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ON THE BANKING CAPITAL IN EUROPE AND ITS RELATIONSHIP WITH RISK AND EFFICIENCY

BY

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ON THE BANKING CAPITAL IN EUROPE AND ITS RELATIONSHIP WITH RISK AND EFFICIENCY

A mis padres y hermanos

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LIST OF ABBREVIATIONS

ALM	=	Asset and Liability Management
ATM	=	Automatic Teller Machine
BIS	=	Bank for International Settlements
CAD	=	Capital Adequacy Directive
CA/TA	=	Capital to total Assets
DEA	=	Data Envelopment Analysis
DFA	=	Distribution Free Approach
EC	=	European Community
ECB	=	European Central Bank
ECU	=	European Currency Unit
EFS	=	Efficient Structure Hypothesis
EU	=	European Union
EMU	=	Economic and Monetary Union
ESX	=	X-Efficiency Version of the Efficient Structure Hypothesis.
EU	=	European Union
FDIC	=	Federal Deposit Insurance Corporation
FI	=	Financial Intermediary/Institution
GARCH	=	General Autoregressive Conditional Heteroskedasticity.
GDP	=	Gross Domestic Product
IEF	=	Institute of European Finance
IFS	=	International Financial Statistics
MF	=	International Monetary Fund
LLR	=	Loan Loss Reserve
M&A	=	Mergers and Acquisitions
NII	=	Net Interest Income
NIM	=	Net Interest Margin
OBSA	=	Off-Balance-Sheet Activity
OTC	=	Over the Counter
OLS	=	Ordinary Least Squares
PACEC	=	Public and Corporate Economic Consultant
PET	=	Pure-Expectation Theory
PV	=	Present Value
QAT	=	Qualitative Asset Transformation
ROA	=	Return on Assets
ROE	=	Return on Equity
SFA	=	Stochastic Frontier Analysis
SMP	=	Single Market Programme
SURE	=	Seemingly Unrelated Regression Estimation.
TBTF	=	Too Big to Fail
TSLS	=	Two Stage Least Squares
UK	=	United Kingdom
US	=	United States
VaR	=	Value at Risk

ABSTRACT

This thesis examines the capital, risk and efficiency relationship in European banking in the 1990s. The topic is particularly relevant in the European context, as the ongoing process of increased financial integration is enhancing competition and emphasising the importance of efficiency. Yet, these factors could also increase incentives for bank risk-taking. In this environment, bank capital has become a focal point of bank regulation as the primary means for limiting risk taking by banks. The empirical analysis conducted builds on the earlier US work by Kwan and Eisenbeis (1997) and Berger and De Young (1997). We developed the aforementioned approaches by including market measures of bank risk, as well as including proxies accounting for charter value, and profit efficiency in a model evaluating the determinants of European bank capital. A positive effect of inefficiency on bank risk-taking, and also of inefficiency on higher leverage were found, supporting the moral hazard hypothesis. The latter implies that inefficient banks are more likely to have more incentives towards risk taking. In addition, excessive rates of loan growth are found to have a negative effect on banking risk and efficiency. This supports the hypothesis that due to agency problems entrenched managers may pursue a growth objective, which may damage both the risk and efficiency position of the institution. The empirical model results show a positive effect of risk on capital probably indicating regulators' preference for capital, as a means of restricting risk-taking activities. Finally, as in most studies analysing the determinants of bank efficiency, capital is found to affect positively the efficiency of banks. The empirical results of this research concord with earlier US work by Kwan and Eisenbeis (1997) and Berger and De Young (1997). Overall, the results presented in this thesis suggest that moral hazard incentives may be playing an important role increasing systematic risk in European banking.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Over recent decades, EU banking markets have become increasingly integrated and liberalised on the road to greater product and service deregulation. This process of financial integration is enhancing competition and emphasising the importance of improved efficiency of financial institutions. Yet, these factors could also be increasing incentives for bank risk-taking both in the transition period and during stable periods (See Danthine, Giavazzi, Vives and Von Thaden, 1999). In this environment, banking crises have become more prevalent (IMF, 1997) and regulators have given capital adequacy regulations a more prominent role in the prudential regulatory process.

However, from a theoretical point of view, the issue of how bank capital ratios affect bank risk-taking, remains largely unresolved (Berger, Herring and Szego, 1995), as the theoretical literature has generated contradictory conclusions about how bank risk-taking and capital are related to one another and about whether risk-taking and capital are determined by regulatory policies or only by private incentives. For these reasons, an empirical model is needed to ascertain which among the several factors are likely to affect the relationship between bank capital and bank risk-taking.

From an empirical point of view, there is a line of US research which started in the early 1970's that examines the effect of bank capital on bank behaviour. This work began by analysing whether financial regulations are effective in altering bank capital positions and then, with the introduction of the Basle Accord from 1987 onwards, the literature focused on the relationship between bank capital and banking risk and on the determinants of bank risk-taking. However due to the difficulties in measuring banking risk, there is very limited US, and almost non-existent European academic literature in this area.

1.2 Aims and methodology

This thesis has three related aims. First it aims to test several hypotheses concerning the relationship between capital and risk in European banking. Secondly, it will seek to understand the determinants of bank risk-taking in Europe. Thirdly, it aims to connect the empirical literature concerning bank efficiency and banking risk with the literature that looks at the determinants of bank capital.

Our empirical approach builds on the model by Kwan and Eisenbeis (1997) and Berger and De Young (1997) for the US. Like the former, we have used a simultaneous equation framework in which we evaluate the determinants of bank capital, efficiency and risk. Our approach introduces several innovations in terms of model specification. First, it includes measures of bank risk, constructed from market prices of banks quoted on the stock exchange, as these are likely to be more informative of the present risk position of the banking firm. Secondly, we include a measure of profit efficiency which is an efficiency concept more aligned with the ultimate goal of most firms, that is to maximize profits. Thirdly, we account for the possible effect of charter value.

The empirical estimation is calculated by applying a Two Stage Least Squares with fixed effects estimation method to a cross-country sample; 440 banks from France, Germany, Italy, Spain and the UK over the period 1990 to 1997.

1.3 Results

The majority of the results concord with those of Kwan and Eisenbeis (1997) and Berger and De Young (1997). A positive effect of inefficiency on bank risk-taking, and of inefficiency on higher leverage was found, supporting the moral hazard hypothesis that states that inefficient organisations are more likely to have more incentives towards bank risk-taking. In addition, as in most studies analysing the determinants of bank efficiency (See Berger and De Young, 1997), the variable banking capital is found to positively affect the level of efficiency of financial institutions indicating that better capitalised banks tend also to operate more efficiently.

Furthermore, a U-shaped relationship is detected between loan growth and banking risk and inefficiency, so that at an excessive loan growth rate, operating inefficiency and bank risk increases with loan growth. This would support the hypothesis that states that due to agency problems, entrenched managers may pursue a growth objective, which may damage both the risk and efficiency position of the institution. The empirical model also shows a positive effect of risk on the level of capital, probably indicating regulators' preference for capital as a mean of restricting risk-taking activities.

The results offer support for the hypothesis already expressed in the established US American literature, namely, that both regulatory action and moral hazard play a role when banking institutions decide on capital, risk and efficiency trade–offs. In terms of specific policy conclusions, our results would tentatively suggest that supervisors should consider bank efficiency measures along with traditional predictors of bank failure to help identify troubled banks. This is because less efficient banks appear to take on additional amounts of risk in order to compensate for the increased costs derived from larger capital requirements.

Finally, as intuitively expected, according to our results, bank supervisors should also be concerned with the effect of rapid loan expansion in terms of bank risk-taking. This could be of importance in Europe as some countries have been experiencing loan growth rates above 20% in recent years, prompted by a positive phase of the economic cycle coupled with an increase in competition in banking and the effect of a single monetary policy. These factors, together with the fact that the financial strength of banks differs widely, and the heterogeneous co-existence of different financial institutions with different economic goals, are making the issue of the determinants of bank risk-taking particular relevant in Europe.

1.4 Structure of the thesis

As banking capital and risk are very dependent on the general institutional and economic environment, Chapter 2 provides an overview of recent trends affecting the European banking industry, so that the chapter reviews how factors of change such as the process of deregulation, changes in technology, privatization, and/or concentration of the financial services industry are likely to have influenced European banks' capital and risk positions during the 1990's and are likely to influence these aspects in the future. Although European banking markets remain highly heterogeneous, competition due to structural deregulation and advances in technology have become stronger. This is forcing European banks to improve their efficiency. Yet, banks in continental Europe appear less efficient and less profitable than in the US. In terms of their overall position, however, it appears that the risk position of banks as measured by accounting figures is at a historically low level. This may be strongly influenced by the relatively good position of the economic cycle in the second half of the 1990s. Regarding the capital position of banks, although it has improved since the early 1990s, it has not changed substantially recently. Consequently, apart from the relatively buoyant macroeconomic scenario, there are reasons to deem the banking sector as riskier, for instance, there has been a large increase in bank lending, margins have been falling and there has been increased volatility of banks' stocks as well as a more intense competitive environment.

Chapter 3 explores further the regulatory process by providing a more detailed analysis of the unprecedented process of integration of the banking and financial markets which has taken place in Europe. It also includes an analysis of the rationale for capital adequacy regulations as well as the main results from selected studies from the theoretical literature on capital adequacy regulations and their relationship with bank risk-taking. It is shown that, among the different tools used by regulators for prudential regulatory purposes, capital adequacy regulations have played an increasingly prominent role, mainly due to concerns about financial stability. However, although there is almost a consensus that prudential regulation should be set up in conjunction with the other prudential regulatory instruments, the theoretical literature offers contradictory results as to the effects of capital requirements on bank risk-taking incentives.

Consequently, Chapter 4 provides a review of the empirical literature that studies the effects of financial regulation on bank behaviour including the relationship between bank risk-taking and capital. Although the majority of studies are American, special interest is paid to the few European studies dealing with this issue. Recent articles emphasise the fact that financial regulations are likely to have an impact on the capital ratios of banks, although due to financial innovation and non-optimal risk weightings some authors are concerned about banks shifting their portfolios towards riskier assets in recent years. Some of the contemporary empirical literature emphasises the importance of including operating efficiency in the models that aim to investigate the capital and risk relationships. Given the identified importance of measuring capital, risk and efficiency appropriately, the second part of this chapter is devoted to how the applied banking literature has measured these variables.

Once the various models used by different authors have been analysed in the literature review, the model to be used in the empirical analysis is presented in Chapter 5. Although the model builds on earlier work by Kwan and Eisenbeis (1997), it also incorporates adjustments to better capture the relationships between capital, risk and efficiency. Foremost among these improvements is the inclusion of market measures of risk. Afterwards, the chapter describes how the variables risk, capital, efficiency and charter value are to be used in the model constructed. The latter part of Chapter 5 discusses the sample selection providing information on the data sources utilised. The chapter ends with a descriptive analysis of several relevant variables included in the final sample.

The results of the empirical model are presented and analysed in Chapter 6. The results show support both for the moral hazard hypothesis and for regulators' preference for limiting bank risk via higher capital requirements. Excessive loan growth is found to be statistically positively related to inefficiency and risk-taking. The majority of the results concord with earlier work by Kwan and Eisenbeis (1997) and Berger and DeYoung (1997). The thesis finishes with the conclusions presented in Chapter 7.

CHAPTER 2

RECENT ENVIROMENTAL FACTORS AFFECTING THE CAPITAL POSITIONS OF EUROPEAN BANKS

2.1 Introduction

As the issue of banking capital is dependent on the general environment, Chapter 2 surveys recent trends affecting the European banking industry and the impact of these factors on bank capital, risk, performance and efficiency. Understanding the nature of these changes will facilitate a better comprehension of the environmental factors that have influenced European banks' capital positions during the 1990s. This chapter discusses market and accounting measures of bank capital and variations in capital levels across different European banks institutions and geographical areas.

2.2 Factors transforming European banking

During recent years, the banking industry has been experiencing an important period of transformation determined by several related factors. Given that a bank's capital position is ultimately determined by the economic value of its assets and liabilities, which are in turn directly linked to individual and structural factors, it is probably worthwhile to start our analysis by briefly reviewing the main factors of change affecting the banking industry.

It is difficult to rank these forces of change according to their relative importance. Given that EU countries have suffered a drastic deregulatory process over the last years which has altered the pattern of competition we will start by mentioning the de-regulatory process which has taken place in Europe, as in turn deregulation has forced most supervisors to focus on the capital positions of institutions (see US Shadow Financial Regulatory Committee, March, 2000). Then, we will also mention the technological change that has taken place in the banking industry as it has been a major influence which will also have a bearing on the capital and efficiency position of institutions. As can be seen in the next section, de-regulation and technology are major drivers of disintermediation and this is considered in section 4. Finally, once these major sources of change have been considered, the macroeconomic environment in Western Europe during our period of study will be examined briefly, as it will be helpful for a better understanding of the study of bank risk, capital and effciency analysed in later chapters.

2.2.1 Deregulation/re-regulation and competition

Traditionally, due to its pivotal role in the economy, and for a variety of other reasons that will be explained in Chapter 3, the banking industry has been heavily regulated. In fact, retail banking in Europe, and unlike other industries, has mainly remained a national industry (see Canals 1997). In contrast, the investment bank sector is largely competing on a global basis.

