiarities of any one small group banks, we estimate the average inefficiency over time of a panel of 28 banks over a 13-year period, from 1993-2005, during which there where significant changes in the banking sector. This was a period of many regulatory changes and many changes in market conditions, making it an almost ideal period how the different frontier approaches identify and measure bank inefficiency over a variety of extreme conditions. The experimental design helps assure that the observed differences in inefficiency scores reflect the effects of the differences in the measurement techniques, rather than any of these other factors.

As noted above, the two frontier approaches differ in the assumptions made about the shape of the frontier and the treatment of random error. These methods also often differ in whether the underlying concept of efficiency is technological or economic, with the nonparametric DEA method usually measuring technological efficiency and the parametric SFA method usually measuring economic efficiency.

In this survey, at this point, we choose cost minimization over profit maximization because it is more commonly specified and accepted efficiency concept in the literature, and because there are problems measuring output prices. Ideally, both cost and profit specifications would be employed and compared, but examining consistency conditions over the two techniques already seem to strain the very limits of space and time.

6.4.1 Comparison of inefficiency distributions with each other

A number of distributional characteristics of the inefficiency scores generated by the two efficiency techniques, SFA and DEA, are reported in Table 6.13.

Table 6.13

	DEA-P	SFA-P
Mean	0,361	0,195
Median	0,327	0,127
Standard deviation	0,254	0,193
Minimum	0,000	0,025
Maximum	0,812	1,000
Num. Banks	244	244

Notes: The inefficiencies are calculated using 13 years of data for 28 banks, and the numbers in the table are based on the average inefficiency for each bank over the entire sample period.

DEA-P: Data Envelopment Analysis (DEA) using the entire 13-year Panel (P) of data as a reference set.

SFA-P: Stochastic Frontier Approach (SFA) forcing the cost function parameters (other than intercepts) to be constant over the 13-year Panel (P) of data.

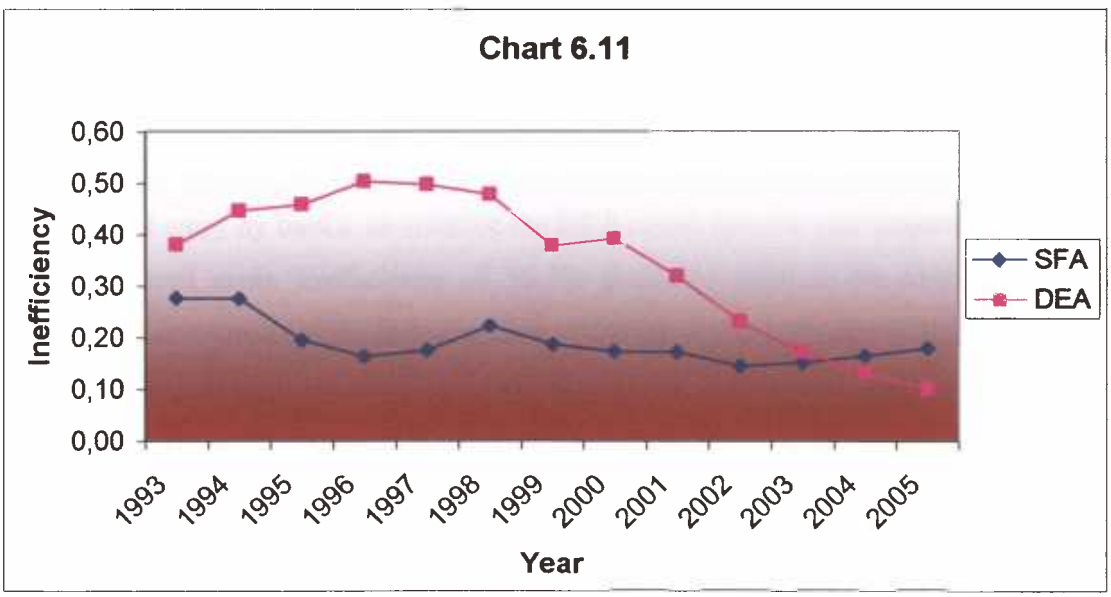
The mean inefficiency from the SFA parametric method averaged 19.5%, while mean inefficiency from the nonparametric DEA method averaged 36.1%, indicating that average bank in the sample could reduce its cost by 19.5% (SFA) or 36.1% (DEA) matching its performance with the best-practice bank. Hence, calculated programming inefficiency scores are almost two times larger than those estimated using stochastic frontier. The average standard deviation of inefficiency estimates from the parametric model (0.193) was less than that for the nonparametric model (0.254). These results are consistent with some studies which compare bank inefficiency between parametric and nonparametric approaches. For example, Eisenbeis, Ferrier and Kwan (1999) found that calculated programming inefficiency scores in U.S. bank holding companies are two or three times larger than those estimated using stochastic frontier.

6.4.2 Comparison of inefficiencies scores over time

The level and time patterns of mean efficiency for each frontier method over the period are displayed in table 6.14 and chart 6.11.

Table 6.14

Year	DEA	SFA
1993	0,380	0,276
1994	0,447	0,275
1995	0,459	0,195
1996	0,503	0,163
1997	0,498	0,175
1998	0,478	0,223
1999	0,380	0,186
2000	0,392	0,173
2001	0,319	0,172
2002	0,231	0,145
2003	0,172	0,151
2004	0,132	0,164
2005	0,100	0,179
During 1993-2005	0,361	0,195



As shown, the parametric method- SFA generally yield relatively high mean efficiencies, between about 15% and 20% , that are reasonably close to one another in terms of level, and do not vary much over time. The most striking result from table

6.14 and chart 6.11 is how much higher the inefficiencies from the DEA approach are. The mean inefficiencies from DEA model are substantially above the inefficiencies from the parametric model. The relatively high mean inefficiency for the DEA method is manifested in high inefficiencies for the great majority of the years. However, inefficiencies scores, found by the stochastic and programming frontier, appear to have gradually declined over the sample period. It is easy to observe an improvement in efficiency estimates from 1993 to 2005.

It is noteworthy also the positive correlation between inefficiencies measured by DEA and SFA: 41%. This correlation and the above cost inefficiencies values look quite satisfactory if one thinks that the mathematical models and the econometric one arise from quite different assumptions: for example, the former do not require any hypothesis on the distribution of the residual and do not allow for any error in the data.

As shown above in table 6.14 and chart 6.11, the parametric method generally yield mean inefficiencies about 15% and 20%, with the vast majority of firms having relatively high efficiency, whereas the nonparametric method yield mean inefficiencies between about 20% to 45%, with the vast majority of firms having relatively low efficiency. It seems fairly clear that the parametric approach is generally more consistent with what are generally believed to be the competitive conditions in the banking industry. The relatively low inefficiencies for the vast majority of banks seem consistent with a reasonably competitive industry in market that allowed entry by banks. In contrast the DEA result that the vast majority of banks have measured mean inefficiency of 36.1% does not seem to be consistent with competitive conditions in the industry. One potential explanation of this finding is that DEA does not take account of random error as the parametric method does. The dispersion from random error would likely result in higher average inefficiency. If there are a few banks with very "lucky" outcomes, the banks that are compared to them may have very high measured inefficiency by DEA, and this may have occurred here, since the DEA inefficiencies are quite higher than those generated by the parametric method and higher than are likely to be allowed by market forces. Note that this problem likely is not as serious as a general concern as it appears here.

6.4.3 Comparison of inefficiencies scores across banks

The estimates of the levels of cost inefficiencies for the parametric and nonparametric frontier methods are quite different across banks. The relatively high mean inefficiency for the DEA method is manifested in high inefficiencies for the great majority of the banks. The nonparametric method identifies that of the 28 banks, 11 have inefficiency levels above 25%, while the parametric method suggests a much closer correspondence of inefficiency across observations, and identifies that of the 28 banks, 10 have inefficiency levels above 20%. In addition, the data suggests that the DEA and the SFA techniques give only very weakly consistent rankings with each other. Hence, the DEA and the SFA models cannot be relied upon to generally rank the banks in the same order, and so may give conflicting results when evaluating important regulatory questions. This result assures the evidence that the structure of the different models proves crucial for the computed inefficiency scores.

6.4.4 Comparison of inefficiencies scores- Firm size and ownership structure

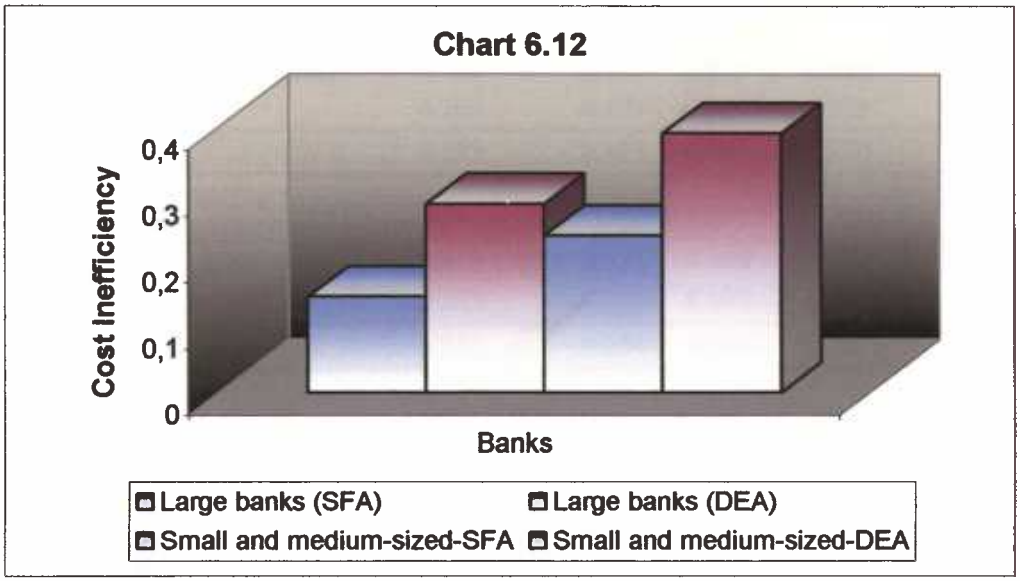
Next, as above, we divide banks into 2 different categories according to the size of their balance sheet in order to check whether or not there is a relationship between size and inefficiency levels and whether or not the two methods (SFA and DEA) result in the same finding about this relationship. We have distinguished between the five larger Greek commercial banks (National Bank of Greece, Alpha Bank, Eurobank, Emporiki Bank, and Bank of Piraeus) and the remaining banks of our sample. Our decision is based to the fact that the most of the Greek commercial banks are extremely small from the point of view of international comparisons and one of the general long-term direction of changes in the industry structure is integration and mergers of banks.

Table 6.15 reports the average cost inefficiency, found by the stochastic and programming frontier methodologies, results for banks of different size. Chart 6.12 offers a graphic presentation of the relative results.

Table 6.15

Average cost inefficiency levels

	Mean	Std. Dev.	Min	Max	Obs
SFA					
Bank size					
Large	0.145	0.037	0.034	0.403	65
Small and medium-sized	0.237	0.202	0.025	0.034	179
All banks	0.195	0.193	0.025	1.000	244
DEA					
Bank size					
Large	0.285	0.130	0.000	0.744	65
Small and medium-sized	0.392	0.233	0.000	0.812	179
All banks	0.361	0.254	0.000	0.812	244



According to SFA, the results suggest that the top five banks are more cost efficient than the rest of the sample, with an average inefficiency score of 0.145. The remaining banks follow with an average inefficiency score of 0.237, indicating an existing relationship between size and cost efficiency. The results indicate that large banks are more efficient than small ones. This superiority in efficiency possibly originates from the presence of economies of scale. According to DEA, we result in the same conclusion about the relationship between firm size and inefficiency level. In particular, the results suggest that large banks are more cost efficient than the small and medium-sized banks, with an average inefficiency score of 0.285. The remaining banks follow with an average inefficiency score of 0.392. At this point, it is obvious the commonality in the inefficiency scores found by the stochastic and programming

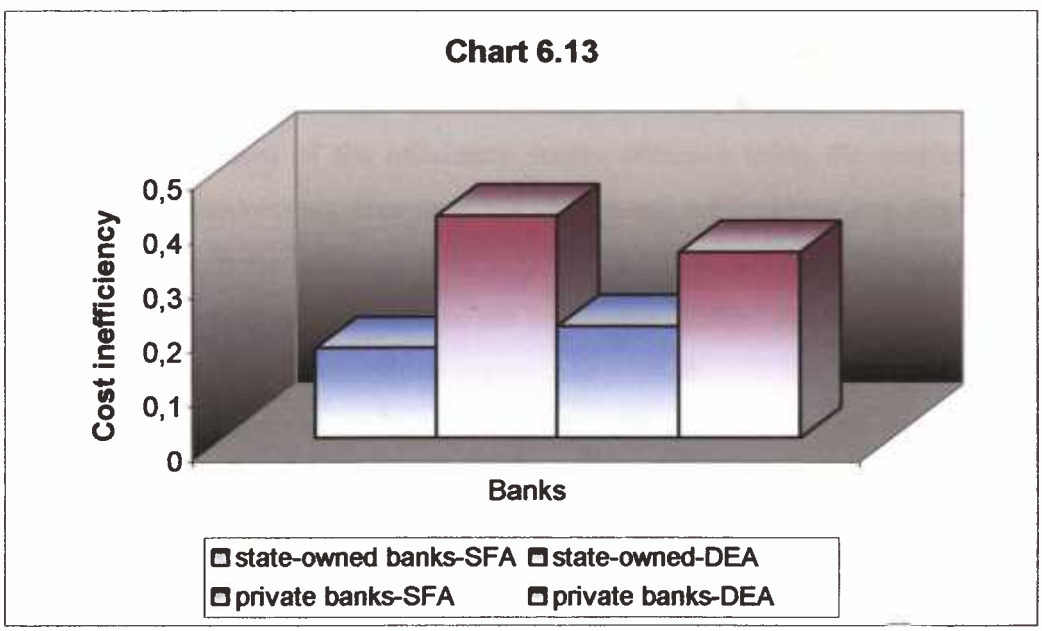
frontier methodologies. So, the level of inefficiencies of cost is, on average, noticeably smaller for large banking firms than the smaller firms. The cost inefficiency results seem to imply that as bank grows larger, they are more able to control costs.

Table 6.16 reports the average cost inefficiency, found by the stochastic and programming frontier methodologies, results for banks grouped according to their ownership. Chart 6.13 offers a graphic presentation of the relative results.

Table 6.16

Average cost inefficiency levels

	Mean	Std. Dev.	Min	Max	Obs
SFA					
Ownership structure					
Government (state owned)	0.166	0.180	0.039	0.989	68
Domestic private	0.206	0.197	0.025	1.000	176
All banks	0.195	0.193	0.025	1.000	244
DEA					
Ownership structure					
Government (state owned)	0.410	0.271	0.000	0.791	68
Domestic private	0.343	0.246	0.000	0.812	176
All banks	0.361	0.254	0.000	0.812	244



According to SFA, our results suggest that state-owned banks are more efficient in cost terms than private banks, a finding that seems to be controversial in

the literature. Thus, private banks are more cost inefficient than banks which are controlled by state, with an average inefficiency score of 0.206. State-owned banks appear to be more cost efficient, with an average inefficiency score of 0.166. On the other hand, according to DEA, our results suggest that private banks are more efficient in cost terms than state-owned banks. Hence, at this point, it is obvious the difference in the inefficiency scores found by the stochastic and programming frontier methodologies. So, the level of inefficiencies of cost is, on average, noticeably smaller for state-owned banking firms than the private firms, according to SFA results. On the other hand, according to DEA results, the level of inefficiencies of cost is, on average, noticeably larger for state-owned banking firms than the private firms. So, our empirical analysis of the banks, according to their ownership structure, suggested different results according to the technique used.

From above results, we can conclude that there are some obvious differences in the inefficiencies scores found by the stochastic and programming frontier, but some commonalities are found as well. This evidence leads us to the conclusion that it is important to use more than one methodology to evaluate bank inefficiencies. Specifically, as discussed above, our rationale for using two different methods is twofold. First, we would like to examine the robustness of our findings. Charnes, Cooper, and Sueyoshi (1988) advocate the use of "methodological crosschecking" whenever important policy decisions are to be based on results that may depend upon the methodology selected to perform the study. Second, we want to examine the relative informativeness of the efficiency scores obtained using the stochastic and programming methodologies. One need not choose one method over the other; rather, both methods could be used, at relatively low cost, to obtain information about performance. The relevant question is not which the "better" method is but how to weight the information the alternative approaches provide.

It is important to know how informative efficiency scores are prior to using them in decision making. To the extent that the efficiency scores from different techniques contain different information, multiple sets of efficiency scores might be used as the basis for decision making. The efficiency scores derived from different methods could be assigned different weights based on how much information they convey to the decision maker. This possibility is the basic idea of the informativeness principle. As noted by Bauer, et al. (1998), efficiency scores that meet certain consistency conditions are likely to be more useful to decision makers than scores that

do not. Among the factors they discuss are the consistencies of efficiency scores with market conditions and traditional measures of firm performance. It could be argued that efficiency scores that satisfy these consistency conditions are more "informative" than those that do not. After deriving and examining the inefficiencies themselves, their informativeness will be investigated by examining the relationship between the inefficiency scores and other measures of bank performance.

Overall, the DEA method yields much higher average inefficiencies and ranks the banks differently from the parametric method. These results suggest that there may be "fragility" in drawing regulatory policy conclusions that may differ according to whether DEA versus SFA approach are specified.

CHAPTER 7

CONCLUSION

During the last two decades, Greek banking has undergone substantial developments. Indicatively, we can mention: the liberalization of interest rate determination, the annulment of various credit rules, the release of capital movements, the advances in information technology, the internationalization of banking activities, the euro circulation, and the phenomenon of disintermediation. These changes enhanced competition in both price and quality levels of the services offered by the banking system and have brought the issue of bank performance in the forefront. Banks have made considerable efforts at increasing efficiency, reducing costs of bank services and diversifying in other business area.

First, this study analyses both cost and alternative profit efficiency of the Greek banking industry over the period 1993-2005, using Stochastic Frontier Approach. We use the Stochastic Frontier Approach by computing a translog cost and profit function with composed error residuals. The translog form is common in the literature, since it does not require too many restrictive assumptions about the nature of the technology. The dominant approach among researchers views the bank as an intermediary producing final outputs such as various kinds of loans, using labor, capital and borrowed funds. Following the intermediation approach, we specify two outputs, loans and other earning assets, and two input variables, labor and total funds, whereas the costs associated with those inputs are total personnel expenses and total interest on funds respectively.

Not surprisingly, our findings, based on the stochastic frontier approach, show a generally low level of cost and an even lower level of profit efficiency. Comparing the efficiency scores obtained from the cost and profit functions, Greek banks seem to be more efficient in controlling costs than in generating profits and this is reflected by the fact that the profit inefficiency scores are far well above cost inefficiency levels. The average cost inefficiency is reported at 0.16, while profit inefficiency for the whole region is estimated at 0.55, with significant inefficiency differences among banks. These results indicate that the average bank in the sample could have reduced

cost by 16.7% had they all been operating at full efficiency. Respectively, the average bank in the sample could have increased profit by 55.3% had they all been operating at full efficiency. Moreover, when decomposing cost efficiency scores by year, no large differences are reported over the period 1993-2005. Large-sized banks are more cost efficient, but lack in terms of profit efficiency, indicating some evidence of unexploited scale economies in terms of cost cutting. Furthermore, state-owned banks appear to be more cost efficient in the sample, while at the same time they are less profit efficient financial institutions. However, the recent literature suggests that ownership is less important for bank behavior and perhaps results from the greater independence which publicly-owned banks acquired in the second half of the 1990s, due to the structural process that followed the liberalization of the financial system.