Spearheaded by the globalisation of financial markets, the de-regulatory financial process tries to achieve economic gains derived from an increase in competition. Indeed, internationalisation of financial markets has forced economic authorities around the globe to deregulate their financial and banking markets in order to balance any possible regulatory disadvantage against domestic firms.

De-regulation is concerned with liberalisation of structural and conduct rules (see Fig 3.1). In order to avoid an excessive increase in risks that may threaten the financial stability of the overall financial system, this deregulatory process has been accompanied by reinforcement on the side of prudential regulation. In this sense, as Dermine (1996) has noted, the impact of deregulation in Europe has been profound because it has altered the form of competition, so that prices and product differentiation are gradually replacing branch network competition.

Consequently de-regulation has had three major effects in terms of the capital position of banks. First, it has fostered competition (see the next section for a more detailed analysis); this increase in competition would reduce the charter value of banks and may increase risk-taking by banks in order to maintain former rates of returns, forcing banks to hold larger amounts of capital[1]. Second, it has also had a direct impact by enhancing prudential regulation, and more specifically capital adequacy regulation, which has received, increased attention over the last years from both by academics and financial regulators (see Chapter 3). Finally, conduct and structural de-regulation has allowed for the development of new products and the expansion into new markets for which there is uncertainty regarding the amount of capital to be held.

2.2.1.1 Competition and mergers and acquisitions

Technological advances coupled with the aforementioned de-regulatory process which started within individual European countries, and then continued at a EU level with the introduction of the single market for financial services, has increased both competition (see Matutes and Vives 1992, and Vives 2000) and contestability (see Davis and De Bandt, 1998) in European banking, especially at the wholesale level.

An outcome of competitive pressure tends to be reflected in the decline in the number of players in the market, normally as a result of mergers and acquisitions. This, in turn, tends to increase the level of domestic market concentration. As Table 2.1 shows, a fall in the number of banks has been a shared tendency in all the largest European countries. The reduction in the number of institutions has been particularly important in the case of Spain, as it started from a relatively low number of institutions, and because it also had the largest relative decline. France and Germany also show a large relative decline. In addition, although less visible, mergers among smaller institutions have been continuing for a number of years, particularly in countries with a very large number of small credit institutions such as Germany and France. Regarding the largest operators, and as a sub product to economic crises in the early 1990's, there

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[1] The existence of deposit insurance and in general, a non-risk related safety net, could prevent institutions to be forced to increase capital by the markets.

was an increase in the number of banking failures, and various leading institutions had to use the public safety net in Finland, Norway and Sweden. To a lesser extent, and more related to mismanagement rather than an overall decline in the health of the banking system, this was also the case in France (Credit Lyonnais), Spain (Banesto) and Italy (Banco di Napoli).

Table 2. 1 Number of institutions in the banking and credit services of five European countries

Country	1985	1990	1995	1998	% Change 85-98
France	1952	2048	1445	1209	-38.1
Germany	4739	4170	3785	3403	-28.2
Italy	1101	1043	970	921	-16.3
Spain	695	696	484	396	-43.0
UK	655	624	578	527	-19.5

Source: Adapted from Eurostat (1999) p. 17.

Another indicator of capacity, which could provide a complementary view to the number of credit institutions, would be the number of bank branches per capita. This indicator is normally used to ascertain the amount of physical capital invested and can be particularly useful when there are substantial elements of non-price competition, which in the case of the banking industry is reflected by greater branch proximity, among other things.

Table 2.2 shows that the number of branches per capita started its decline much later than was the case in the reduction in the number of institutions, which could be tentatively interpreted as an indication that competition, as related to a more efficient allocation of physical resources, is a relatively recent phenomena. The table shows that most countries showed a decline in the number of branches, particularly those in which the savings and cooperative banks do not play a large role. However, for 3 out of 11 euro-area countries (Italy, Spain and Ireland), this measure of banking density continued to increase until 1998. Differences in this indicator varied substantially ranging from 0.98 branches for every 1000 inhabitants in Spain to 0.31 in Portugal, which is higher than the figure in the United Kingdom (0.27) or the United States (0.23). Although this significant range of variation is probably mainly due to geographical conditions, competitive conditions are also very likely to have played a role in the declining number of branches per inhabitant.

Table 2. 2 Number of bank branches per 1,000 per capita

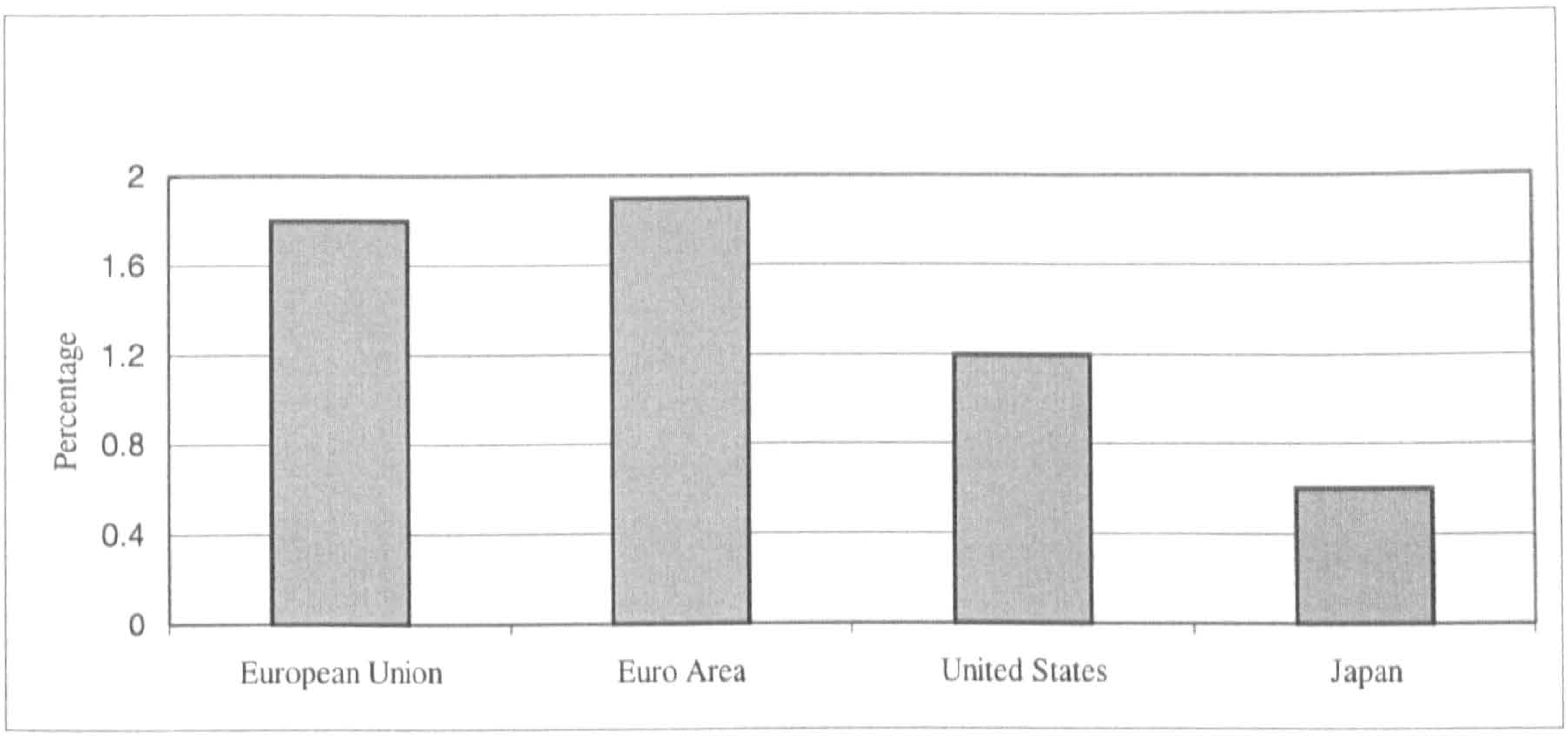
	1990	1995	1996	1997	1998
Germany	0.50	0.59	0.59	0.58	0.55
France	0.45	0.44	0.44	0.43	0.43
Italy	0.31	0.41	0.43	0.44	0.46
Spain	0.90	0.92	0.94	0.96	0.98
Austria	0.58	0.58	0.58	0.58	0.57
Belgium	1.35	0.76	0.74	0.72	0.70
Finland	0.66	0.38	0.34	0.32	0.31
Ireland	0.27	0.35	0.42	0.30	0.42
Luxemburg	0.78	0.85	0.92	0.95	0.92
Netherlands	0.54	0.44	0.44	0.40	0.39
Portugal	0.20	0.35	0.38	0.38	0.31
United Kingdom	0.38	0.30	0.28	0.28	0.27
United States	0.20	0.22	0.22	0.23	0.23
Japan	0.39	0.38	0.38	0.35	0.35

Source: ECB (2000d), and Eurostat (1999), Banking in Europe (1999), p. 20.

Other factors which may be suggestive of investment in the banking sector, would be the amount of employment in the banking industry as a percentage of total employment, which is shown in Figure 2.1 to be substantially larger in Europe than in the United States or Japan.[2]

[2] See Davis and Salo (1998) for a study in overcapacity in European banking.

Figure 2.1 Employment in the financial sector banking as a % of total employment (1997)



Source: European Commission (1999) p. 5.

The institutional background behind these figures comes from the fact that until the early 1990's, retail banking was relatively isolated from competition, either through formal or informal barriers to entry into the market, collusive agreements or regulatory capture. This situation appeared to occur in various European countries. In this sense, Molyneux, Lloyd-Williams and Thornton (1994), have suggested that between 1986 and1989, banks in Italy and France earned revenues as if under monopoly or conjectural variations short-run oligopoly conditions. This lack of competition probably produced oligopolistic rents for stakeholders[3], not only for owners but also for employees and managers in the case of expense preference behaviour and the 'quiet-life-hypothesis'[4]. In general, the limited competitive environment led to substantial inefficiencies and low returns on equity throughout the industry during the 1970's and 1980's. This lack of competition did not appear to be associated with industry concentration at a national level as the traditional Structure-Conduct-Performance paradigm would suggest, but rather at a local level. Various banks were also protected through more lenient tax/regulatory treatment (see Belaisch et al., 2001).

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[3] Normally labour in the case of expense preference behaviour that was clearly taking place in the case of saving banks, but also for customers in the form of more branches or subsidised services.

[4] See Hicks (1935).

The Single Market Programme (SMP), was a credible commitment to liberalisation intended to produce a substantial change in the competitive scenario of European banking. Although home currency advantage started to disappear in most continental European countries with the introduction of the euro on 1 January 1999, regulatory harmonisation is still not complete. It is, however, notoriously difficult to assess to what extent competitive forces have overcome these obstacles. On the one hand, as we will see later, there has been a decline in net interest margins, in X-inefficiencies and in operating cost to total income ratios in European banking during the 1990's. On the other hand, in some instances prices have not fallen: for example in the case of commercial loans, current accounts and personal equity transactions the differences between the highest and the lowest prices have actually increased between 1987 and 1996 (see EC 1997). While various commentators suggest that European markets have become more competitive and contestable (see for instance Davis and de Bandt, 1999) the industry still has important over capacity problems and substantial parts of the financial system appear to be quite inefficient and largely isolated from competition (Molyneux and Forbes, 1995) (Bikker and Haaf, 2000). The European Union is trying to tackle this problem by attempting to enhance competition while preserving financial stability with the implementation of the Financial Services Action Plan. (See Chapter 3).

Overall, competition would force concentration in Europe as less efficient institutions will be driven out of business or be taken over by more efficient competitors. An interesting example is the case of the US banking system, which has undergone similar forces of change at an earlier stage than Europe. A direct consequence of these forces in the US has been a substantial increase in M&A activity over the last fifteen years[5]. Indeed, from 1950 to 1980, the number of credit institutions was quite stable at around 14,000 institutions. Yet, between 1980 and 1992, the number fell to 11,500, and between 1992 and 1997, the number fell further to 9,200. With the advent of nationwide banking and the full dismantling of the Glass Steagal Act, the

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[5] The main consequences underlined by Berger, Demsetz and Strahan (1999) in their recent review of the literature on this topic in the US were an increase in systemic risks or expansion of the safety net, the existence of market power in prices (not in profits), a more efficient payment system and increased profit efficiency.

number is expected to fall to 4000 (Mishkin 1999).The US experience may be illuminating because of the arguably strong parallel between financial service de-regulation in Europe and in the United States. Indeed, particularly striking is the common experience with geographical restrictions, namely interstate restrictions in the case of the US which began to fall in the early 1980s, and the cross border deregulation brought about by the Single Market in 1992 and the introduction of the Euro in 1999. Consequently, as shown in Table 2.4, and at a lower pace than in the U.S., there has been an increase in the number of M&A of credit institutions in the European Union. However, to date, there has been significant domestic consolidation of banking firms as well as significant M&A activity involving securities and insurance firms in European nations, but little international consolidation of European banks (Berger, Demsetz and Strahan, 1999). The preference for national consolidation is that it offers clearer opportunities for reducing costs and fewer complications in terms of handling the merger due to a normally more homogeneous corporate culture. Besides firms try first to gain a stronger national presence so that they could be large enough to compete in a likely latter cross-country consolidation phase.