As a next step, we also investigated the relationship between inefficiency and various bank characteristics. Our results suggest that more cost efficient banks tend to be better capitalized and have lower liquidity, while more profit efficient banks tend to be smaller in terms of the size of their balance sheet. Moreover, our results indicate the existence of a positive relationship between cost efficiency and loan quality, and a negative relationship between profit efficiency and liquidity ratio. Underperforming banks tend to have a lower fraction of bank deposits.

At a further stage, the same data panel was analyzed through DEA model, imposing variable returns to scale. We first define the common frontier following the traditional approach, i.e. building the frontier by pooling the data set for the 28 banks in the sample. This allows us to compare the banks against the same benchmark. The results of the exercise turned out to be robust to slight changes in the sample. The findings reveal an average inefficiency score of 0.373 across all banks, over the examined period, indicating that the average bank in the sample could reduce its cost by 37.3% matching its performance with the best-practice bank. Overall, the results show relatively high average inefficiency scores.

Comparing the two methods, the mean inefficiency from the SFA parametric method averaged 19.5%, while mean inefficiency from the nonparametric DEA method averaged 36.1%, indicating that average bank in the sample could reduce its cost by 19.5% (SFA) or 36.1% (DEA) matching its performance with the best-practice bank. Hence, calculated programming inefficiency scores are almost two times larger than those estimated using stochastic frontier. Furthermore, inefficiencies scores, found by the stochastic and programming frontier, appear to have gradually

declined over the sample period. It is easy to observe an improvement in efficiency estimates from 1993 to 2005. It is noteworthy also the positive correlation between inefficiencies measured by DEA and SFA: 41%. This correlation and the cost inefficiencies values look quite satisfactory if one thinks that the mathematical models and the econometric one arise from quite different assumptions. In addition, the estimates of the levels of cost inefficiencies for the parametric and nonparametric frontier methods are quite different across banks. According to firm size, both methods indicate that as bank grows larger, they are more able to control costs. On the other hand, our empirical analysis of the banks, according to their ownership structure, suggested different results according to the technique used. From above results, it is concluded that there are some obvious differences in the inefficiencies scores found by the stochastic and programming frontier, but some commonalities are found as well. This evidence leads us to the conclusion that it is important to use more than one methodology to evaluate bank inefficiencies.

In conclusion, during the sample period, banks have made significant efforts to improve their efficiency and as our results indicate they have largely achieved their goals. However, these efforts should further intensify, as there is room for improvement, especially in the case of profit efficiency. Nevertheless, as financial integration within the European Union is increasing, Greek banks will need to further increase their efficiency in order to compete with their European counterparts.

ΠΕΡΙΛΗΨΗ ΣΤΑ ΕΛΛΗΝΙΚΑ (SUMMARY IN GREEK)

Η παρούσα διπλωματική εργασία πραγματεύεται την αποτελεσματικότητα στο ελληνικό τραπεζικό σύστημα. Η βιβλιογραφία σχετικά με την αποτελεσματικότητα των τραπεζών στηρίζεται σε δύο προσεγγίσεις: η πρώτη εκτιμάει την αποτελεσματικότητα με βάση τις οικονομίες κλίμακας και φάσματος ενώ η δεύτερη εφαρμόζει το efficient frontier concept ή αλλιώς X-inefficiency. Γενικά υπάρχει διαφωνία σχετικά με το πώς θα εκτιμηθεί η αποτελεσματικότητα. Οι υπάρχουσες μεθοδολογίες διακρίνονται στις παραμετρικές, οι οποίες χρησιμοποιούν οικονομετρικά μοντέλα και στις μη παραμετρικές, οι οποίες εφαρμόζουν τεχνικές γραμμικού προγραμματισμού. Στην διπλωματική μου εργασία έχω εφαρμόσει μια παραμετρική και μια μη παραμετρική μέθοδο για την εκτίμηση της αποτελεσματικότητας στο ελληνικό τραπεζικό σύστημα. Ο τραπεζικός τομέας παίζει κεντρικό ρόλο στη λειτουργία ολόκληρου του χρηματοπιστωτικού συστήματος, διότι προσδιορίζει την κατανομή κεφαλαίων σε παραγωγικές δραστηριότητες, η οποία όταν γίνεται αποτελεσματικά συμβάλλει στην οικονομική πρόοδο. Τα τελευταία χρόνια έχουν σημειωθεί σημαντικές αλλαγές στο ελληνικό τραπεζικό σύστημα, όπως η απελευθέρωση της κίνησης κεφαλαίων, η αποκανονικοποίηση των εγχώριων πιστωτικών χώρων, η απελευθέρωση των επιτοκίων, η κυκλοφορία του ευρώ, η επανάσταση στην τεχνολογία της πληροφορικής και των επικοινωνιών καθώς και οι καινοτομίες προϊόντων και υπηρεσιών στις χρηματοπιστωτικές αγορές. Οι παραπάνω αλλαγές στο εξωτερικό περιβάλλον του ελληνικού τραπεζικού συστήματος συνέβαλλαν στη διαμόρφωση ενός νέου περιβάλλοντος λειτουργίας των τραπεζών πιο ανοικτού και ανταγωνιστικού τόσο σε επίπεδο τιμών όσο και ποιότητας των υπηρεσιών που προσφέρονται από αυτές. Επομένως, σε ένα τραπεζικό περιβάλλον που γίνεται καθημερινά περισσότερο ανταγωνιστικό καταλαβαίνουμε ότι η αποτελεσματικότητα των τραπεζών καθίσταται αναγκαία για την επιβίωση τους. Το γεγονός αυτό φέρνει στο προσκήνιο το θέμα της επίδοσης των τραπεζών, ενώ αυτές καταβάλλουν πλέον μεγάλες προσπάθειες για να αυξήσουν την αποτελεσματικότητα τους είτε μέσω της μείωσης του κόστους των τραπεζικών τους εργασιών, είτε μέσω της διαφοροποίησης τους σε άλλες επιχειρηματικές περιοχές.

Ένα βασικό χαρακτηριστικό του ελληνικού τραπεζικού συστήματος, έτσι όπως είχε διαμορφωθεί τα παλιότερα χρόνια, ήταν η ουσιαστική παρέμβαση του Κράτους σε αυτό. Η παρεμβατική αυτή πολιτική του Κράτους για πολλά χρόνια

εμπόδιζε τον ανταγωνισμό και δημιουργούσε ένα διαστρεβλωμένο περιβάλλον στην αγορά των τραπεζών. Το περιβάλλον του τραπεζικού συστήματος έτσι όπως αυτό διαμορφώθηκε από το 1993, οδήγησε στην ίδρυση και τη λειτουργία νέων πιστωτικών ιδρυμάτων, είτε εγχώριων, είτε υποκαταστημάτων ξένων τραπεζών, ενώ παράλληλα σημειώθηκε μια σειρά από συγχωνεύσεις και εξαγορές, γεγονότα τα οποία επηρέασαν το βαθμό συγκέντρωσης αλλά και τη δομή του ελληνικού τραπεζικού συστήματος.

Η μελέτη της αποτελεσματικότητας των τραπεζών έχει απασχολήσει ένα μεγάλο μέρος της βιβλιογραφίας παγκοσμίως. Όσον αφορά στο ελληνικό τραπεζικό σύστημα, μέχρι σήμερα δεν έχει μελετηθεί αρκετά η αποτελεσματικότητα του, λόγω των ελλείψεων που υπάρχουν σχετικά με τα δεδομένα που χρειαζόμαστε.

Η διπλωματική μου στοχεύει στην εκτίμηση της αποτελεσματικότητας του ελληνικού τραπεζικού συστήματος για ολόκληρη την περίοδο 1993-2005, κατά την διάρκεια της οποίας έχουν γίνει σημαντικές αλλαγές ενώ μέχρι σήμερα δεν έχει μελετηθεί ολόκληρο αυτό το διάστημα. Σκοπός, λοιπόν, της διπλωματικής μου είναι να εκτιμήσει και να αναλύσει την αποτελεσματικότητα του ελληνικού τραπεζικού συστήματος για ολόκληρο το διάστημα 1993-2005, να εξετάσει την εξέλιξη της αποτελεσματικότητας, να μελετήσει τις αποτελεσματικότητες μεταξύ των τραπεζών διαφορετικού μεγέθους και ιδιοκτησιακής μορφής, να εξετάσει σε δεύτερο επίπεδο ανάλυσης, μέσω παλινδρομήσεων, τους παράγοντες εκείνους οι οποίοι επηρεάζουν την αποτελεσματικότητα των τραπεζών και να κάνει σύγκριση των αποτελεσμάτων που προέκυψαν από τις δύο μεθόδους που χρησιμοποιήθηκαν (μια παραμετρική και μια μη παραμετρική).

Όσον αφορά στην μεθοδολογία εφάρμοσα αρχικά την παραμετρική μέθοδο Stochastic Frontier Approach, σύμφωνα με την οποία υπάρχει ένα composite error term. Για την εκτίμηση της αποτελεσματικότητας κόστους και εναλλακτικού κέρδους χρησιμοποιήσαμε την translog συνάρτηση κόστους και κέρδους, αντίστοιχα. Το δείγμα μου αποτελείται από όλες τις ελληνικές εμπορικές τράπεζες, ενώ έχουμε συμπεριλάβει και μία ξένη τράπεζα, την τράπεζα Κύπρου. Για τον προσδιορισμό των inputs και outputs υιοθέτησα την intermediation approach.