The reasons for banks to merge as well as the potential benefits from mergers are not clear in the literature[6]. Focusing only on the Euro area, empirical studies tend to find that the main factors of competitive advantage are not economies of scale but rather improvements in X-efficiencies[7]. Yet, it is surprising that in reality mergers and acquisitions do not offer improvements in either efficiency measures or better stock market returns[8].

Table 2. 3Total number of M&As of credit institutions (domestic and foreign)

					1st half	Average
	1995	**1996**	**1997**	**1998**	**1999**	**95-98**
Germany	122	134	118	202	97	144
France	98	123	119	160	27	125
Italy	78	60	46	58	31	61

6 See Dermine (2000) for a survey of the literature.

7 See European Commission (1997), Van der Vennet (1996), Altunbas, Molyneux and Thornton (1997)

8 Although according to Cybo-Ottone and Murgia (2000), abnormal returns can be expected associated with the announcement of domestic bank deals.

					1st half	Average
	1995	1996	1997	1998	1999	95-98
Austria	14	24	29	37	0	26
United Kingdom	6	11	21	24	5	16
Spain	13	11	19	15	9	15
Luxemburg	3	2	3	12	5	5
Greece	0	1	3	9	3	3
Belgium	6	9	9	7	2	8
Finland	9	6	5	7	2	7
Portugal	6	6	2	5	2	5
Ireland	3	4	3	3	3	3
Netherlands	7	11	8	3	2	7
Denmark	2	2	2	1	1	2
Sweden	1	2	5	1	1	2
Sum:	368	406	392	544	190	

Source: ECB. (2000d), Mergers and acquisitions involving the EU banking industry-facts and implications, p. 36.

Table 2. 4 Recent Merger and acquisition activity in the Euro area, the United States and Japan

(Euro billions, number of deals and percentage growth over the previous year)

		Euro area		United States		Japan	
		Bank	Non-bank	Bank	Non-bank	Bank	Non-bank
Value of transactions in EUR	1997	41.1	174.3	86.0	857.9	1.9	15.2
	1998	110.2	335.3	271.7	1,309.5	1.5	17.1
	1999	174.5	1,012.6	91.6	1,813.8	77.1	75.1
Annual % change in value of transactions	1998	168.0	92.3	215.9	52.7	-22.0	12.1
	1999	58.4	202.0	-66.3	38.5	5,202.7	340.0
		Bank	Non-bank	Bank	Non-bank	Bank	Non-bank
Number of deals	1997	199	4,323	596	12,325	26	497
	1998	245	5,167	651	13,757	19	564
	1999	278	7,315	535	12,402	82	1,387
Annual % change in the number of deals	1998	23.1	19.5	9.2	11.6	-26.9	13.5
	1999	13.5	41.6	-17.8	-9.8	331.6	145.9

Source: Author's estimations from Securities Data Company data.

The reduction in the number of banks, due to the increased number of mergers and acquisitions, would also suggest an increase in concentration across European banking markets in recent years. In fact, when we compare the percentage of the banking and credit sector controlled by the five largest banks, measured in terms of total assets, we observe an increase in this figure for most countries. Table 2.5 shows that the largest EU banking markets have experienced increasing[9] market concentration. Interestingly, activity among Europe largest banks has accelerated recently, so that more than half of the 30 largest European banks are the result of recent mergers. As a consequence, the average size of the top five European banks in terms of total assets has doubled since 1995.

The degree of concentration is particularly striking in the smaller Euro-area countries, where a very small number of banks dominate the national markets. For example, in the Netherlands and Belgium, two large groups control more than half of banking sector assets. In the rest of the smaller European countries, the top five banks hold more than 50% of the total assets. Among the largest countries, (see Table 2.5 and Table 2.6), the highest increase in market concentration took place in Spain probably due to the mergers of the biggest banks in recent years: in 1988 Banco de Bilbao merged with and Banco de Vizcaya to become BBV (Banco Bilbao Vizcaya), which then took over Argentaria in 1998. In 1992, Banco Hispano Americano and Banco Central formed Banco Central Hispano (BCH), and in 1995, Banco de Santander bought Banesto, after the Central Bank of Spain intervened in Banesto, which had needed support from the public safety net. Bank of Santander and BCH merged in 1998 to form BSCH. In Italy, market concentration has also substantially increased because of recent large mergers. For example, the following banks have been 'created' through merger activity during the last 4 years: San Paolo IMI (merger between Istituto Bancario San Paolo di Torino and Istituto Mobiliare Italiano), Banca Intesa (Banco Ambrosiano Veneto, Cariplo, CPP and Banca Commerciale Italiana), and Unicredito Italiano (Credito Italiano and Unicredito). In France, there has also been increased activity in

[9] The Herfindahl index, which is better proxy for market concentration as it takes into account the full population. As indicated in table 2.9, this figure also pointed towards shows an increase in concentration particularly over the last two years.

merger and acquisitions as shown by the mergers between BNP and Paribas, Credit Mutuel and CIC, Societe Generale and Credit du Nord, Banque Populaires and Natexis, and the three way merger between Credit Agricole, Banque Ofinco and Banque Indosuez. An explanation for the fall in market concentration in France probably relates to the problems and subsequent bailout suffered by Credit Lyonnais. A similar trend has also taken place in Germany with the merger of the neighbouring Bavarian banks, Bayerische Vereinsbank and Hypobank and the failed merger between Deustche and Dresdner Banks.

In addition to the commercial banking sector, savings banks are also undergoing an important wave of rationalisation and modernisation in which private sector concepts of market value, capital allocation and operative efficiency are given further emphasis. These trends are affecting savings banks at a different pace. In Italy, the near privatisation of the 'Casse di Risparmio' took place in the early 1990's, in Germany, concentration of the Sparkasse and Volksbank sector has taken place only recently, whereas in the UK an increased number of building societies have converted to become publicly listed banks. Despite significant differences from country to country, savings banks have become one of the fastest growing segments across European banking markets and further consolidation is expected within the sector (Molyneux, Altunbas and Gardener 1996), (Arthur Andersen 1993).

Table 2. 5 firm concentration ratio as percentage of total assets

								1st half	%-point change	
	1980	1985	1990	1995	1996	1997	1998	1999	95-2Q99	97-2Q99
SE		80.8	82.7	86.5	86.5	86.8	85.7	87.0	0.5	0.2
NL		72.9	73.4	76.1	75.4	79.4	81.7	82.9	6.8	3.5
DK	62.0	61.0	76.0	72.0	72.0	72.0	76.0	78.0	6.0	6.0
BE	54.0	48.0	48.0	51.2	52.2	53.9	72.5	75.8	24.6	21.9
PT	60.0	61.0	58.0	74.0	80.0	76.0	75.2	74.7	0.7	-1.3
FI	37.0	38.0	41.0	70.6	71.7	72.7	73.5	72.8	2.2	0.1
GR	n.a.	80.6	83.7	75.7	74.5	71.8	72.8	72.3	-3.4	0.5
ES	n.a.	35.1	34.9	47.3	46.0	45.2	44.6	50.8	3.5	5.6
AT		35.9	34.7	39.2	39.0	48.3	50.1	50.4	11.2	2.1
IT			29.2	32.4	32.1	30.7	38.7	40.2	7.9	9.5
IE	59.1	47.5	44.2	44.4	42.2	40.7	40.1	40.0	-4.4	-0.7
UK				28.3	29.1	28.3	27.8	27.6	-0.7	-0.7
LU	31.1	26.8		21.2	21.8	22.4	24.6	26.2	4.9	3.7
DE			13.9	16.7	16.1	16.7	19.2	19.4	2.7	2.7
FR		46.0	42.5	41.3	41.2	38.0	39.2			
Av.	37.9	52.8	50.9	51.8	52.0	52.2	54.8	57.0		

Source: ECB. (2000d), Mergers and acquisitions involving the EU banking industry-facts and implications, pg.42. Where SE (Sweden), NL (The Netherlands), BE (Belgium), PT (Portugal), FI (Finland), GR (Greece), ES (Spain), AT (Austria), IT (Italy), IE (Ireland), UK (United Kingdom), LU (luxemburg), DE (Germany), FR (FRANCE).

Table 2. 6 Standard Herfindahl[10] index on total assets

	1980	1985	1990	1995	1996	1997	1998	1st half 1999	%-change 95-2Q99	%-change 97-2Q99
SE		0.196	0.225	0.195	0.200	0.204	0.201	0.197	0.010	-0.034
FI				0.179	0.179	0.181	0.204	0.191	0.067	0.050
NL		0.134	0.117	0.160	0.154	0.165	0.180	0.176	0.095	0.061
GR		0.247	0.250	0.178	0.166	0.153	0.154	0.150	-0.156	-0.022
BE				0.064	0.067	0.070	0.131	0.141	1.217	1.017
DK				0.121	0.119	0.116	0.134	0.138	0.139	0.185
PT		0.112	0.096	0.140	0.149	0.130	0.131	0.127	-0.089	-0.020
AT			0.036	0.044	0.045	0.083	0.097	0.098	1.233	0.174
ES		0.037	0.035	0.053	0.050	0.050	0.049	0.070	0.330	0.415
IE				0.065	0.058	0.050	0.047	0.047	-0.277	-0.060
IT		0.016	0.014		0.031	0.031	0.041	0.044	n.a.	0.432
LU						0.020	0.022	0.024	n.a.	0.168
UK		0.016	0.019	0.019	0.021	0.021	0.022	0.023	0.194	0.101
DE						0.011	0.013	0.014	n.a.	0.286
FR				0.042	0.044	0.045	0.049		-1.000	-1.000
Av.		0.108	0.099	0.105	0.099	0.089	0.098	0.103		

Source: ECB. (2000d), Mergers and acquisitions involving the EU banking industry-facts and implications, pg.42. Where SE (Sweden), NL (The Netherlands), BE (Belgium), PT (Portugal), FI (Finland), GR (Greece), ES (Spain), AT (Austria), IT (Italy), IE (Ireland), UK (United Kingdom), LU (luxemburg), DE (Germany), FR (FRANCE).

This increase in concentration should be a regulatory concern as the increase in the size of the institutions can give raise to 'too big to fail' problems (TBTF). That is the fact that the central bank is more likely to bail out a large bank because its failure may disrupt the payments system and/or create a systemic collapse of the financial system. These largest institutions which could at times be actively promoted by governments aiming to create national champions may be subject to more lenient regulatory scrutiny than their smaller counterparts. They may be also allowed to operate on a lower than optimal capital base, as given the systemic risk implications of their failure, it is assumed by the institutions and other market participants that they would receive public support when faced with insolvency. Consequently, and due to TBTF

[10] The Herfindahl index (HI) is a widely used measure of concentration which for its calculation takes into account all n banks in a market. For that reason, the index is often called the 'full information index' $HI=\Sigma_i^n S_i^2$, where SI are the market shares. The definition of the HI stresses the importance of larger banks by giving them a higher weight than smaller banks, and it incorporates each bank separately and differently so that arbitrary cut-offs and insensitivity to the share distribution are avoided. The HI-index ranges between 1/n and 1, reaching the unity in case of monopoly (See Bikker and Haaf, 2000).

considerations, domestic consolidation is likely to have implications for the capital positions of banks as it could increase incentives for a reduction in the capital positions of the largest banks.

Table 2. 7 Recent mergers and acquisitions among large banking groups

Country	Banking group
Austria	Bank Austria (Bank Austria + Creditanstalt)
	Erste Bank (Giro Credit + Erste SpaCasse)
Belgium	KBC (Kredietbank + Cera)
	Bacob + Artesia Bank
Denmark	Unibank (Unibank + Tryg-Baltica)
France	BNP-Paribas (BNP + Paribas)
	Banques Populaires + Natexis
	Credit Mutuel + CIC
	Caisse d'epargne + Credit Foncier
	Societe Generale + Credit du Nord
	Credit Agricole + Banque Sofinco +Banque Indosuez
Germany	Hypo Vereinsbank (Bayerische Vereinsbank + Hypobank)
	Deutsche Bank + Bankers Trust
Italy	San Paolo IMI)Instituto Bancario san Paolo di Torini + IMI)
	Banca Intesa (Banco Ambrosiano Veneto + Cariplo CPP + BCI)
	Unicredito Italiano (Credito Italiano + Unicredito)
Netherlands	ABN-Amro (ABN + Amro)
Portugal	Banco Comercial Portugues + Banco Portugues do Atlantico
	Caixa Geral de Depositos + Banco Pinto & Sotto Mayor
United Kingdom	Lloyds + TSB
	Royal Bank of Scotland and Natwest
Cross- border	Dexia (Credit Locale de France and Credit Communal de Belgique)
	Fortis (Generale de Bank and ASLK-CGER Bank)
	Merita-Nordbanken-Unidanmark
	ING + Banque Brussels Lambert
	HSBC + CCF
	BSCH + Totta & Acores
Aliances/ minority stakes	BSCH - Royal Bank of Scotland - San Paolo IMI - SG - Commerzbank - Champalimaud
	Credit Agricole – Credit Lyonnaise - Banca Intesa
	BBVA - Banco di Napoli - BNL - Credit Lyonnais
	ABN - Amro – Banca di Roma

Source: adapted from the IMF (2000). Appendix. P.8

2. 2.2 Technology

Technological innovations have transformed most industrial sectors, especially due to the evolution of information based technologies. In the case of the banking industry, due to the role of banks as information-based firms and their role in gathering and analysing information, these changes have been even sharper.

Information technologies offer savings in the cost and time of providing financial services, and increased revenues through the development of an array of new financial products often only limited by the level of potential demand, which can be created. Indeed, the rapid progress in information technology is transforming the way in which the banking industry works, through a dematerialization of informational sources, a substantial increase of information available, and the possibility of diversification into new business areas compatible with the banks' core activities.

Two main factors can be pinpointed as consequences of technological innovation. First, the production function in banking has become more capital-intensive, given that the share of non-staff operating costs has increased in most of the European systems, at the expense of staff costs (see Table 2.20). Consequently, it has contributed to a reduction in the costs associated with the management of information (collection, storage, processing and transmission) by replacing paper-based and labour intensive methods with automated processes. Secondly, diffusion of information technology is radically transforming banking delivery channels. In this respect, the competitive advantage which geographical proximity once provided by means of a large number of branches have been achieved through the installation of ATMs or alternative delivery systems and more recently through the introduction of internet banking across Europe. It is clear that all major banks through the EU use remote banking (ECB 2000b), but most of it is still offered via automated teller machines (ATMs) (see Table 2.8) rather than by the use of internet banking.

Table 2. 8 Cash dispensers and ATMs

	Number of machines per one million inhabitants (End of year)			Number of transaction per capita		
	1993	1997	Change 93-97	1993	1997	Change 93-97
Belgium	280	492	+76%	11	16	+40%
Denmark	108	253	+134%	na	na	Na
Germany	308	504	+64%	na	na	Na
Grecee	82	209	+155%	na	6	Na
Spain	557	863	+55%	12	15	+27%
France	325	462	+42%	13	20	+51%
Ireland	220	286	+30%	16	24	+54%
Italy	262	444	+69%	3	7	+117%
Luxemburg	294	613	109%	10	10	+5%
Netherland	292	410	+41%	21	33	+61%
Austria	320	533	+67%	7	10	+38%
Portugal	283	631	+123%	10	21	+120%
Finland	591	445	-25%	40	43	+8%
Sweden	255	268	+5%	28	35	+24%
UK	328	393	+20%	21	30	+41%
EU	324	488	+51%	14	20	+46%

Source: ECB (2000b). Payments systems in the EU, appendix.

On the other hand, the introduction of telephone banking (see Table 2.9), which started during the 1980s, was not as successful as initially expected. Indeed, even the apparent important success of phone banking in France depended to a large extent on country specific factors such as the experience of the government-subsidised use of Minitel. Internet banking is also expected to radically change the distribution channels of the banking industry, although, since its introduction it has yet to conquer a substantial share of the market[11]. However, according to most experts the potential for internet banking will be enormous.

Table 2. 9 Indications of telephone banking penetration.

Belgium	**5%**
Germany	**6%**
Spain	**6%**
France	**10%**
Ireland	**5%**
Italy	**3%**
Netherlands	**5%**
Finland	**2%**
Sweden	**4%**
United Kingdom	**10%**

Source: ECB (1999b). The effects of technology on the EU banking systems p. 12.

Regarding its effect on the overall profitability of banking firms, the success of technologically related innovations cannot be evaluated independently from the existing financial regulation and regulatory changes in process. Yet, even taking into account changes in the regulatory framework in Europe and its potential effects promoting financial innovation and technological developments, there is no doubt that technology by itself has substantially altered production and distribution of financial services over the last decade. This has radically affected banks' balance sheets as well as their profit and loss accounts. It has also boosted absolute measures of productivity. In fact, overall cost as a proportion of income or total assets has decreased in European countries[12]. This factor becomes apparent in Table 2.10, in which it can observed that from 1994 to 1997 operating cost to total income has declined in most Euro area countries with the exceptions of Germany, the Netherlands and Sweden.

[11] Some Scandinavian countries and particularly Finland are an exception.

[12] See also section 2.6.a.

Table 2. 10 Aggregate operating costs per total income (%)[13]

	1994	1995	1996	1997	1998
Euro area	67	69	67	67	66
EU	66	67	65	65	64
BE	68	66	63	64	60
DK	69	53	50	54	61
DE	64	67	68	68	68
GR	63	69	69	62	60
ES	68	66	63	62	62
FR	73	76	69	68	65
IE	62	59	57	58	52
IT	71	70	70	72	64
LU	39	40	40	38	42
NL	68	68	69	71	72
AT	66	67	66	67	66
PT	66	70	68	62	64
FI	79	83	76	59	64
SE	47	52	50	60	60
UK	62	63	61	59	59
Average	64	65	63	62	61
St Deviation	9	10	9	8	7

Source: ECB (2000a), EU banks' income structure, p. 56. Where SE (Sweden), NL (The Netherlands), BE (Belgium), PT (Portugal), FI (Finland), GR (Greece), ES (Spain), AT (Austria), IT (Italy), IE (Ireland), UK (United Kingdom), LU (luxemburg), DE (Germany), FR (FRANCE).

Although this measure would also be affected by the denominator (namely total income) that would be influenced by the economic cycle, this would not be the case with figures showing the average number of bank staff necessary for managing one billion ECU of assets. According to Table 2.11, from 1986 to 1997, there has been a substantial decline in this figure in all European countries. This development is particularly pronounced in the case of Portugal, Finland or Ireland. This increase in productivity has accelerated in relative terms in the 1995-1997 period, so that divergences in productivity (according to this measure) have narrowed considerably. These developments are believed to be largely attributable to the development of new technologies. A natural consequence of this is that a higher amount of investment has gone towards IT capital-intensive investment, yet this investment has not been distributed evenly. Recent research also shows that overall cost saving associated with IT investments tends to increase with bank size.

[13] See also table 2.22.

Table 2. 11 Number of bank staff per ECU 1 billion of assets

	1985	1995	1997	% Change 1985-95	% Change 1995-97
Belgium	267	131	122	-50.9	-6.9
Denmark	316	174	135	-44.9	-22.4
Germany	380	184	158	-51.6	-14.1
Grecee	886	627	511	-29.2	-18.5
Spain	637	318	288	-50.1	-9.4
France	347	155	134	-55.3	-13.5
Ireland	512	239	118	-53.3	-50.6
Italy	491	287	219	-41.5	-23.7
Luxemburg	55	38	37	-30.9	-2.6
Netherlands	456	186	155	-59.2	-16.7
Austria	344	193	175	-43.9	-9.3
Portugal	1393	426	316	-69.4	-25.8
Finland	929	327	271	-64.8	-17.1
Sweden	205	137	102	-33.2	-25.5
United Kingdom	388	186	144	-52.1	-22.6
EU	507	241	192	-52.5	-20.3

Source: ECB (2000d), and Eurostat (1999), Banking in Europe p.10.

Overall, progress in information technology has allowed the set up of new delivery channels and products. It has also accelerated competition, making it easier to compare prices, lowering switching costs and diminishing barriers to entry into markets[14]. Although these factors have intensified competition, they have increased efficiency as well, and other things been equal, reduced the amount of capital optimally held by banks. On the other hand, they have also contrived to the existence of over-capacity in terms of staffing levels in traditional or 'physical' delivery channels, which combined with the lack of flexibility in European labour markets, could result in aggressive pricing in order to avoid restructuring. In the short term, this may lead to

[14] In fact new players have entered the traditional banking market such as powerful financial subsidiaries of industrial corporations, retail supermarkets, and new brokerage firms.

excessive risk that would probably call for an increase in the amount of capital held by institutions.

2.2.3 Trends in credit and deposits activities

Another major factor that has affected European banking over recent years has been the process of disintermediation and the entry of new competitors. Broadly speaking, disintermediation relates to the connection between borrowers and savers without the intervention of the banking sector. The trend towards disintermediation has been characterised by the shift of personal financial assets from bank deposits into mutual funds investments, which may or may not be actually managed by banks (See Table 2.12).

Table 2. 12 Total Net Assets of Mutual Funds in Europe (million ecu)

Country	1989	1994	1998	% Increase 1989-98
Austria	10,601	19,155	54,336	513
Belgium	4,215	15,434	48,236	1,144
Denmark	3,126	4,452	16,605	531
Finland	79	889	4,878	6,175
France	248,591	406,498	534,123	215
Germany	52,300	92,065	166,834	319
Greece	111	4,551	27,425	24,707
Ireland	5,631	6,359	20,241	359
Italy	32,520	65,425	371,912	1,144
Luxembourg	61,676	231,376	433,037	702
Netherlands	19,419	39,043	75,102	387
Portugal	1,917	10,521	19,845	1,035
Spain	6,674	70,129	203,779	3,053
Sweden	19,976	16,482	47,136	236
United Kingdom	78,864	108,881	243,607	309
Euro area	545,700	1,091,260	2,267,096	415
European Union	443,623	956,894	1,932,323	436

Source: European Federation of Investment Funds (FEFSI), (2000), Annual Statistics, statistical annex.

Indeed, the pool of mutual funds (open and closed) managed in the European Union has increased by more than 400% between 1989 to 1998. The growth has been particularly noticeable in countries which were traditionally more banking orientated, such as Greece, Italy, Spain and Finland. On the asset side of banks balance sheet, disintermediation relates to the transformation of traditional banking assets into tradable securities. Although still underdeveloped in Europe (although finally clearly growing in importance), recent regulations in France, Italy and Spain have encouraged the development of bank asset securitisation in Europe, thus facilitating greater disintermediation. Finally, disintermediation has also been encouraged by the development of new technologies as they have allowed the creation of channels that circumvent banks by directly connecting savers and lenders. An example of this would be the case of internet brokerage firms in the retail sector, or corporate bonds issued via the internet in the corporate sector.

The process of disintermediation is reflected in the structure of banks' balance sheets and profit and lost accounts. On the liability side, traditional deposits have shrunk to the benefit of liquid mutual funds, so that European banks have developed other sources of funding, like the Pfandbriefe in Germany, subordinated debt or channelled some of the short term mutual fund investment towards the purchase of certificates of deposits or banks debentures (Belaisch et al 2001). As shown in Table 2.14, from 1995 to 1998, the decline in customer deposits to total assets has been particularly steep in Germany (-11.5%), the Netherlands (-10.9) and Spain (-6.6), whereas in Italy and France, they rose slightly. The rest of European countries have also experienced a fall in the customer deposits to total assets ratio ranging from –17.3% in Ireland to –4.3 in Austria. On the asset side, it is interesting to note that EU banks assets structure reflects the rapid increase in lending due to more buoyant economic conditions (see Table 2.14), so that the share of loans to total assets has been increasing in Italy, Spain, Austria, Finland, Ireland, Luxemburg and Portugal, whereas it declined in France, Germany, Belgium and the Netherlands. This process of increased bank credit demand by banks has been generated by four main factors. First, overall macroeconomic recovery has boosted credit demand by firms and households (see Section 2.5). Second, historically low interest rates accompanied by a surge in M&A has intensified credit demand for leveraged loans. Finally, the reduction in margins and the need to grow in size, may have forced banks to take on a larger proportion of loans. This latter factor may be of particular importance as it may have increased the risk-taking propensity of European banks. As previously mentioned, disintermediation is also taking place as highly rated companies are increasingly obtaining funds via the capital markets by the issuance of shares and bonds. In fact, the growth of corporate bonds in the Euro area has increased spectacularly since 1997 onwards, although from a very low base. The introduction of the euro, the reduction of several barriers to entry into the market, and more efficient information technology systems are creating an almost Euro area wide corporate bond market[15]. From a capital and risk perspective, this development is also of interest as it has boosted non-interest income for certain banks that underwrite these issues. These fees however, appear to be concentrated on a handful of banks. Besides, it can also lead to a deterioration in the portfolio of banks as better borrowers would be able to obtain funds from the market at cheaper terms, leaving the banks with lower quality borrowers or those in which asymmetries of information and relationship lending are too strong.

The decline in deposits due to disintermediation coupled with the decline in interest rate margins is creating strong incentives for banks to look for new sources of income. Foremost among these growing sources of income would be commissions derived from mutual fund management, a stronger presence in the stock market, or the generation of fees derived from investment banking activities.[16](See Table 2.13)

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[15] For developments in the Euro area see Marques, Van Rixtel and Santillan (2000), for a detailed economic analysis of the process see Prati and Schinasi (1997).

[16] See Davis and Tuori (1999) for a comprehensive analysis on the evolution of non-interest income in European banks.

Table 2. 13 Aggregate net non-interest income per aggregate total income (%)

	1994	1995	1996	1997	1998
BE	22	25	28	32	38
DK		25	23	22	26
DE	24	25	27	30	32
GR	60	41	45	46	46
ES	18	26	28	31	32
FR	40	36	45	43	43
IE	28	30	32	35	38
IT	31	28	33	36	44
LU	29	38	40	47	54
NL	29	34	36	40	40
AT	28	27	29	30	31
PT	24	27	32	33	35
FI	43	40	48	47	41
SE	31	31	37	35	46
UK	41	43	42	44	43

Source: OECD (2000), and FITCH-IBCA

Table 2. 14 Main components of banks' balance sheets as a percentage of total assets.