Από τα αποτελέσματα της μέσης αναποτελεσματικότητας κόστους και εναλλακτικού κέρδους για όλη την εξεταζόμενη περίοδο, παρατηρούμε ότι η μέση αναποτελεσματικότητα κόστους είναι 16,4%, ενώ κέρδους 55,4%. Συνεπώς, προέκυψε ότι μια μέση τράπεζα του δείγματος πρέπει να μειώσει τα κόστη της κατά

16,4% και αντίστοιχα να αυξήσει τα κέρδη της κατά 55,4%, εάν θέλει να πλησιάσει τα επίπεδα επιδόσεων της τράπεζας που λειτουργεί με τον αρτιότερο τρόπο. Επίσης, παρατηρείται ότι οι τράπεζες στην Ελλάδα είναι πιο αποτελεσματικές όσον αφορά στον έλεγχο του κόστους τους απ' ότι στη δημιουργία κερδών. Ένα άλλο αποτέλεσμα που προέκυψε είναι ότι υπάρχει θετική σχέση μεταξύ μεγέθους και αποτελεσματικότητας κόστους, ενώ οι μικρότερες τράπεζες φαίνεται να είναι πιο αποτελεσματικές όσον αφορά στο κέρδος. Επίσης, παρατηρήθηκε ότι οι δημόσιες τράπεζες είναι πιο αποτελεσματικές από πλευράς κόστους και πιο αναποτελεσματικές από πλευράς κέρδους.

Στη συνέχεια, εξέτασα σε δεύτερο επίπεδο ανάλυσης τους παράγοντες εκείνους που ενδεχομένως επηρεάζουν την αποτελεσματικότητα κόστους και κέρδους μέσω παλινδρομήσεων της εκτιμημένης αναποτελεσματικότητας πάνω σε ορισμένες ανεξάρτητες μεταβλητές. Τα αποτελέσματα έδειξαν ότι υπάρχει θετική σχέση μεταξύ της αποτελεσματικότητας κόστους και της ποιότητας των δανείων, ενώ υπάρχει μια αρνητική σχέση μεταξύ της αποτελεσματικότητας κέρδους και του δείκτη ρευστότητας. Επίσης, οι πιο αποτελεσματικές τράπεζες από πλευράς κόστους παρουσιάζουν καλύτερη κεφαλαιοποίηση και έχουν χαμηλότερη ρευστότητα, ενώ οι πιο αποτελεσματικές τράπεζες από πλευράς κέρδους τείνουν να έχουν μικρότερο μέγεθος όσον αφορά στο Ενεργητικό τους.

Προχωρώντας την διπλωματική μου άλλο ένα βήμα, εφάρμοσα την μη παραμετρική μέθοδο Data Envelopment Analysis πάνω στο ίδιο δείγμα τραπεζών και για την ίδια εξεταζόμενη περίοδο, για να εκτιμήσω την αποτελεσματικότητα κόστους. Για να είμαστε σίγουροι ότι τα αποτελέσματα των δύο μεθόδων είναι συγκρίσιμα, οι δύο μέθοδοι έχουν το ίδιο efficiency concept (cost inefficiency), το ίδιο δείγμα, την ίδια εξεταζόμενη περίοδο, και την ίδια εξειδίκευση inputs και outputs. Συγκρίνοντας τις δύο μεθόδους, η μέση αναποτελεσματικότητα με βάση την παραμετρική μέθοδο, SFA, είναι 19,5%, ενώ με βάση την μη παραμετρική μέθοδο DEA είναι 36.1%. Επομένως, υπολογίζοντας την αναποτελεσματικότητα με βάση την μη παραμετρική μέθοδο τα αποτελέσματα που προέκυψαν είναι περίπου δύο φορές μεγαλύτερα από αυτά που προέκυψαν από την μέθοδο SFA. Επίσης, τα αποτελέσματα που προέκυψαν και με τις δύο μεθόδους, δείχνουν ότι η τιμή της αναποτελεσματικότητας μειώνεται κατά τη διάρκεια της εξεταζόμενης περιόδου. Πρέπει να επισημάνουμε και τη θετική συσχέτιση μεταξύ των αναποτελεσματικοτήτων που εκτιμήθηκαν με τις δύο μεθόδους: 41%. Οι εκτιμήσεις, όμως, που προέκυψαν για την αναποτελεσματικότητα

κόστους με την παραμετρική και μη παραμετρική μέθοδο διαφέρουν μεταξύ των τραπεζών. Όσον αφορά στο μέγεθος των τραπεζών και οι δύο μέθοδο κατέληξαν στο ότι όσο μεγαλύτερη είναι η τράπεζα, τόσο πιο ικανή είναι να ελέγχει τα κόστη της. Αντίθετα, όσον αφορά στην ιδιοκτησιακή μορφή των τραπεζών, προέκυψαν διαφορετικά συμπεράσματα από κάθε μέθοδο. Από τα παραπάνω συμπεράσματα φαίνεται ότι υπάρχουν κάποιες διαφορές και κάποιες ομοιότητες μεταξύ των αποτελεσμάτων των δυο μεθόδων. Αυτό το γεγονός οδηγεί στο συμπέρασμα ότι είναι σημαντικό να χρησιμοποιούμε περισσότερες από μία μεθόδους για να εκτιμήσουμε την αποτελεσματικότητα των τραπεζών.

Στα παραρτήματα παρουσιάζουμε ένα σύντομο «προφίλ» για κάθε μία από τις εν λειτουργία ελληνικές τράπεζες, για να μπορέσει ο αναγνώστης να πάρει μια γεύση του «τοπίου» του ελληνικού τραπεζικού συστήματος και να βάλει τα προεκτεθέντα μέσα σε κάποιο «πλαίσιο», περιληπτικά στοιχεία των ξένων τραπεζών, και την εξήγηση του λόγου που δεν τις συμπεριλάβαμε στο panel μας και που έχει να κάνει με την μη υποχρέωσή τους να καταρτίζουν πλήρεις λογιστικές καταστάσεις (εκ του Ευρωπαϊκού δικαίου) και τη συνακόλουθη έλλειψη κρίσιμων δεδομένων για εμάς, όπως ιδίως τα έξοδα τόκων.

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APPENDIX I – The profile of Greek banks

National Bank of Greece (www.nbg.gr)

National Bank of Greece (NBG) is the oldest and largest among Greek banks, and it heads the strongest financial group in the country. It boasts a dynamic profile internationally, particularly in Southeastern Europe and the Eastern Mediterranean. In the 1990s and 2000s it has expanded its operations in the newly-liberalized economies of the Balkans. Particularly notable is the recent (2006) acquisition by NBG of Finansbank, the eighth (8th) largest bank in Turkey by assets; this is the largest ever Greek investment in Turkey, and bears particular importance given the, at times, tense and delicate, relationship between the two countries.

NBG was founded in 1841 as a commercial bank, and enjoyed the right to issue banknotes[79], until a central bank, namely the Bank of Greece, was established in 1928. It has been listed on the Athens Stock Exchange since the exchange was founded in 1880. Since October 1999, NBG has been listed on the New York Stock Exchange; it is the only Greek bank that does so. The NBG Group provides a full range of financial products and services targeted to both corporate customers and private individuals, including, but not limited to, investment banking services, brokerage, insurance, asset management, leasing and factoring.

The bank's branch and ATM network is the largest in Greece (it includes more than 570 domestic banking units and over 1300 ATMs), effectively covers the entire country. It is developing and expanding alternative distribution channels for its products, such as Mobile and Internet banking. Today, after recent acquisitions in the Balkans the Group's network overseas includes 290 units. One of the Bank' s main strengths is the confidence shown in it by its customers, who hold over 9 million deposit accounts and more than 1 million lending accounts with the bank. Most importantly, in **February 2006** the board adopted a detailed set of Corporate Governance Guidelines that set out the Bank's corporate governance arrangements and policies. As a result of these changes, NBG has broadly aligned its corporate governance to global best practice and is now a corporate governance leader in the both the Greek banking sector and the Greek capital market.

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[79] This right was an exclusive one from 1920 on.

NBG views corporate governance as a key factor in the group's competitiveness and a fundamental driver of confidence amongst NBG investors and stakeholders. Corporate governance is especially important in view of the Bank's transformation from a state-controlled entity to a widely- held group with a growing regional footprint and more than 30% of its capital in the hands of foreign institutional investors.

According to the 2005 Annual Report of the bank, 22.2 per cent of the bank's shares are owned by pension funds and other entities of the Greek public sector. Other domestic institutional investors own 15.8 per cent of the stock, while private domestic investors own another 23.2 per cent[80]. However, (dispersed) international ownership has become increasingly larger in the last years, reaching a particularly significant share of 38.8 per cent by the end of 2005. This trend is expected to continue with a vengeance, since NBG is planning to double its equity in order to finance its acquisition of Finansbank of Turkey.

Alpha Bank (www.alpha.gr)

Alpha Bank is the second largest bank in Greece and the largest fully private-sector one (the Greek state, and funds controlled by it, still own a significant block of shares in the largest bank of Greece, namely the National Bank of Greece). The Bank's activities cover the entire range of financial services. The group of Alpha Bank has 450 branches, and in addition to its presence in Greece, is also active in the international banking market, with presence in Cyprus and Southeastern Europe as well as in New York, London and Jersey in the Channel Islands.

Alpha Bank was founded in 1879 by John F. Costopoulos, when he established a commercial firm in the southern Greece city of Calamata (Calamai). In 1918 the banking department of the "J.F. Costopoulos" firm was renamed to "Bank of Calamai". In 1924 the Bank's headquarters were moved to Athens, and it was renamed to "Banque de Crédit Commercial Hellénique". In 1947 the name of the bank was changed to "Commercial Credit Bank", in 1972 to "Credit Bank", and finally in March 1994 to "Alpha Credit Bank". The bank grew considerably in the last decades, and beyond providing banking services and products, it offers a wide range of financial services in the context of the group's activities.

[80] NBG subsidiaries own a negligible 0.02 per cent

In 1999, the bank acquired a 51 per cent stake in the Ionian Popular Bank. On April 11, 2000 Alpha Credit Bank absorbed the whole of the Ionian Popular Bank, also changing the name of the bank emerging from the merger, to the present name, i.e. Alpha Bank.

The Costopoulos family owns 9 per cent of the bank's shares, while the rest of ownership is dispersed, with 42 per cent held by private investors, 46 per cent by institutional investors (of which 11 per cent Greek and 35 per cent foreign), while 3 per cent of yhe stock is owned by the bank itself.

EFG Eurobank Ergasias (www.eurobank.gr)

EFG Eurobank Ergasias was first established in 1990 as Euromerchant Bank aiming at providing mainly investment services. Today, it offers a full range of banking products, aimed at individuals, corporations and institutions. The Bank has built up leading market positions in a number of areas. In addition to its providing of consumer loans, credit cards, small business lending, SME lending and mutual fund management, it has a significant presence in corporate banking, investment banking, and capital markets, through its subsidiaries. It employs over 17,000 people, in Greece and abroad, with a local distribution network of over 900 branches and 750 ATMs. In 2006, Eurobank EFG group is entering the banking markets of Poland and Turkey.

EFG Eurobank Ergasias is one of the companies with the largest shareholding base in Greece, as over 300,000 private and institutional investors own its shares through the Athens Exchange. The ultimate parent company of EFG Eurobank Ergasias is the EFG Bank European Financial Group, controlled by Latsis family interests, which holds 40.8 per cent of total shares. The control of bank mainly lays with Spiros Latsis, son of the Greek shipping tycoon. The remaining 59.2 per cent of the bank's ownership is dispersed, with 29.7 per cent belonging to retail shareholders, 5.8 per cent to Greek institutional investors, and finally 23.7 per cent to foreign institutional investors.

Agricultural Bank of Greece (www.ate.gr)

The Agricultural Bank of Greece was founded on July 27, 1928[81], by way of a contract between the Greek state and the National Bank of Greece, as an "autonomous banking organization of a public welfare character", having as its goal the effecting of banking operations, especially towards providing agricultural credit, but also towards exercising supervision on agricultural cooperatives[82]. However, with the provision of article 26, paragraph 1 of Law 1914/1990, Agricultural Bank of Greece was incorporated as a *société anonyme*. Although, it still maintains the supervision of agricultural cooperatives, in that sense being an agent of public authority, the exercising of this supervision seems to have lost its erstwhile significance. Indubitably, however, agricultural credit and all other banking operations the Agricultural Bank of Greece engages in constitute normal commercial acts and it is this sense that we consider the Agricultural Bank of Greece a fully-fledged participant in the Greek banking system.

So, the Agricultural Bank was established as a non-profit organization, providing credit to the agricultural sector. The bank mainly aimed (and still does) at implementing programs for financing both the activities of the primary sector of the economy and the processing and marketing of agricultural products, and enhancing rural development. In 1950 the bank expanded its activities in the agricultural sector by founding a host of companies producing farming products and exploiting resources across the country.

In 1980, the Agricultural Bank of Greece expanded in the non-agricultural sector, by developing both a broad branch network across Greece and a variety of new financial products and services. To the same direction, the bank entered the insurance industry.

As we already mentioned above, 1991 was another milestone year for the Agricultural Bank of Greece, since it was marked by the bank's incorporation as a *société anonyme*. Finally, in 2000 the bank entered the Athens Stock Exchange.

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[81] See Psychomanis (2006), in particular pp. 118-9

[82] It is this aspect of Agricultural Bank of Greece that lends it a special character beyond it being a mere for-profit corporation

Agricultural Bank is the Greek public sector bank *par excellence*, since the Greek state still holds 84.49 per cent of the bank's stock[83]. In [July] **2006** the Bank expands its activities in the area of Balkans with the purchase of MINDbank and the permission for banc assurance operations in Romania.

Emporiki Bank (www.emporiki.gr)

The life of Emporiki Bank essentially began in 1886, the year in which its founder, Grigorios Empedoklis, established the "Gr. Empedoklis" Banking Office. In 1907, the Emporiki Bank was established after the "Gr. Empedoklis Bank" Limited Partnership changed its status to that of a *société anonyme* named "Emporiki Bank S.A.". The new company was listed in the Athens Stock Exchange.

In 1951, Gr. Empedoklis passed away in South Africa, and in the next year, 1952, Professor Stratis Andreadis joined the bank and took over its management. In 1957 Emporiki Bank acquired the Ionian Popular Bank, in 1958 it acquired the "Ionian" insurance company, in 1962 it acquired Piraeus Bank and the "General Insurances" insurance company, in 1963 it established the Investment Bank, and in 1964, it acquired the Bank of Attica. This series of acquisitions resulted in the Emporiki Bank establishing itself as one of the two major banks in Greece, the other being the National Bank of Greece.

In 1975, the Greek state took control of the bank. A Government Trustee was appointed and Stratis Andreadis was removed from his post. In the next year, 1976, the majority of shares came under the ownership of state-controlled organizations, by way a share capital increase, and Stratis Andreadis became merely a minority shareholder.

The next major change came in 1991-92, where, in the context of deregulation of the banking system in Europe in general, and in Greece in particular, several subsidiaries of the (still under state control) Emporiki Bank were sold, including Piraeus Bank. Another bank controlled by the Emporiki Bank, Bank of Attica, was divested a few years later, in 1997, while in 1999 the Ionian and Popular Bank was sold to Alpha Bank; this concluded the selling off of banks controlled by the Emporiki

[83] See the pertinent section of the bank's annual report for 2004 at http://www.ate.gr/en/pdf/annual04/pages_17_32.pdf

Bank. This control of other banks by Emporiki Bank during the time span examined by our study (Bank of Attica, 1993-97; Ionian and Popular Bank, 1993-99) is significant for our purposes, since it might have been more correct if those controlled credit institutions were subsumed into the controlling entity, Emporiki Bank, for the respective time periods.

Emporiki Bank was one of first domestic credit institutions that had a foreign credit institution become a blockholder. In particular, in 2000, Crédit Agricole of France acquires a 6.7 per cent stake in Emporiki, a stake that was augmented to 8.74 per cent in 2002.

In 2004, Emporiki Bank absorbed ten subsidiaries, including the aforementioned Investment Bank. In a manner analogous to Bank of Attica for the 1993-97 period and Ionian Popular Bank, it would have been more correct if the financial figures of Investment Bank were subsumed into those of Emporiki Bank for the purposes of our study. In 2005 it sell of own shares equal to 5.2 percent of the bank's share capital

As of September 2006, the shareholder structure of the Emporiki Bank is as follows: [84] In addition to the approximately 72 per cent of shares owned by Crédit Agricole, 9 per cent is directly or indirectly (pension funds, the Greek unemployment organization OAED) owned by the Greek state, 14 per cent by Greek small stockholders, while other investors own the remaining 5 per cent of the bank's stock.

In 2006, Emporiki bank announces that significant changes occurred to the composition of its share capital after the increase of **Crédit Agricole's participation and the reduction of the Greek State's participation in the share capital.**

Piraeus Bank (www.piraeusbank.gr)

Piraeus Bank Group was founded in 1916. It was bought over by the Emporiki Bank in 1962 and was its subsidiary since 1975. Then, after Emporiki Bank coming under the control of the Greek state, Piraeus Bank also went through a period of state-ownership and management (1975-1991) before it was privatized in December 1991. Since then, it has significantly grown in size and activities.

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[84] http://www.emporiki.gr/cbgen/gr/emporiki_group/group_story.jsp?docpath=/GR/Investor/static/metoxiki_synthesi&section=stock

Along with its organic growth, Piraeus Bank made a series of strategic moves with the goal of establishing a strong presence in the domestic market. In 1998, the bank absorbed the operations of Chase Manhattan in Greece, took over a controlling interest in Macedonia-Thrace Bank and acquired Crédit Lyonnais (Grèce). In 1999, the Bank acquired Xiosbank and also absorbed the activities of National Westminster Bank in Greece. In early 2002, Piraeus Bank acquired the Hellenic Industrial Development Bank (ETBA) from the Greek state, thus enhancing the group's capital base and market share. ETBA was fully absorbed by Piraeus Bank in December 2003. Also, at the beginning of 2002, a strategic alliance agreement for the Greek market was signed between Piraeus Bank Group and ING, mainly focused in the field of banc assurance.

Piraeus Bank and its subsidiaries cover all financial and banking activities in the Greek market. Piraeus Bank mainly operates in the areas of retail banking, small and medium-sized businesses (SMBs), capital markets and investment banking, leasing and financing of the shipping sector.

Piraeus Bank is characterized by dispersed ownership. . At the end of June 2006, its assets were €23,860.6 million and the pre-tax profit of the period was €267.9 million. The market share for 30.06.2006, among commercial banks operating in Greece, is 12.0% in terms of loans and 10.8% in terms of deposits. At the end of June 2006, the branch network included 289 units (288 in Greece, 1 in London) and the Bank had 4,502 employees. Piraeus Bank's stocks are listed in the Athens Stock Exchange (ATHEX) since 1918.

Greek Postal Bank (www.ttbank.gr) **(SPECIALIZED INSTITUTION)**

The Greek Postal Savings Bank began its operations in Crete in 1900, before the island had even become part of the modern Greek state. It was in 1909 that the Greek Postal Savings Bank commenced operating across Greece. In particular[85], the Greek Postal Savings Bank[86] In 1914-15 was initially established by Law

[85] See Psychomanis (2006), in particular p. 118

[86] Greek name: "Ταχυδρομικό Ταμιευτήριο"; please note the lack of the word "bank" ("τράπεζα") in its name. Although the Greek name has been translated as "Greek Postal Savings Bank" in English, the more direct mapping of the Greek word "ταμιευτήριο" is to German "Sparkasse" (hence "Postsparkasse" if a postal one; actually Austria has a financial institution named exactly so; see http://www.psk.at – in German) or to French "Caisse d' Epargne". This is stressed in order to render

ΓΥΜΣΤ/1909[87] as a standalone public service under the supervision of the Minister of Transport and Communications, having as its mission the cultivation and development of the spirit of saving, the exploitation of deposits for the economic development of the country, the fulfilment of more general goals of public welfare and the execution of credit operations. It was that year (1909) that the organization's headquarters were moved from Crete to Athens.

In 2002, the organization became a *société anonyme* as Law 3082/2002 came into effect. This marked the transitioning of the Greek Postal Savings Bank into a full-blown banking institution; in 2003, home credit products started getting provided to individuals outside the public sector, while in 2004 operations expands into retail banking. As of this writing, the Greek Postal Savings Bank is performing an IPO that will bring it into the Athens Stock Exchange.