	France	Germany	Italy	Spain	Netherlands
1998					
Loans	40.8	51.1	54.0	50.6	57.9
Customers deposits	39.1	35.3	33.9	56.4	45.7
Total contingent liabilities	30.4	14.4	31.0	5.3	8.5
1995					
Loans	41.3	56.4	52.7	43.5	62.3
Customers deposits	38.2	39.9	33.1	60.4	51.3
Total contingent liabilities	23.7	13.1	25.7	6.6	15.5
1992					
Loans	48.0	56.9	51.4	49.7	62.1
Customers deposits	33.7	40.1	30.5	54.5	53.4
Total contingent liabilities	23.7	13.1	25.7	6.6	15.5
Percentage change 1995-1998					
Loans	-1.2	9.4	2.6	16.3	-7.1
Customers deposits	2.2	-11.5	2.5	-6.6	-10.9
Total contingent liabilities	28.3	9.8	20.4	-19.5	-45.0

Source: IMF (2000), Euro banking at the crossroads, appendix. Data from FITCH IBCA.

2.2.4 Macroeconomic Environment

As can be seen in Table 2.15, from 1990 to 1992, there was a decrease in the rate of growth in terms of real GDP. The economic recession reached its peak in 1993 when this figure was negative in most of the major European countries. As in previous economic cycles, the UK shows an earlier fall in output and an earlier recovery from the economic recession that its European counterparts. Indeed, in 1993, the UK showed strong signals of recovery, whereas its continental counterparts still had negative rates of growth. In 1994, European countries started to recover from the economic recession, this trend improved from 1996 onwards (although for some countries such as Germany and Italy the economic recovery was not as strong as in other cases such as Finland or The Netherlands) so that the second half of the 1990's was a period of economic expansion. Clearly, these factors have affected gross public debt, which increased between 1990 and 1993. After 1993, most of the EU governments made important efforts to reduce their budget deficit in order to accomplish both the Maastricht criteria and to improve their macroeconomic conditions. This trend continued with the Financial Stability Pact that aim to provide a co-ordinated effort to avoid possible disruptive or opportunistic fiscal policy action by any of the European Union members. Monetary policy has been, in general, less dependent on political cycles and pressures than in the past.

Greater co-ordination between monetary and fiscal policies, and tighter overall policy coupled with the economic deregulatory process and the arrival of the EMU, were among the main factors that resulted in a decrease in the rate of inflation and interest rates in recent years as shown in Table 2.16 and Table 2.17.

Table 2. 15 Real GDP (calculated at market prices) changes in five selected European countries

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998
France	2.80	1.00	1.49	-0.89	2.07	1.67	1.10	1.97	3.16
Germany	5.7	4.5	2.24	-1.09	2.35	1.73	0.76	1.45	2.15
Italy	1.97	1.39	0.76	-0.88	2.21	2.92	0.87	1.48	1.34
Spain	3.6	2.2	0.8	-1.0	0.2	0.3	2.34	3.84	3.96
UK	0.4	-2.2	-0.6	1.9	3.8	3.4	2.56	3.51	2.16

Source: Constructed from Eurostat data

Table 2. 16 Private consumption deflator in five selected European countries

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
France	2.7	2.8	2.4	2.1	1.7	1.6	1.4	1.4	0.9	0.3
Germany	3.4	4.5	4.7	4.0	2.7	1.8	1.0	0.8	1.1	0.9
Italy	7.5	7.1	5.4	4.8	4.0	5.2	5.3	2.4	2.7	1.5
Spain	7.3	6.9	6.2	5.1	4.7	4.7	2.6	2.4	2.0	2.5
UK	6.8	6.9	5.0	3.5	2.4	2.8	3.3	2.9	3.0	2.5

Source: Constructed from data Eurostat data.

Table 2. 17 Long-term interest rates in five selected European countries.[17]

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998
France	10.01	9.00	8.60	6.91	7.35	7.59	6.39	5.63	4.69
Germany	8.97	8.61	7.96	6.28	6.67	6.50	5.63	5.08	4.39
Italy	11.96	11.40	13.27	11.31	10.56	12.21	9.40	6.86	4.90
Spain	13.04	11.98	12.17	10.16	9.69	11.04	8.18	5.84	4.55
UK	11.09	9.92	9.12	7.87	8.05	8.26	8.10	7.09	5.45

Source: Adapted from the IMF database, and the Economist for 90-91 data.

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[18] Ten year government bond rate p.a.

As Tables 2.16 and 2.17 show, there were still substantial differences in inflation and interest rates among EU countries by the end of 1998. In 1999, Spain, Ireland and Finland had substantially higher inflation rates, than Germany and France. Nevertheless, governments in Europe were pursuing policies that aimed to bring their economies closer to the Maastricht criteria. As a consequence, European economies were expected to be less prone to the more volatile swings of the economic cycles which have characterised recent history (Morgan Stanley 1995)[18].

All in all, in the 1990's, the macroeconomic scenario was characterised by a short but intense economic slowdown in the early 1990's which left many banks undercapitalised at the time[19], yet the second part of the 1990's brought economic expansion coupled with lower interest rates and subdued inflation that raised the demand for loans, lowered the amount of credit defaults and resulted in improved banking sector financial strength and performance.

2.3 Impact of these changes on European banking markets: structure, performance, capital position and risk

2.3.1 Structure

In comparative terms, European economies constitute an important share of the global economy, as shown in Table 2.18. Europe accounts for more than one quarter of total world GDP, and has both a larger GDP and population than the US and Japanese economies. Therefore any trend affecting the European economy will obviously have an important degree of influence on both the European and global financial system.

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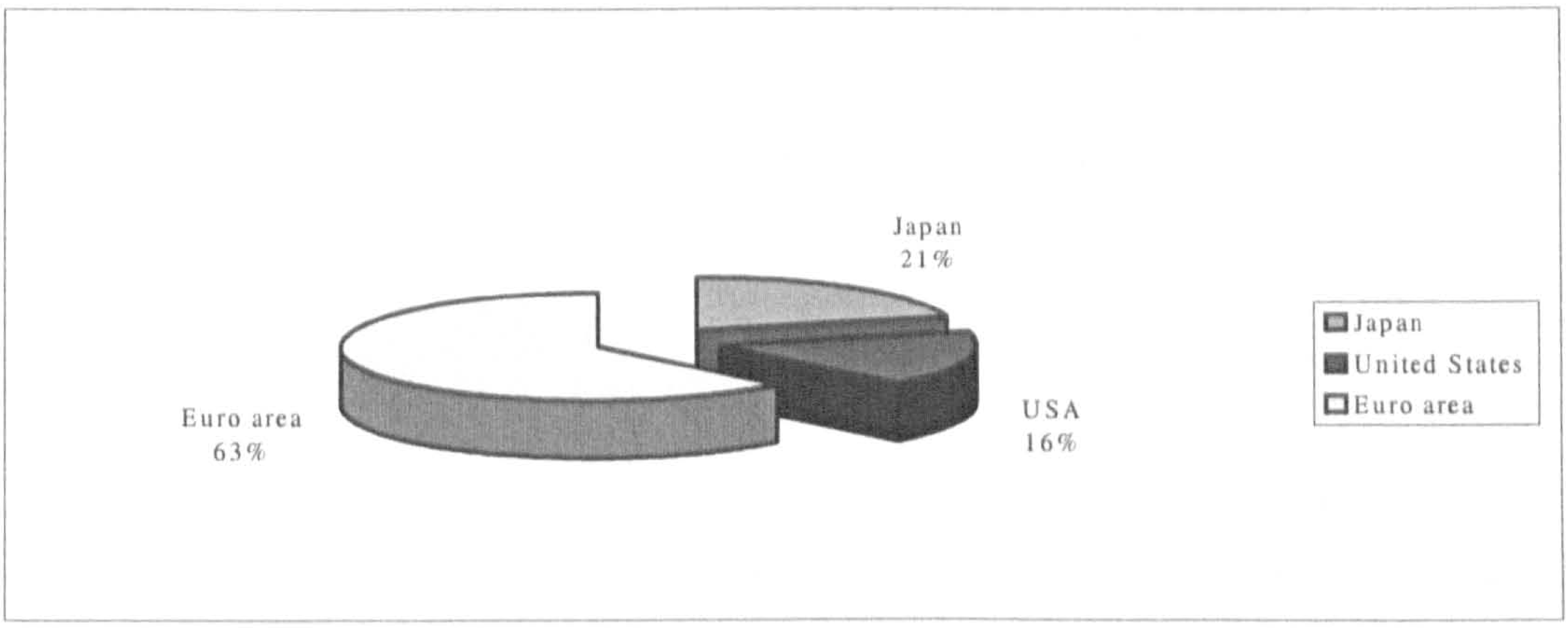
[18] This is probably also the case in the United States, See McConnell and Perez-Quiros (2000).

[19] That was the case in American banks in which capital was 'Granger related' to Return on equity. See Berger (1995). This relationship also held in Europe for the lower capitalised banks in the early 1990's (Marques 1997).

The European banking market has an important degree of heterogeneity both in terms of the kind and the number of institutions. Germany has the largest number of banking institutions (over 3000) with a very large number of local credit institutions, and Ireland has the smallest number of institutions with less than 60 institutions (see G10, 2001). Although, it is difficult to characterise the European banking sector as a whole, as compared to the US, it is reasonable to assume that it continues to be bank-dominated. In this sense the proportion of the banking loans as a percentage of GDP are twice the ratio in the US, or, as Figure 2.2 shows, the relative size of the banking markets measured by the size of the banking sector balance sheet is much larger than in the US.

Figure 2.2 Relative size of main banking markets measured by balance sheet totals (%), 1997



Source: Eurostat 1999 p. 4

Table 2. 18 Macroeconomic statistics of three major economic areas

	Population (million)	GDP (EURO billion)	Public deficit (EURO billion)
EU 15	370	5,798	2,919
US	258	5,663	3,028
Japan	125	3,780	1,935

Source: Dermine (2000) , appendix figures. Data from IMF, ECB and OECD

Within Europe two main banking systems can be distinguished: bank based systems such as in Germany, France and Italy and Spain and market based systems which would be more representative of the UK and the Netherlands. Foremost among the common elements of traditional European continental banking systems would be (Revell 1987):

- The presence of various special credit institutions, which are usually publicly owned and provide funds for various sectors such as industry, agriculture and property;

- The increased importance of savings banks, cooperative banks and cooperative credit associations together with their central institutions;

- A long history of commercial bank participation in the ownership and management of industrial enterprises, relics of which still linger on;

- The importance in many European countries of banks and other institutions, which are organised on a local or regional basis, usually reflecting the prevalence of small enterprises in both industry and agriculture;

- A degree of similarity between the new banking laws that were enacted in many countries following the 1930's crisis.

In general terms, it can be argued that this continental system has been increasingly questioned[20] over the last years and is increasingly becoming more market orientated[21]. Indeed, there has been a substantial process of banking privatisation in recent years across continental Europe that started in the mid-1980s but acquired momentum only in the 1990s. The aim of this privatisation process is twofold; it tries to increase efficiency and improve resource allocation, but it was also a consequence of governmental efforts to accomplish public debt and public deficit convergence criteria, required to enter into the single currency.

2.3.1.1 Privatisation

Overall, this process of banking privatisation has been an uneven process in Europe. In France, privatisation has taken place in two tranches, and although it was quite substantial, it still left room for further reduction of State controlled banks. Initially, by the end of the 1980's, Suez, Paribas, CCF and Societe Generale were privatised. This first phase did little to enhance competition (Morgan Stanley 1995) since the two major banks were still public. In the second tranche, BNP, and Credit Local de France were privatised; this provoked more aggressive tactics by the French banks. However, savings banks ('Caisses d'Epargne') are still indirectly publicly controlled, and have even acquired some major commercial banks (e.g. Credit Foncier). In Spain, the gradual privatisation and rationalisation of Argentaria spearheaded the privatisation process,

[20] See Allen and Gale (2000) comprehensive book, for a thorough literature review of the microeconomics of this area.

[21] For major changes in the financial structure in recent years see the European Central Bank article on this topic, in the January 2000 Monthly Bulletin.

however the weight of the public sector in the Spanish banking system has increased in recent years as a result of the expansion of the savings banks ('Cajas'). The policy of the Italian government to privatise an important number of public banks was to a greater extent imposed by the need to reduce public indebtedness. Banco de Napoli (1992), San Paolo di Torino (1993), Credito Italiano (1993), IMI and Banca Commerciale Italiana have been privatised recently with considerable investor enthusiasm, and heavy oversubscriptions. Banca Nazionale del Lavoro followed suit. As EC (1997) noted, in Germany, the concept of privatisation of commercial banks owned by a complex network of industrial participations has not been discussed so intensively as in France or Italy. However, there is an increasing pressure for privatisation, and the funding privileges of the Landesbanks (owned by the regional government) are coming under closer scrutiny by the European Commission.

De-regulation and privatisation have also impacted on the savings bank industry. Traditionally, they have been operating in a rather limited geographical area, tend to be small in size, and their management is typically influenced by local and/or regional government (Arthur Andersen 1993). Although still more protected from competition than commercial banks, technological advances and deregulation have also substantially affected this sector. Moreover, there has been a larger fall in the number of mutual banks in European countries, with the exception of Germany (in which concentration has started to pick up lately), due to mergers and restructuring. However, this increase in competitiveness shown by the savings banks has been criticised by commercial banks, which argue that saving banks have certain regulatory advantages in collecting savings. In this sense, most Italian saving institutions have transformed themselves into limited companies, able to obtain a stock exchange quotation, and only 23 out of 77 saving banks that have undergone this process are still wholly owned by their respective foundations. This gradual process of market orientation for both savings and commercial banks has considerable implications, since it would increase the competition and the need for more readily available accurate information on portfolio quality.