Given that neither the legal form of the Greek Postal Savings "Bank" until 2002 (it was public service, rather than a *société anonyme*) was that of a banking institution, nor was it included in the purview of the Basic Banking Law 2076/1992 (according to article 3 of that law, "the following credit institutions: α. the Bank of Greece, β. the Greek Postal Savings Bank, γ. ETBA, δ. the Deposit and Loans Fund" "are excluded from the application of the present law"), in addition to the fact that is really was an institution akin to a Savings & Loan association in the United States, and certainly not a bank in the classical sense of the word, led us to omit the financial data of this institution from our study. The institution's incorporation is a step in the goal of it becoming a "mainstream" bank[88].

The Greek Postal Saving Bank is now [2006] in a modernization stage, after having been altered to a Societe Anonyme and after have been permitted to proceed with an enlargement of its transactions, so to cover the entire range of the market

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clear that this Greek financial institution was not established as a bank per se, and actually legally only became one in 2002; the English translation, which predates the institution's transformation to a banking S.A., was a misnomer and should be treated as such. The incorporation of the Greek postal savings institution as a bank and its anticipated IPO, is in line with recent analogous moves in major EU countries: the banking operations of Deutsche Post became PostBank in 1990, incorporated as an Aktiengesellschaft (AG) in 1995, and entered the Deutsche Börse in 2004; likewise in January 2006, the French Post ("La Poste") spun off its banking operations, creating La Banque Postale S.A.

[87] Ancient Greek numbering, using Greek letters, was using to number laws in certain periods of the modern Greek state

[88] "Une banque comme les autres", as the slogan of La Banque Postale goes.

banking products. The Greek Postal Savings Bank is a member of the Hellenic Bank Association, the Association of the European Savings Banks and the World Saving Banks Institution. The Greek Postal Saving Bank is listed at the Athens Stock Exchange **since June 2006**.

Geniki Bank (www.geniki.gr)

In October 1937, the Army Pension Fund founded the precursor of today's Geniki Bank, the Bank of the Army Pension Fund. It performed a limited range of banking operations and its customers were mainly army officers. In September 1966, by a decision of the Minister of Commerce, the bank was renamed to Geniki Bank. At that time it had just 7 branches, of which 5 is Attica, one in Thessalonica, and one in Patras. The bank entered the Athens Stock Exchange in 1985. **In 2006,** Geniki Bank, member of Societe Generale, one of the largest financial groups in the euro-zone, with more than 90.000 employees, serving more than 16 million clients worldwide, stands today at a very important point. The bank enters a new era. Many positive initiatives have been taken and improvements have been achieved at all levels. The network of branches is being renovated and, by the end of the year, a significant number of new branches will be opened. New products are being prepared and soon will be launched in the market.

Egnatia Bank (www.egnatiabank.gr)

Egnatia Bank was founded in Thessalonica in 1991 by a group of Greek entrepreneurs. In 1999 it acquired the Bank of Central Greece; this way it also entered the Athens Stock Exchange. 49.76 per cent of the bank's stock is widely dispersing, while the controlling 50.24 per cent is owned mainly by Greek entrepreneurs, most notably Vassilis Theocharakis. By May 10, 2006, Marfin Financial Group had acquired the ownership of 40.66 per cent of Egnatia Bank.

Laiki Bank (www.laiki.gr)

The first branch of Laiki Bank (Hellas) S.A. was opened in 1992. At the time the bank's operations in Greece went under the name "European Popular Bank", even though the parent (Cypriot) bank was called Laiki. Today Laiki Bank (Hellas) operates 55 branches.

The parent bank was established in Limassol, Cyprus (then under British rule) in 1901 when Agathoclis Francoudis, loannis Kyriakides, Christodoulos Sozos and Neoklis loannides establish the "Popular Savings Bank of Limassol". Currently the Laiki Group has operations in Cyrpus, the UK, Greece, Australia, the USA, Canada, South Africa, Russia, and Serbia and Montenegro.

Attica Bank (www.atticabank.gr)

Attica Bank operates as a Banking Societe Anonyme, according to the provisions of the Law 2190/20, on the Societes Anonymes, as it is now valid, the provisions of the Law 2076/92 on the Financial Institutions and, also, the provisions of other related legislation. Duration is defined to hundred years from the date of its founding statutory decree, i.e. from February 5, 1925 to February 4, 2025. According to the Article 2 of its Statutes, main object of this banking company is to act in the area of banking industry on its own behalf and on behalf of others.

In 1964 it became a member of the Emporiki Bank Group and on June 2, 1964 it got listed in the Athens Stock Exchange.

On June 26, 1997 the group handed a portion of its stock over to TSMEDE (the Engineers and Public Works Contractors and Pension Fund) and the Deposits and Loans Fund. On September 9, 2002, the Emporiki Bank Group handed all of the remained shares over to the Greek Postal Savings Bank.

As a result, as of November 2006, the Engineers and Public Works Contractors' Pension Fund, holds 41.96 per cent of the shares, the Greek Postal Savings Bank, holds 19.10 per cent, while the Deposits and Loans Fund is owner of 19.13 per cent. The remainder of the bank stock is widely dispersed.

Aspis Bank (www.aspisbank.gr)

Aspis Bank S.A. was established in June 1992 by AEGON GRIEKENLAND HOLDING B.V. and entrepreneur P. Psomiades, each holding 50 per cent of shares. Initially the bank was established as a specialized mortgage bank, only recently becoming a general-purpose, "universal" bank. When it still was a mortgage bank, Aspis Bank and the erstwhile National Housing Bank were the only credit institutions that could provide mortgages subsidized by the Workers' Housing Organization (OEK, after the Greek acronym).

In 1998, the bank was listed on the Athens Stock Exchange and consolidated its presence in the capital market by acquiring 30% of ASPIS Mutual Fund Management Co S.A. and 20% of ASPIS Securities S.A. In 2001, the bank's transition from a mortgage bank to a commercial one was successfully materialized. The bank significantly expanded its network by adding 16 new branches in 2001, having already added 5 new ones in the previous year, 2000.

The bank's network grew from 41 branches at the end of 2001 to 62 branches at the end of 2002. 16 new branches came through the acquisition of the branch network of ABN AMRO in Greece, while 5 new branches were the result of organic growth.

Panagiotis Psomiadis is, since 1987, the majority shareholder of Aspis Pronoia, one of the major insurance groups in Greece. Aspis Bank can be considered, in a sense, as the banking arm of a wider group, of which the insurance company is the flagship.

NovaBank (www.novabank.gr**)**

NovaBank is 100 per cent owned by Banco Comercial Portugues (BCP), the largest private Portuguese bank. It was founded in 2000 as a joint venture between Greek entrepreneur Dimitris Contominas (40 per cent and control), BCP (50 per cent), and Eureko, a European insurance group of primarily Dutch interests (10 pent). By early 2005, Dimitris Contominas sold off his share in the bank, with BCP being the purchaser. Given that Eureko had already sold off its share by that time also, BCP acquired full ownership of the bank. It is interesting to note that Dimitris Contominas was founder and major shareholder of Interbank in the early 1990s; Interbank was taken over by Eurobank in 1996.

NovaBank has a significant presence in the major urban centers of Athens and Thessalonica, and a sparser one in smaller cities around the country. It controls about 1 per cent of the total market share. The parent institution (BCP) also owns banks in Poland (Bank Millennium) and Turkey (BankEuropa), in countries where there is significant presence of Portuguese immigrants (USA, Canada), as well as in countries that formerly constituted Portuguese colonies (Angola, Mozambique). The focus areas for NovaBank are loans to SMBs and home mortgages. In 2006, **NovaBank has a network of** 112 Retail Banking branches, 3 Private Banking centers, and 19 Business Banking and Factoring units.

ProBank (www.probank.gr)

ProBank was founded in 2001 by executives that left EFG Eurobank-Ergasias after Ergasias ("Ergobank") was acquired by Eurobank. Dispersed ownership is one of the basic characteristics of the bank. The first branch was opened in November 2001. In 2006, no other individual shareholder owns more than 3.5% of the shares issued and outstanding. The Banker magazine ranked it in 2005 as being among the 50 Contender Banks for entering the Top 1000 World Banks this year. The focus of the bank is in providing credit to SMBs.

Omega Bank (www.omegabank.gr)

Omega Bank obtained a license for operating as a credit institution from the Bank of Greece in January 2001. In October of the same year it opened its first branch, offering retail, private, and corporate banking services. By the end of 2001 Omega Bank had seven branches in operation.

In 2006, PROTON BANK absorbed OMEGA Bank, with the new entity's share capital reaching € 350 mil.

FBBank – First Business Bank (www.fbb.gr) **(CORPORATE BANKING)**

First Business Bank was established in November 2001, and it acquired the assets and liabilities of the Greek branch of the Bank of Nova Scotia (also known as ScotiaBank, one the top six Canadian banks). The Bank of Nova Scotia had built a strong corporate banking business over its 30 years of presence in Greece. The focus of the Canadian bank's operations in Greece had been in the shipping and hotel sectors; however, it also maintained relationships with a host of firms in other industries too. At the same time, FBBank also acquired the branch network of Bank of Nova Scotia, which included seven branches, mainly in Athens, serving primarily corporate customers.

In 2004, the bank entered the retail banking market by developing and offering a wide range of services to private customers. Today, FBBank offers a wide range of services targeted both to business and private customers. It has established a presence beyond Athens, including most important Greek cities.

The bank's shareholder structure is as follows: private investors (primarily from the shipping business) hold 51 per cent of the share capital, the Agricultural Bank of

Greece holds 44 per cent, while the Bank of Nova Scotia owns the remaining 5 per cent.

Marfin Bank (www.marfingroup.gr)

Marfin Bank specializes in private and personal banking, commercial banking, treasury, and capital markets. The primary aim of the bank is to provide complete investment and financial services to private and corporate clients. The bank currently operates nine (9) branches, of which six (6) in the Athens metropolitan area, and one (1) each in Thessalonica, Larissa, and Chios.

The bank was incorporated in 1981 under the name of Hellenic-French Bank, as a joint venture of ETEBA (the "development" bank controlled by NBG) and Crédit Lyonnais of France. In 1991, ETEBA sold its stake to Crédit Lyonnais[89], which thus became the sole shareholder of the bank, changing its name to Crédit Lyonnais (Grèce). In 1998, Crédit Lyonnais (Grèce) was acquired by Piraeus Bank and renamed into Piraeus Prime Bank. The saga continued in 2002, Marfin Financial Services S.A. bought Pireaus Prime Bank over, giving it its current structure and naming it Marfin Bank S.A.

As of year end 2005, the largest single shareholder in Marfin Bank was Morgan Stanley with 14.04 per cent of shares; Andreas Vgenopoulos, the chief executive of the firm held 6.35%. Nine (9) other individuals and corporations held percentages of the share capital between 2.3 and 5.0. On May 16, 2006, Dubai Financial acquired a 31.5 per cent stake in the Marfin Financial Group holding company. Also, by May 10, 2006, Marfin Financial Group had acquired the ownership of 40.66 per cent of Egnatia Bank.

Panellinia Bank (www.panelliniabank.gr)

Panellinia Bank was established in April 2001 and commenced its operations in June 2001. All Greek cooperative banks (16 in total), along with 13 credit

[89] Isn't this the fate of so many joint ventures? Cf. for instance the NovaBank case where Dimitrios Contominas sold his share in the bank less than four years after its opening. Lester Thurow of MIT in his talk "The Emergence of China in the Global Economy" (http://mitworld.mit.edu/stream/218/) quips: "If you come back 3-5 years later, one of three things has happened: one side bought out the other side, or one side have become a silent financial partner – all the management is done by one side, or they're at war with each other! There are no successful long-term joint ventures; or very few."

cooperatives, felt the need for a centralized, yet independent operation (for purposes of achieving economies of scale, synergies, and coping with market competition); to that goal they jointly decided to form Panellinia Bank.

The twenty-nine (29) institutions represent over 150,000 shareholders. The largest of the aforementioned financial institutions are the Pan-Cretan Cooperative Bank (based in Heraclion, the largest city in the island of Crete), the Cooperative Bank of Chania (Chania is the second largest city in Crete), the Achaean Cooperative Bank (based in the city and major port of Patras) the Cooperative Bank of the Dodecanese (with headquarters in Rhodes), and the Cooperative Bank of Lamia (based in the city of Lamia, a major commercial hub in Central Greece). Together they own more than 72 per cent of the share capital of Panellinia Bank. The German central cooperative bank DZ Bank AG participates in the equity of the bank with a share of 10 per cent.

Proton Investment Bank (www.proton.gr) **(INVESTMENT BANKING)**

PROTONBANK was established in September 2001 and officially commenced operations in February 2002. The founders of the bank are the late John Markopoulos, and Messrs A. Athanasoglou and E. Lianos. Following a rapid development path, the Bank was listed on the Athens Stock Exchange in December 2005 and later absorbed three listed closed-end funds, namely Arrow, Exelixi and Eurodynamics. PROTONBANK focuses on investment banking and the provision of specialized corporate advisory and investment services. PROTONBANK does not engage in traditional banking services and therefore its organic growth does not rely on its loan portfolio income. Its engagement in extending credit is limited, mainly to the underwriting of marketable instruments placed through syndications. Given the above, PROTONBANK did not making the cut for getting included in our data set. **In 2006, PROTON BANK absorbed OMEGA Bank**, with the new entity's share capital reaching € 350 mil.

Investment Bank of Greece (www.marfingroup.gr) **(INVESTMENT BANKING)**

The Investment Bank of Greece (IBG) was incorporated in 2000 as a specialized investment banking institution. In 2004, IBG merged with Marfin Helliniki Securities of the Marfin Group (see Marfin Bank above).

The services provided are targeted to the investment needs of enterprises and private investors such as local brokerage, access to foreign stock exchanges, research, consulting services, commodities and derivatives markets in Greece and abroad. In addition to the above, the bank provides investment banking services (syndicated loans, project finance, etc.). IBG is also a market maker in the Athens Stock Exchange and the Athens Derivatives Exchange.

Aegean Baltic Bank (http://www.hsh-nordbank.de/) **(CORPORATE BANKING)**

One of the most important changes in the sector of late has been the merger, completed at the start of June 2003, between Hamburgische Landesbank and the Schleswig -Holstein Landesbank, LB Kiel, to create HSH Nordbank.

The unified institution, easily the world's largest ship finance institution with a $16bn portfolio worldwide, becomes the second- largest force in the Greek market for shipping credit[90]. The two banks in January 2003 had separate portfolios summing up to $2.1bn.

The German giant gained an indirect presence in Greece in the fall of 2002 with the opening of Athens-based Aegean Baltic Bank, 51 per cent owned by it (initially by LB Kiel), with a 49 per cent participation by independent Greek bankers and marine finance experts.

Aegean Baltic Bank functions independently, but in close cooperation with the German major shareholder. The main intention of HSH Nordbank is for Aegean Baltic Bank to serve smaller owners with whom HSH Nordbank would like to have a relationship for the future, but who might otherwise fall outside the big bank's parameters (http://www.petrofin.gr/mc/2003/bkp/bkp.html).

Emporiki Credicom (www.emporiki.gr) **(CORPORATE BANKING)**

Emporiki Credicom is a subsidiary of Emporiki Bank, specializing in "wholesale consumer" banking. It was founded on July 2002 as a strategic alliance between Emporiki Bank and Crédit Agricole. In particular, Emporiki Credicom is a

[90] This brings us to the definition of the market, an issue of major importance of applying competition policy. Does it really make sense to lump banks by geography when capital is mobile and can shop around for debt (or other banking products) across geographical lines? I.e. how relevant is geography as a classificatory criterion that will at the end determine decisions about competition policy?

joint venture by Emporiki Bank and Sofinco, which is a subsidiary banking company of Crédit Agricole sharing the same scope of operations. Sofinco is one of the leading forces in the field of consumer credit in France - since 1951, but also in Europe, being present in the related markets of eight countries other than France.

Citibank Shipping (under liquidation, www.citibank.gr**)** **(CORPORATE BANKING)**

In 1989 Citibank established "Citibank, Shipping Bank S.A." in Greece with the goal of providing credit to the shipping industry. In 1998, however, Citibank Shipping merged with Citibank S.A. of Greece, its parent company, in order to aid an administrative restructuring[91]. The move helped in simplifying procedures, and saving customers' time and money. The shipping department remained in the port of Piraeus in the same premises, continuing to offer the same services as before.

Unlike its parent, namely the Greek branches of Citibank proper, Citibank Shipping was a full-blown Greek bank registered with and regulated by the Bank of Greece. This means that unabridged financial statements are available for the years of operation of Citibank Shipping, whereas data such as (gross) interest income and interest expense are unavailable for the (larger and still extant) parent.

Investment Bank (www.emporiki.gr**)** **(INVESTMENT BANKING)**

Investment Bank was the first investment bank in Greece. It was founded in 1962 by Emporiki Bank and Ionian Popular Bank of Greece, together with large international investment organizations, such as Bank of America, Dresdner Bank, etc. By the end of the 1980s, a large portion of Investment Bank operations had been transferred to Emporiki Bank, resulting in the shrinking of the Investment Bank, and, practically, it becoming inactive. In 2001, the Emporiki Bank Group reactivated the Investment Bank, with the goal of it providing new, specialized investment banking services.

In its last reincarnation, the Investment Bank specialized in providing investment banking services to corporations, institutional investors, insurance funds and organization, but also individuals.

On December 10, 2004 Emporiki Bank absorbed, *inter alia,* the Investment Bank, in the context of group consolidation. As the merger of Emporiki Bank with the

[91] http://www.hri.org/news/greek/ana/1998/98-12-12.ana.html

Investment Bank was concluded, it resulted in the consequent increase of the share capital of Emporiki Bank.

APPENDIX II - Foreign Banks in Greece

Table A.II.1 Foreign Banks Operating in Greece and Year they Began to

Country of Controlling Interest in the Bank	Year of Opening First Branch in Greece
Cyprus	
Bank of Cyprus	1991
Hellenic Bank	1998
France	
BNP Paribas (Hellas)	1982
BNP Securities Services	2000
CETELEM	2001
Credit Commercial de France	1981
Société Générale	1980
Germany	
Bayerische Hypo- und Vereinsbank	1989
EUROHYPO	2004
Iran	
Bank Saderat Iran	1977
Italy	
FIDIS BANK	2003
SANPAOLO IMI	1993
The Netherlands	
ABN AMRO	1974
Spain	
Unión de Créditos Inmobiliarios	2003
United Kingdom	
HSBC Bank	1981
Royal Bank of Scotland	1973
United States of America	
American Bank of Albania	2004
American Express	1921
Bank of America	1968
Citibank	1964
FCE Bank	1995
GMAC Bank	2002

Table A.II.2 Branches Of Foreign Credit Institutions: Total Assets (in millions of euros)