Overall, and despite cross-country and institutional heterogeneity, there is a clear trend towards a more market orientated banking system across Europe. This should result in a more efficient allocation of resources but also render the evaluation of soundness of financial institutions more accountable to the financial markets. However, and unlike in the United States, lack of transparency of asset quality and bank strength prevails in European banks as shown for instance by the fact that several countries do not even have explicit rules to classify loans as non-performing. This would allow banks an important amount of leeway for accounting discretion. More importantly, some countries (Germany, the Netherlands, Austria and Luxemburg) do not publish figures on the levels of non-performing loans. Hence, the move to a more market orientated financial structure means that private investors rather than depositors are increasingly evaluating the performance of banks and other institutions. In this environment, the quest for transparency becomes increasingly more important.

2.3.2 Efficiency

The concept of efficiency is nevertheless at the core of economics (Leibenstein 1965) and in the case of the banking industry, the importance of this concept is enhanced as a result of the potential externalities in terms of financial stability, economic growth and consumer protection. Hence, financial markets, academics, financial supervisors and policy makers should closely monitor the efficiency of financial institutions. For the purpose of this work, the concept of efficiency is important, as the degree of efficiency of individual banks will play a pivotal role affecting the link between the capital positions of banks and the amount of risk taken by them (see Berger 1992) (Wheelock et al. 1995) (De Young 1994).

According to traditional microeconomic theory, under perfect competition, less efficient banks will be driven out from the market normally via consolidation. Although it is clear in the literature that this is not always the case and often consistently non-efficient banks are allowed to survive in the market (see Kwan and Eisenbeis, 1996), it is also known that the increase in competition in Europe brought about by deregulation would lead to further consolidation, normally in the form of less efficient banks being taken over by more efficient ones. Hence, also from a political point of view, the concept is also of great importance, as it will affect the long-term viability of the banking sector in individual countries in Europe (Bikker 2000). However, both to measure changes in efficiency and determine its determinants are difficult tasks. Two major handicaps are: firstly, the fact that banking is a service industry heavily affected by changes in information technology and, secondly, the demand characteristics of the banking industry. Banking demand is heterogeneous in two dimensions. The demand for retail financial services still depends to a large extent on the peculiarities of each country. Besides, this industry offers a myriad of different products and is subject to an important degree of change.

Bank efficiency is typically described by a variety of measures such as: the number of branches per inhabitant, average number of employees needed to manage a certain amount of assets (see Table 2.19), the cost to income ratio, or the labour cost share, or even concepts such as net interest margins and competition indices (such as the H value of Panzar and Rosse). A recent study by Bikker (2000) tried to obtain a ranking of the efficiency of the banking sectors in nine countries including the largest Europeans, the US and Japanese markets. The author calculated an array of possible indicators that had been used as efficiency proxies in previous studies showing that once calculated and compared they offered no conclusive and often contradictory results. In fact, it was not possible to obtain an efficiency based ranking of the studied countries as:

> *' Virtually each country is indicated as efficient in one index, and each country but one is referred as inefficient in at least one' (Bikker 2000, pg. 6)*

Table 2. 19 Cost structure in the banking sector

	Number of branches per 1000 inhabitants			Employment per $100 000 assets		
	1990	1995	1998	1990	1995	1998
United States	0.29	0.28	0.29	0.40	0.32	0.29
Japan	0.18	0.19	0.19	0.07	0.06	0.06
Euro area	0.56	0.55	0.55	0.21	0.15	0.15

Source: Data from IMF (2000), Euro Banking at the Crossroads appendix , and Eurostat (1999), banking in Europe.

Although it is important to keep these shortcomings in mind, the wide use of simple ratios such as the cost to income ratio and the percentage of total costs derived from personnel costs also offer useful insights into financial firm efficiency, complementary to those obtained by more sophisticated procedures (see Humphrey 1999).

Table 2.20 shows that the ratio of operating costs to total income[22] has declined in virtually all European countries in the 1990s but remains high (78%) in most continental European systems compared with the United States (65%) or the United Kingdom (69%). These data would clearly mesh with performance differences observed as well as the institutional developments observed, given that these latter two countries, and particularly the United States, experienced earlier deregulation and have more market orientated financial structures.

More importantly, the share of personnel costs remains the largest single component of operating costs, greater than 50% of total costs in most Euro area countries compared with 43% in the US, and 45% in the United Kingdom. Typically, the UK and the US have a higher degree of labour flexibility and therefore it is easier for banks to reorganise their staff levels in the new operating environment.

A more formal approach to measuring bank efficiency comes from the production and cost function literature in microeconomics. The academic literature has considered three main types of efficiencies in the banking sector: scale, scope and X-efficiencies. A bank experiences economies of scale, when the unit average cost of production falls as output increases, while economies of scope occur when production costs for a group of goods or services are less than the sum of the cost for each of the individual products. The underlying philosophy of both is that fixed costs are spread among a number of production units (economies of scale) or through different product mixes (economies of scope)[23]. In the case of X-efficiencies, the concept refers to the efficiency differences that do not derive from scale and scope economies but from the optimisation of the technical and allocative behaviour, or, in other words, the ability of the firm to produce at the minimum attainable cost, and price at the optimal market level. Berger, Hunter and Timme (1993), in their review of the bank efficiency

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[22] Unlike most reported ratios on this issue provisions have not been excluded, as the aim is to evaluate efficiency.

[23] Another sources currently considered by the literature to obtain scope economies would be: information economies, risk reduction and customer services. See Molyneux, Altunbas and Gardener (1996).

literature, found that X-inefficiencies account for around 20% or more of costs in banking, while scale and product mix inefficiencies, when accurately estimated, are usually found to account for less than 5% of costs. Consequently, the analyses of differences in average costs have been orientated less towards the question of economies of scale, and scope and more towards the analysis of the cost and revenue X-efficiency of banks. Thus measuring X-efficiency in banking markets has currently replaced the study of economies of scale as the main object of empirical research (see Berger and Humphrey, 1998). A more detailed analysis of these concepts is considered in Chapter 4. The remainder of this section focuses on a selected number of cross-country empirical studies that examine X-efficiency across European banking.

An early approximation to the problem of relative measurement of efficiency in European banking was undertaken by Molyneux, Gardener and Altunbas (1996) who used the Stochastic frontier approach and found that X-inefficiencies for individual European banking markets amounted to 20% on average between 1987 to 1994. In addition, when all European Union banking markets were considered together, they found that European banks, on average, moved closer to the EU efficient cost frontier between 1990 and 1994. Mean levels of X-inefficiencies fell from around 27% in 1990 to 22% in 1994. This finding, they argue, was consistent with increased levels of competition in the European banking market. Another interesting result of the aforementioned study was that X-inefficiencies of larger banks were lower than for their smaller counterparts. This finding, supports the hypothesis that increases in competition had a bigger impact on improving large bank efficiency compared with that of small banks.

Studying the impact of Internal Market Integration on the banking and credit sector, the EC in 1997 found evidence of scale economies across a broad range of bank output sizes in the European banking market. This result, the EC argued, pointed towards cost reductions that had been brought about by the EU's single market programme. In contrast, the same study also attempted to investigate the impact of internal market integration on the realisation of economies of scope in the banking sector. Here scope economies were only found to exist for two size categories of banks: those with assets size in the range ECU one to ten billion and banks larger than ECU 50 billion. However, the consideration of scope economies has traditionally been analysed by fewer studies, and '*has been proved somewhat problematic*'. (EC, 1997). Consequently, the main conclusion of the few cross–country empirical studies was that the introduction of the Single Market for Financial Services produced a small increase in X-efficiency in European banks, which were actually larger than scale and scope economies.

A recent study by Bikker (1999), attempted to rank bank efficiency by countries. This study found that Spanish, French and Italian banks appear to be less efficient than those in Germany, the Netherlands and the UK, while banks in Luxemburg and Belgium emerge as the most efficient. Larger differences in average X-inefficiencies and costs levels between countries also exist, Spain being 40% above and Luxemburg 35% below the European average (see Bikker 1999).

Finally, Maudos, Pastor, Perez and Quesada (2000) studied the efficiency of European banks analysing cost and profit efficiency as well as possible sources of differences in efficiency levels. Their results underlined the importance of inefficiencies both on the asset and liability side of the balance sheet. Regarding the likely explanations for the differences in efficiency between countries, they show that higher loan to assets ratios; market concentration and economic growth are positively related to cost and profit efficiency. Higher risks are positively related to profit efficiency, whereas larger networks of branches are negatively related to bank cost efficiency. Overall, as in the case of EC (1997) and Bikker (2000), they also emphasize the substantial range of variation in efficiency levels across banking systems in the European Union.

Overall, this section shows that efficiency is an important indicator when trying to analyse structural features of the banking industry. Yet, the measurement of efficiency is a difficult issue, particularly in the banking industry. The use of conventional financial cost ratios shows that UK and US banks are more efficient than the continental Europeans. Besides, when more sophisticated production function techniques are used, the empirical literature shows that there are substantial differences in X-efficiencies across European banking markets.

Table 2. 20 Accounting indicators of efficiency: cost to income and personnel expenses ratio.

		Belgium	France	Germany	Italy	Netherlands	Spain	EU-11	UK	Japan	US
Cost to income	92	85	94	77	81	80	89	85	86	84	65
	95	80	89	77	84	78	80	81	61	127	65
	98	65	85	78	77	83	75	78	69	159	65
Of which: Personnel cost		Belgium	France	Germany	Italy	Netherlands	Spain	EU-11	UK	Japan	US
	92	61	55	49	61	57	59	56	36	29	46
	95	59	42	54	58	38	41	---	47	27	46
	98	54	57	49	55	55	57	53	43	20	45

Sources: Constructed from FITCH-IBCA data.

Efficiency is therefore an important element when a bank is to determine its capital and risk position, and obviously it will have a major bearing on the performance attained by the institution. Simple measures of efficiency can provide at times contradictory results as they measure only conceptual elements indirectly related to efficiency. They are nevertheless useful in indicating that the efficiency levels of continental European banks stand well below those of American and British banks. More sophisticated measures of efficiency also support this view, and indicate that efficiency is improving, albeit slowly and at a heterogeneous pace in Europe.

2.3.3 Performance

Given the heterogeneous ownership features and different economic goals of European banks, it is important to present a disaggregated analysis of performance by type of institution. Besides, the share of mutually owned or savings institutions, is important in several continental European countries such as Spain, France and Germany. Focusing on the main continental European countries, the main caveat would be that profitability comparisons across bank types are not straightforward because of different constraints and regulatory frameworks in which each kind of institution operates. Indeed, whereas commercial banks are under pressure from shareholders to create market value, savings and cooperatives typically have different managerial objectives such as to supply credit to certain sectors or areas, or to generate a 'social fund' to be employed for public and community purposes. Consequently, these different objectives and regulatory and market constraints between different kinds of institutions are likely to have a bearing on performance.

When analyzing different measures of performance by kind of institution, it is clear that net interest margins decreased from the early 1990's as would be expected in a more competitive and less banking intermediated marketplace (see Table 2.21 and 2.22). The decline has been less profound for savings and cooperative banks than for private banks. Surprisingly when compared to their peers, Spanish saving banks and French cooperatives have enjoyed increases in their interest margins. These differences in margins can be partly explained by the comparative advantage that savings and cooperatives may have in funding themselves at lower costs for two main reasons. First, they tend to have a quite loyal and non-sophisticated deposit base. Secondly, they benefit from implicit or explicit government guarantees that lower the funding costs of these institutions. Overall, this aspect seems to suggest a two-tier market in which cooperatives and savings banks benefit from more favorable market conditions that their private sector counterparts. In fact, looking at the share of different types of institutions on the overall sector's profits, savings and cooperatives banks have grown at the expense of commercial banks in France and Spain whereas they have declined in Italy and Germany[24].

Regarding the overall performance in terms of returns on assets, the ROA of savings and cooperatives does not appear to be considerably different from that of commercial banks. Instead differences in ROA seem to be more related to the country rather than to the institutional characteristics of the institution, this figure being particularly strong in Spain and Italy, and lower in France and Germany (see Table 2.22). Yet as a whole, return on assets in continental Europe (with the exception of Spain, and Finland) has been substantially lower compared with the US or the UK.

Increases in competition from other banks and non-bank financial institutions such as mutual funds, pension funds, or credit card organisations has driven up the cost of funds. This fierce competition, together with a decline in asset quality due to the economic recession at the beginning of the 1990's, reduced net interest margins in the European Union from 2.49% in 1990 to 2.09% in 1994[25], this trend continued, although at a slower pace in most countries during the second half of the 1990s. The decline has been more pronounced in countries, which traditionally had been enjoying higher margins such as Italy or Spain. According to the OECD (1992a), the main reasons for increasing pressure on interest margins are:

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[24] However note that market share dynamics are more difficult to ascertain in Italy where institutions classified as savings banks in the past have now a status of commercial private banks since their reform in the early 1990's.

[26] Net Interest Income/Earning assets.

- Removal of administrative constraints when fixing interest rates on customer deposits;

- Elimination of protectionist barriers preventing competition;

- The movement towards disintermediation, which allows companies to raise capital directly;

- Removal of branching limitation, eroding monopolistic earnings in local markets.

Table 2. 21 Net interest revenue (% of total earning assets)

	Average 1989-94	Average 1995-97	Difference
Austria	1.94	2.07	+0.13
Belgium	2.39	3.87	+1.48
Denmark	5.30	4.74	-0.56
Finland	3.58	1.80	-1.78
France	3.09	2.66	-0.43
Germany	2.47	2.90	+0.43
Greece	3.11	3.05	-0.06
Ireland	2.67	1.82	-0.85
Italy	4.74	4.44	-0.30
Portugal	4.52	2.29	-2.23
Spain	4.37	3.68	-0.69
Sweden	2.76	2.21	-0.55
United Kingdom	2.36	2.50	+0.14
United States	4.08	4.19	+0.11

Source: Danthine et al. (1999). Appendix

Table 2. 22 Performance indicators for the largest EMU banking markets by type of institution

	Commercial banks		Saving banks		Cooperatives	
Net interest margins to total assets						
	1991	1998	1991[26]	1998	1991	1998
France	2.2	1.2	2.4	1.5	1.8	1.3
Germany	2.3	1.3	1.4	1.4	1.2	1.6
Italy	2.5	2.2	3.0	3.0	3.2	2.8
Spain	3.6	2.7	2.8	3.5	4.2	3.5
Return on assets						
	Commercial banks		Saving banks		Cooperatives	
	1991	1998	1991[27]	1998	1991	1998
France	0.3	0.3	0.3	0.3	0.2	0.4
Germany	0.2	0.3	0.2	0.2	0.2	0.2
Italy	0.4	0.4	0.7	0.5	0.4	0.4
Spain	1	0.9	0.8	1	1.4	1.3
Operating cost/income						
	Commercial banks		Saving banks		Cooperatives	
	1991	1998	1991[28]	1998	1991	1998
France	93.3	91.4	85.0	82.2	90.2	82.0
Germany	101.1	84.0	88.0	74.4	104.8	81.1
Italy	82.0	77.8	71.5	76.3	76.2	74.5
Spain	78.5	75.8	77.0	69.1	66.8	65.0
Share of sector's profits						
	Commercial banks		Saving banks[29]		Cooperatives	
	1991	1998	1991	1998	1991	1998
France	64	35	3	3	29	38
Germany	25	33	42	38	12	11
Italy	34	45	33	14	18	18
Spain	65	51	17	31	1	2

26 1992 figure for Spain.

27 1992 figure for Spain.

28 1992 figure for Spain.

29 1992 figure for Spain.

Source: Constructed from Fitch-IBCA data

While interest margins have fallen, European banks have increased their non-interest income (Table 2.13). This factor can be partly explained by the increased emphasis on the brokerage function[30] and partly by the need of banks to maintain profitability and reduce cross subsidisation. As was considered earlier, technology has been a major factor responsible for the reduction in overhead costs in favour of investments in technological innovations. This will ultimately have a bearing on earnings per unit of capital invested.

Return on equity is the accounting measure most closely monitored by financial analysts and regulators, as it incorporates both profits and financial leverage in one single profitability measure (Arthur Andersen 1993). As is normally the case, in recent years, it has closely followed the economic cycle. However, as can be inferred from Table 2.23, there has been a substantial impact of national forces affecting ROE in different countries. For the European Union as a whole, there was a considerable reduction in returns in the early 1990's, declining from 10.9% in 1990 to 6.8% in 1992, and then down to 5.1% in 1994 and 1995, and an improvement in the second half of the 1990's up to 14% in 1998. The reduction of ROE in the early 1990's hit commercial banks more heavily than savings banks. Besides, the volatility of the change in performance is lower for commercial banks than savings banks. (EC 1997). After a generalised credit expansion in the late 1980s, the UK and Sweden were among the first European countries to bear the brunt of the economic crises in terms of profits. In the earlier 1990s, Scandinavian countries were hit particularly strongly by the banking crises and obtained particularly poor results as evidenced by a negative ROE of –27% in Finland that wiped out their capital base. This was also the case although to a lesser extent in Denmark were banks recorded losses in 1993 and 1994. Yet, Scandinavian countries also recovered earlier than their continental counterparts as provisions for bad loans in France and Italy were dramatically affecting profits well into 1994/1995.

[31] By which the banks are specialist intermediaries that can provide an array of services that do not necessarily imply qualitative transformation of the subjacent asset for the banks (see Bhattacharya and Thakor 1993).

Table 2. 23 Return on Equity (aggregate profits after provisions and taxes per own funds)

	1994	1995	1996	1997	1998
Euro area	5.1	5.1	6.4	6.3	7.4
EU	6.8	7.5	8.9	8.8	9.1
BE	9.8	9.9	11.7	11.5	10.6
DK	-0.5	16.0	16.3	12.4	10.8
DE	5.1	5.5	4.9	4.6	4.4
GR	17.3	17.5	16.5	17.8	19.9
ES	11.3	11.4	12.1	14.5	14.4
FR	3.4	0.5	5.4	5.3	6.2
IE	14.5	15.0	15.7	17.3	18.0
IT	0.8	1.2	3.6	1.0	7.5
LU	14.2	14.0	15.3	15.7	35.7
NL	5.9	7.8	8.4	8.6	7.4
AT	4.7	6.7	5.7	6.4	5.3
PT	9.6	9.0	11.8	13.6	13.3
FI	-26.6	-11.4	8.2	18.2	26.0
SE	7.3	12.4	14.7	10.0	13.9
UK	16.3	18.6	18.8	19.3	14.4
Average	6.2	8.9	11.3	11.7	13.9
St Deviation	10.2	7.6	4.8	5.4	8.2

Source: ECB (2000a). EU banks' income structure, p. 54.

The harrowing times experienced by the French banks are a reflection of two main factors, namely, the real estate crisis and the problems of small businesses. Real estate losses adversely affected the asset portfolio quality of most French banks. From 1990 to 1995, commercial property prices fell by at least 50%, and there was an estimated six million square metres of vacant office space in the Paris region in 1995 (Morgan Stanley 1995). Medium-sized banks have been seriously affected by the decline in ROE, and larger banks have acquired many of them. Simultaneously the French banks preoccupation with market share at the expense of profits has helped to raise competition that bogged down the margins and consequently the return on equity. Italian banking suffered the highest decrease in profitability from 11.16% of ROE in 1990 to 0.70% of ROE in 1994. Indeed, in 1994 ROE for commercial banks in Italy was negative (-0.84%). These results come from lower interest spreads, higher loan provisions and heavy taxes. Italian banks have been forced to achieve better productivity. In this sense, there has been a fall in staff numbers in spite of the increase in the number of branches. Italy remained under-branched, and over-banked (The Banker 1994), due to the previous limitations about branching regulation, and reluctance about mergers of several major banks.

In contrast with France, Germany did not suffer an important decline in the quality of the real estate portfolio of banks, in the earlier 1990s, but its performance has always been very low in comparison with its European counterparts. In general European banking underwent a harrowing experience in the early 1990's that hit Scandinavian, French and Italian banks hardest.

As shown in Table 2.24, from 1994 onwards, European bank performance has improved substantially, helped by better macroeconomic conditions and superior productivity. Credit demand also increased substantially in most countries from 1996 to 1999. There are, nevertheless, two elements that deserve more careful attention. On the one hand, volatility of earnings both across countries and across institutions is rising. On the other hand, when the results obtained in continental Europe are compared with those of the United Kingdom or the United States, they remain considerably poor. Indeed in 1998 ROE in the US or the UK was almost double that of banks in the Euro area.

Table 2. 24 Performance indicators in three major economic areas.

	EU-11			UK			US			JAPAN		
	92	95	98	92	95	98	93	95	98	92	95	98
ROA	0.3	0.3	0.4	0.3	0.8	0.7	1.8	0.9	0.9	0.2	-0.2	-0.7
ROE	9.5	5.1	7.4	6.2	14.3	11.9	28.1	13.7	13.4	5.2	-5.5	-17
Earning power	0.9	0.8	0.9	1.3	1.4	1.0	3.4	1.6	1.7	0.7	1.5	1.5

Source: Author's own estimation from FITCH – IBCA and IMF (2000), appendix.

The economic crisis of the early 1990s reduced the performance (at one stage or another) of banks in all European countries. Since then, accounting measures of profits have followed an upward trend over the last few years. However, from the point of view of financial soundness, it is interesting to note that the volatility of earnings has increased and that the gap between EU-11, the United Kingdom, the US and Japan in terms of performance has not narrowed in recent years, probably an indication that there is substantial room for further integration in economic conditions in coming years.

2.3.4 Impact of the above mentioned structural trends on capital and risk

All the aforementioned structural factors are likely to have some influence on the value of firms and, hence on the economic value of their capital. The amount of capital to be held by a bank would depend not only on deliberate decision taking by bank owners and managers but also on the structural features of their market as well as economic shocks and other external factors often exogenous and outside of the control of the bank. Foremost among these factors affecting banks capital would be prudential regulation, and more specifically capital adequacy regulations. Indeed, as we will be seen in Chapter 3, the deregulatory process has made regulators increasingly focus on capital adequacy regulations. Ultimately, the main goal of capital adequacy regulations is to improve the overall soundness of the financial system as well as to preserve a level playing field.

In Europe, the adoption of the Second Banking Directive which aimed to create a single market for financial services, was supplemented by the introduction of the capital adequacy directives (Own Funds, Solvency Ratio and Capital Adequacy Directive for Investment Firms CAD II)[31], which normally following the pattern of international prudential regulation of the Basle Committee, were specifically designed to boost capital ratios, and aimed at creating a situation in where all European banking markets could compete fairly with each other with none having an unfair capital advantage. This regulatory process has probably played a fundamental role in determining the capital positions of banks after its implementation.

If we try to relate the earlier mentioned trends that pointed towards a more competitive environment, most observers (see for instance Bennink and Benston, 2000, or IMF, 2000) conclude that most European banks have been under pressure to boost their capitalization. As previously mentioned, a key determinant for this trend was the Capital Adequacy regulation, other important explanations were: (1) the increase in competition, (2) the reduction on the premiums on funds raised in the financial markets

[31] See next chapter.

(3) the need to increase capital bases to expand business, and (4) to hold a sufficient capital base on a probably riskier loan portfolio.

From a static point of view, in 1998, the BIS risk-weighted capital ratio of the five largest banks in most European countries exceeded 10% (see Table 2.25), which is reasonably above the international BIS threshold of 8%. Among the largest countries, the Netherlands, Ireland and Spain had the highest BIS total capital to risk weighted assets ratio. This concords with the fact that these three countries experienced a substantial increase in outstanding credit in the second half of the 1990s. In contrast, Italy and Germany had the lowest BIS capital to risk weighted to total assets ratio. Concerning the simple equity to total assets ratio (see Table 2.25), the main observation is that despite recent developments, it varies considerably from one country to another, ranging from 3.4 per cent in Germany to 6.4 in Spain. Country specific factors, such as the percentage of 'hidden reserves' (e.g. Germany[32]) and the importance of inter bank lending (e.g. France), as well as differences in inflation and non-performing loans (traditionally larger in Italy and Spain) among other variables, can partly explain these differences.

[32] Note that with the new German government's 2000 tax reform proposal, the taxation of capital gains on equity holdings will be substantially reduced.

Table 2. 25 Risk and capital measures in 1998 (unless otherwise indicated)

	France	Germany	Italy	Spain	Belgium	Finland	Ireland	Luxemburg	Netherlands	Portugal	Average	Standard deviation
BIS ratio 5 largest banks	11.0	10.1	9.6	12.0	11.0	11.9	13.0	13.0	14.0	11.4	11.7	1.3
Provisions/NPL	6	---	6	---	60	---	42	---	---	115	57.0	39.4
Non-performing loans/total loans												
1995	8.5	---	9.0	6.0	4.0	6.0	---	---	---	5.9	6.6	1.9
1998	6.3	---	8.9	1.7	3.2	1.8	2.4	---	---	2.8	3.9	2.7
Equity/total assets	4.4	3.4	6.3	6.4	3.5	5.0	6.1	3.7	4.2	5.3	4.8	1.1
Equity/net loans												
1992	8.1	7.5	12.6	12.9	7.0	8.8	8.8	13.5	6.9	15.9	10.1	3.1
1995	10.6	6.9	12.9	13.1	7.4	10.2	12.9	17.5	7.4	14.0	11.0	3.4
1998	10.7	6.7	11.8	12.7	9.4	8.5	10.8	17.9	7.3	10.6	10.3	3.2
% Change 1992-1998	32.1	-10.9	-6.4	-0.8	35.5	-3.4	23.3	32.4	4.7	-33.7	2.8	

Sources: Adapted from several issues from The Banker and IMF (2000) pg.19.

If we look at the trends in changes of core capital over recent years (see Table 2.26), it is noticeable that there was an increase in both capital ratios in 1993, and more evidently in 1994 after the full implementation of the EU Second Directive and the accompanying capital adequacy regulations. Yet, overall, there is not a clear trend regarding changes in core capital positions during the 1990's. Some countries such as France and the Netherlands have experienced a slight increase, whereas Italy and Germany have had a small decline in this ratio.

Given that loans are normally recognized to be riskier than other investments, the ratio of equity to net loans could give some further insight into the developments of the capital position of banks. Table 2.25 shows that, for the EU area as a whole, the ratio equity to net loans has experienced an increase in the average from 1995 to 1998, yet this change has been very heterogeneously distributed, with countries such as France, Belgium or Luxemburg experiencing substantial increases and other countries such as Portugal, Germany and Italy experiencing decreases in this figure. Finally, the variability of capital position across countries has declined over the 1990s, probably as a result of the trend towards more similar competitive conditions.