Credit Institution	Dec 31, 2005		Dec 31, 1993	
	Total Assets	Rank	Total Assets	Rank
Bank of Cyprus	7,162.62	1	324.02	14
Citibank	5,635.01	2	1,595.10	1
Royal Bank of Scotland	3,701.99	3	391.47	8
HSBC Bank	2,872.07	4	701.9092	2
BNP Paribas (Hellas)	1,423.10	5	-	-
Bayerische Hypo- und Vereinsbank	1,356.86	6	326.78	9
Hellenic Bank	943.97	7	-	-
ABN AMRO	751.82	8	684.29	4
SANPAOLO IMI S.p.A.	429.63	9	-	-
FCE Bank Plc	238.04	10	-	-
Bank Saderat Iran	127.63	11	16.06	19
Société Générale	127.17	12	434.34	7
American Express	120.90	13	324.02	10
American Bank of Albania	24.81	14	-	-
CETELEM	22.25	15	-	-
FIDIS BANK	16.10	16	-	-
BNP Securities Services	10.29	17	-	-
Volkswagen Bank	1.91	18	-	-
EUROHYPO A.G.	N/A	N/A	-	-
Credit Commercial de France	To HSBC	-	290.78	12
Bank of America	N/A	N/A	184.77	17
GMAC Bank	N/A	N/A	-	-
Barclays Bank	To HSBC	-	686.13	3
Banque Nationale de Paris	Merged into BNP Paribas	-	486.96	5
National Westminster Bank	To Piraeus Bank	-	474.00	6
Banque Paribas	Merged into BNP Paribas	-	323.89	11
Bank of Nova Scotia	To First Business Bank	-	280.48	13
Chase Manhattan Bank	To Piraeus Bank	-	226.82	15
ANZ Grindlays Bank	To Aspis Bank	-	214.74	16
Arab Bank	-	-	84.67	18

[92] As Midland Bank

Table A.III.3 Branches Of Foreign Credit Institutions: Loans (in millions of euros)

Credit Institution	Dec 31, 2005		Dec 31, 1993	
	Loans	Rank	Loans	Rank
Bank of Cyprus	4,287.48	1	124.62	9
Royal Bank of Scotland	2,027.77	2	256.72	5
Citibank	1,617.71	3	273.69	4
HSBC Bank	1,413.27	4	241.67	6
Bayerische Hypo- und Vereinsbank	660.38	5	38.31	15
BNP Paribas (Hellas)	659.71	6	-	-
Hellenic Bank	506.07	7	-	-
ABN AMRO	372.46	8	502.57	2
FCE Bank Plc	231.22	9	-	-
SANPAOLO IMI S.p.A.	180.82	10	-	-
American Express	33.63	11	59.31	13
CETELEM	20.83	12	-	-
FIDIS BANK	14.05	13	-	-
Société Générale	11.88	14	133.91	7
Bank Saderat Iran	1.08	15	13.74	19
American Bank of Albania	1.02	16	-	-
BNP Securities Services	0.37	17	-	-
Volkswagen Bank	0.31	18	-	-
EUROHYPO A.G.	N/A	N/A	-	-
Credit Commercial de France	To HSBC	-	92.33	11
Bank of America	N/A	N/A	30.80	18
GMAC Bank	N/A	N/A	-	-
Barclays Bank	To HSBC	-	514.58	1
Banque Paribas	Merged into BNP Paribas	-	307.85	3
Banque Nationale de Paris	Merged into BNP Paribas	-	133.34	8
Bank of Nova Scotia	To First Business Bank	-	110.92	10
National Westminster Bank	To Piraeus Bank	-	70.12	12
Arab Bank	-	-	42.83	14
Chase Manhattan Bank	To Piraeus Bank	-	34.02	16
ANZ Grindlays Bank	To Aspis Bank	-	31.75	17

Table A.III.4 Number of Employees Of Foreign Credit Institutions

Credit Institution	Dec 31, 2005		Dec 31, 1993	
	Employees	Rank	Employees	Rank
Bank of Cyprus	2,407	1	110	10
Citibank	1,334	2	675	1
HSBC Bank	501	3	207	4
Hellenic Bank	372	4	-	-
BNP Paribas (Hellas)	181	5	-	-
American Express	99	6	341	2
CETELEM	82	7	-	-
ABN AMRO	81	8	161	6
Bayerische Hypo- und Vereinsbank	78	9	51	17
Royal Bank of Scotland	75	10	59	14
Société Générale	42	11	125	7
FCE Bank Plc	39	12	-	-
BNP Securities Services	38	13	-	-
American Bank of Albania	31	14	-	-
GMAC Bank	30	15	-	-
Union de Creditos Inmobiliarios	29	16	-	-
Bank of America	28	17	41	18
SANPAOLO IMI S.p.A.	22	18	-	-
Bank Saderat Iran	19	19	13	19
FIDIS BANK	18	20	-	-
EUROHYPO A.G.	4	21	-	-
Barclays Bank	To HSBC	-	282	3
National Westminster Bank	To Piraeus Bank	-	187	5
Bank of Nova Scotia	To First Business Bank	-	120	8
Banque Nationale de Paris	Merged into BNP Paribas	-	118	9
ANZ Grindlays Bank	To Aspis Bank	-	87	11
Chase Manhattan Bank	To Piraeus Bank	-	81	12
Credit Commercial de France	-	-	57	15
Arab Bank	-	-	60	13
Banque Paribas	Merged into BNP Paribas	-	54	16
TOTAL	5,510		2,829	

APPENDIX III – WHY FOREIGN BANKS[93] HAD TO BE EXCLUDED FROM OUR DATA SET

We shall go into some detail into its legal aspects and explaining why some banks were included in our panel data while others were not and its unavailability owing to European directives transposed into Greek legislation for a certain set of banks (branches of foreign banks operating in Greece) constitutes a limitation in examining the full range of the Greek banking system, without, on the other hand, rendering its results by any means valueless!

There are numerous foreign (i.e. non-Greek) banks operating branches in Greece, making up a sizeable (and significant) proportion of the Greek banking system, as may be seen in the table above. The reason from excluding them[94] from our panel data is solely *lack of cost data for these bank branches as these data are needed by our SFA and DEA methods.* To be more specific, we employ the *(interest expense) / (total funds),* ratio as a parameter (input price) of our models, where interest expense is clearly cost datums. However, according to the Greek law governing the operation of corporations (Regulatory Law 2190/1920 "on *Sociétés Anonymes*", as subsequently modified), and, in particular, articles 50δ and 50ε thereof [see indicatively Rokas (2004)], transposing articles 2 and 3 respectively of EEC directive 89/117/EEC[95] [I translate 50δ from the Greek text; article 50ε merely lays out certain specificities regarding branches of non-EU institutions that are irrelevant to the purposes of this study]:

"Article 50δ. (Article 2 of Directive 89/117/EEC) Provisions relating to branches of credit institutions and financial institutions having their head offices in other Member States

[...]

3. Branches are not required to publish annual financial statements (annual accounts) relating to their own activity.

4. The branches of credit and financing institutions operating in Greece that have their head office in another Member State, are required to publish, for their activity in Greece, according to the

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[93] But one

[94] All but Bank of Cyprus, for reasons to be explained next

[95] "Council Directive 89/117/EEC of 13 February 1989 on the obligations of branches established in a Member State of credit institutions and financial institutions having their head offices outside that Member State regarding the publication of annual accounting documents"

provisions of paragraph 1 of article 131 of the present law[96], the complementary information and annual totals below [...], for the following accounts of the balance sheet and income statement templates [...]:

[...]

A. For assets:

[...]

B. For liabilities:

1. Liabilities to financial institutions

[...]

2. Liabilities to customers

[...]

3. Liabilities arising from credit securities

α. Bonds

[...]

Γ. Off-balance-sheet accounts [...]

[...]

Δ. For income:

1. Interest and equated income

Interest from fixed-income securities

Other interest from equated income

[...]

E. For expense:

6. Results from financial transactions (when the final result is a loss)

8. General administrative expense

α. Personnel expense

[...]

β. Other administrative expense

ΣΤ. Other information:

α. The number of personnel [...]"

It is clear from the above excerpt from the pertinent article in the law, that foreign banks operating branches in Greece are *not* required to publish full-blown annual financial statements for their branch operations in Greece. Instead, they are merely obliged to publish *abridged* such statements, which lack discrete interest income and interest expense information, in their place providing the net interest

[96] Which, in a nutshell, requires that a foreign bank ensures that its (annual) balance sheet and income statement for its branches in Greece are entered into a special register for sociétés anonymes and published in the official publication of the Greek Government ("Government Gazette")

income datum only. The lack of explicit interest expense information renders the SFA(parametric) and DEA (non-parametric) methods we employ unusable for foreign banks, since it requires the value of the *(interest expense / total funds)* ratio, of which the value of the numerator are unavailable.

To add insult to injury, as the careful reader will have observed, there is no requirement for the equity to be reported either (under *B.* "For liabilities"). This means that the fixed netput in the first approach of SFA method is missing too, so that the set of foreign banks operating branches in Greece is rendered unusable for our purposes.

Given that the limitation above is not arising by some legal constraint specific to Greek legislation, but rather stems from an EEC Council Directive directly transposed into municipal law, it follows that the particular methodologies have to be "spared" of foreign bank data for any EU member state. The severity of this limitation is to be determined in a case-by-case (country-by-country) basis and stems in a causal manner from the extent to which foreign banks have entered the particular local banking market by way of establishing a credit institution in the corporate form provided by the legislation of the particular country vs. merely opening branches of the parent credit institution domiciled in its home country. The larger the "slice" of the local market "pie" captured by branches of foreign credit institutions, the lower the power of the SFA and DEA methodologies in question to provide an accurate measure of the degree of inefficiency in the overall banking sector.

It is important to note here that the dependency of this "cut-off" criterion for including or excluding banks on a somewhat arbitrary, arguably arcane legal requirement, devoid of economic intuition, is to our detriment. For instance, it would be hard to find convincing arguments for claiming that (say) the branch operations of Citibank in Greece that, were they incorporated as a Greek bank, would be one of the ten (10) largest in assets, are not a part of the Greek banking landscape, merely by virtue of the fact that Citibank chooses to operate in Greece by way of the "common European license" enjoyed by its U.K. subsidiary, but (say) Nova Bank which is also 100% owned by a foreign credit institution, namely Banco Comercial Portugues of Portugal, is completely qualitatively different, to the degree that the one should be excluded and the other be included.

Let us note here that Bank of Cyprus has consistently, for the period 1993-2005 that we examine, chosen to go above and beyond the aforementioned legal

requirements and publish full financial statements, as if it were incorporated in Greece (which it is not). Hence, we have decided to include it in our data set, since thus we increase our coverage of the Greek banking system, without causing any significant conceptual impurity.

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