Table 2. 26 Median TierI capital ratio

	Germany	France	Italy	Netherlands	United Kingdom	United States
1990	5.9	4.4	7.8	---	5.5	5.1
1991	6.0	4.7	6.9	---	8.6	7.8
1992	5.4	5.0	6.9	6.0	7.4	9.5
1993	5.7	5.2	6.7	6.9	7.7	10.0
1994	6.0	5.7	7.7	7.9	10.6	10.0
1995	5.9	6.1	9.1	8.8	10.0	10.4
1996	5.5	5.9	9.3	7.9	10.4	10.2
1997	5.9	5.9	7.4	8.1	9.3	10.1
90-97	5.7	5.4	7.6	7.9	9.6	10.1

Source: De Bond and Prast (2000), p. 86.

Table 2. 27 Median total capital ratio

	Germany	France	Italy	Netherlands	United Kingdom	United States
1990	9.1	8.0	9.6	---	10.3	8.4
1991	8.8	8.7	9.0	---	12.0	9.6
1992	9.3	8.7	9.2	10.3	12.0	11.4
1993	9.1	9.0	9.7	11.2	13.1	11.9
1994	9.6	9.8	10.5	12.8	14.4	11.8
1995	9.4	9.7	11.0	12.5	15.0	12.1
1996	9.4	9.9	10.2	12.4	15.4	11.9
1997	9.9	10.4	10.2	10.8	14.2	11.8
90-97	9.4	9.2	10.1	11.3	14.2	11.8

Source: De Bond and Prast (2000), p. 87.

The changing environment of European banks in which capital can be seen as relatively more expensive, particularly when the economic cycle is on an upward swing coupled with the need for increased capital when credit demand is peaking could be the main factors explaining these developments.

2.3.4.1 Impact on risk

Overall, the pressure to increase the amount of bank capital can be related to the fact that banks are taking on more risk. In this sense, various factors outlined above, such as increased competition from new and established operators, de-regulation and technological developments as well as the continuous upwards-economic cycle have overall probably been conducive to a relaxation in credit standards[33]. This would have probably implied an increase in the risk position of banks.

Table 2.25 shows that the amount of non-performing loans to total loans in the Euro area countries[34] declined substantially from 1995 to 1998, from 6.6% to 3.9% of total loans, pointing towards a lower risk portfolio of loans. According to this measure, Spain, Finland, Ireland and Portugal show a considerably larger amount of non-performing loans than France, Italy and to a lesser extent Belgium. Clearly, a favorable economic period has helped to reduce the amounts of defaults and raise the amount of

[33] This process will probably be also applicable to the US. See for instance Greenspan (2000).

[34] Excluding Austria, Germany, Luxemburg and the Netherlands.

loans granted. Yet, a problem with accounting measures of risk such as provisions or non-performing loans is that they only provide historical information on the amount of risk and are normally registered when the default has occurred. For the purpose of our study, the use of complementary measures of risk would be helpful to give a broader view on the likely amount of risk held by European banking institutions.

Given that foreign loans tend to be riskier than domestic loans, an indicator that could give complementary information on possible risk problems derived from a deterioration in external macroeconomic conditions would be the amount of foreign exposure taken by banks. Foreign assets as percentage of claims of the domestic private sector (Table 2.28) rapidly expanded from 1995 to 1998 in most European countries with the exception of Spain and Portugal[35]. A more disaggregated measure, incorporating the countries in which foreign assets are invested in, shows that Latin America and Eastern Europe are the regions benefiting from the largest amount of percentage growth from 1995 to 1999. From a banking soundness perspective, it is interesting also to point out that investment in Latin America has been limited to a handful of Spanish and to lesser extent Portuguese banks. Investment growth in Eastern Europe has been shared by a larger number of banks and it has a lower standard deviation of growth, but in absolute terms it is very concentrated in two countries: Austria and Germany.

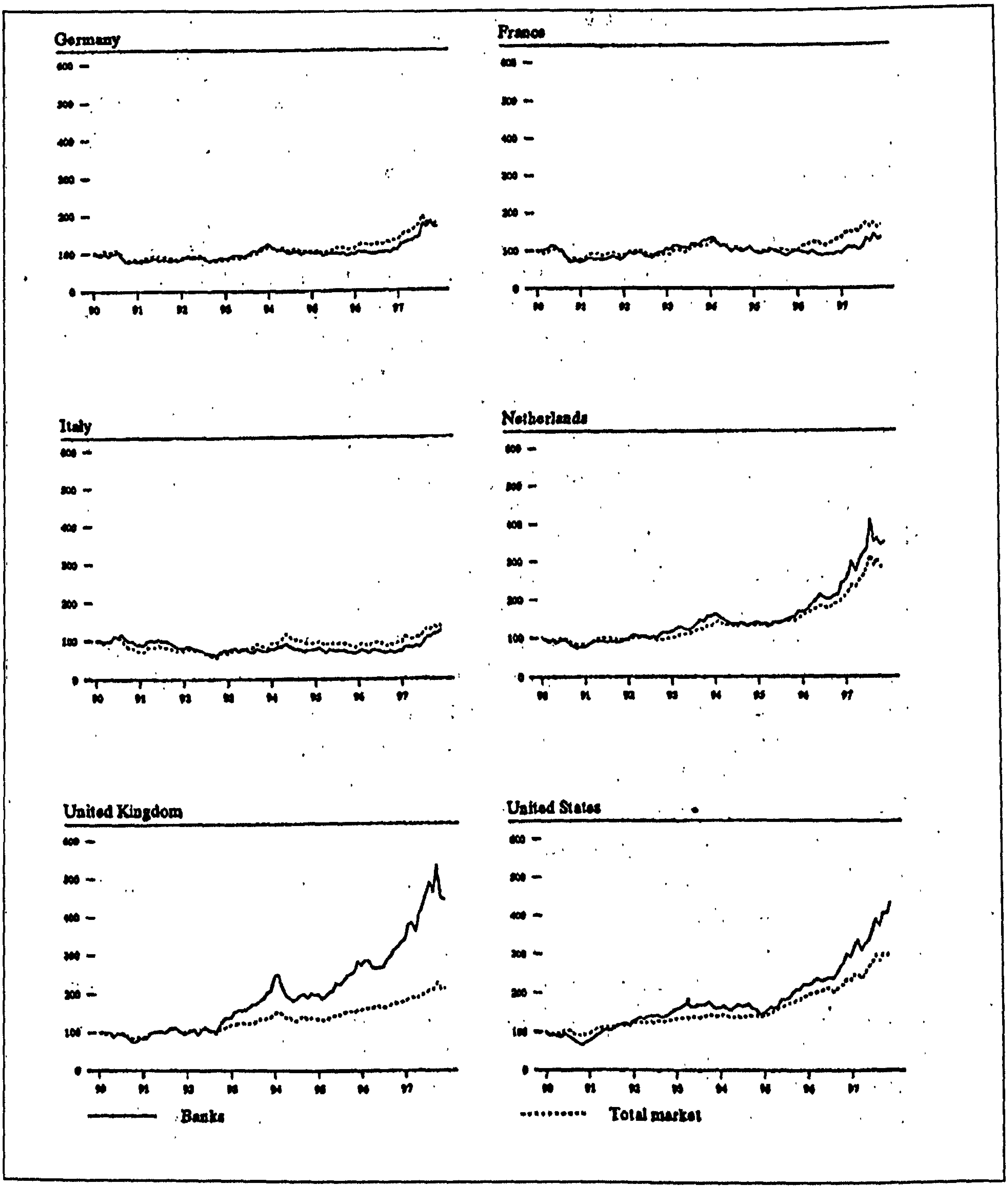
Table 2. 28. Foreign assets as a percentage of claims to the domestic private sector

	FR	DE	IT	ES	AT	BE	FI	IE	LU	NL	PT	Average	Standard Deviation
1995	51.2	22.8	22.5	33.0	41.7	131.7	30.1	99.9	2826	59.9	48.2	54.1	35.5
1998	65.0	31.0	26.2	23.8	-----	143.6	31.0	176.9	2828	67.4	47.7	65.4	52.8
% Change in ratio	27.0	35.8	16.3	-28.0	-----	9.0	3.1	77.0	0.1	12.5	-1.1		

Source: constructed from BIS data (1999), Quarterly Review, December.

[35] Although this two countries have been actively investing into foreign bank equity, particularly in Latin America.

Table 2. 29 Stock market performances of the total market and banking sector index.



Source: Datastream (from De Bond and Prast (2000), pg. 88).

A more forward looking measure of performance could come from the comparative analysis of performance of the banking against the overall stock market index, as it could be an interesting indicator regarding markets participants views on the banking sector. This value which has been obtained by regressing the national banking sector index against each national broad stock market index[36], can be identified as the CAPM beta, that is normally associated in finance literature with the amount of systematic risk in this sector

As could be reasonably expected, over the first half of the 1990's the banking sector indices mirrored the overall market indices (Figure 2.29). This was largely expected for two reasons:

1. The banking sector constituted a larger proportion of the stock market in terms of total capitalization. Yet, recent trends in the European financial landscape, such as the increase in competition of a previously largely protected sector and disintermediation processes, are provoking a decline in the banking sector share in terms of overall stock market capitalization;

2. It is also one of its more cyclical components.

In countries in which the financial system is more market orientated such as the United Kingdom, or the Netherlands[37], bank share prices increasingly diverged from the overall index trend (see Table 2.29). Indeed, during the second part of the 1990s bank share prices in these countries performed better than the all market indices, whereas in Germany, France, Italy and, although to a lesser degree in Spain, returns on bank stocks followed their respective country indices more closely although under performing them. According to standard portfolio theory, this would suggest that for banks in the US, the Netherlands and the UK, the sensitivity of bank stock prices to movements in the stock

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[36] All the data has been obtained from Datastream, a private data provider. The indices are the total national broad market and banking sector indices also provided by Datastream. Data was obtained daily.

[37] This would be also the case of the United States in which this factor was actually more relevant.

market as a whole (the so called beta), is considerably larger than one. According to portfolio theory, this would imply an increase in risk by those banks.

The volatility of the sector in most countries has been increasing in relative terms in relation to most other sectors with the exception of the so-called 'new economy stocks' (see De Bondt, 2001). Besides, when we look at how the banking sector is performing using the overall stock index as a benchmark (Table 2.30), deviations against the overall market have also been increasing. According to De Bond and Prast (2000), there is circumstantial evidence of increased risk in the commercial banking industry in several European countries, and especially in the Netherlands and the UK. This factor, together with the high return on equity figures for these countries would give support to the hypothesis under which banks engaged in riskier activities are compensated with higher returns as a result of increased market discipline.

Overall, the pressures towards capital increases seen in the previous section, should be seen in light of the possible increases in risk shown by market and some accounting indicators of risk. Yet, and concerning the topic of banking risk, a caveat is necessary as an assessment of banking risk is notoriously difficult (see for instance Estrella 1998, and Chapter 4). Firstly, and unlike in the United States, evaluation of banks' assets quality is very difficult due to the lack of uniformity in the treatment of non-performing loans across European countries. In fact, some countries do not publish information on asset quality. Secondly, information disclosed by European banks is very limited in terms of disaggregate information, disclosed market values or market and credit risk figures. Finally, the use of financial derivatives instruments and other OBS instruments could distort the information made available by financial statements.

Table 2. 30 All bank share Price index vs. all share Price index (1996q4=100)

	96q4	97q1	97q3	98q1	98q3	99q1	99q3
BE	1.00	1.10	1.08	1.23	1.35	1.21	1.09
DK	1.00	1.04	1.01	0.99	1.06	0.95	0.88
DE	1.00	1.09	1.19	1.10	1.00	0.90	1.03
GR	1.00	1.17	1.11	1.07	1.28	1.58	1.36
ES	1.00	1.07	1.17	1.31	1.23	1.24	1.24
FR	1.00	1.08	1.18	1.39	1.02	1.33	1.27
IE	1.00	1.08	1.13	1.24	1.59	1.48	1.27
IT	1.00	1.06	1.18	1.36	1.47	1.44	1.38
LU	1.00	1.15	1.25	1.10	1.37	1.24	1.33
NL	1.00	1.05	0.97	1.03	0.97	1.05	1.01
AT	1.00	1.04	0.80	0.89	0.87	0.92	0.94
PT	1.00	0.95	1.07	1.30	1.39	1.32	1.30
FI	1.00	1.08	1.09	1.24	0.96	0.58	0.54
SE	1.00	1.06	1.02	1.32	1.24	1.08	0.99
UK	1.00	1.05	1.23	1.17	0.99	1.18	1.15
Average	1.00	1.07	1.10	1.18	1.19	1.17	1.12
St Deviation	0.00	0.05	0.11	0.14	0.21	0.25	0.22

Source: Constructed from Datastream. ECB (2000), PSD, appendix.

2.4 Conclusion

The purpose of this chapter was to describe the environment of European banking in the 1990s and to provide an overview of the factors that have affected the capital positions of European banks. This is necessary in order to understand the elements that determine the capital and risk position in European banking. Although European banking markets remain highly heterogeneous, competition has heightened and advances in technology have become more rapid. The increased competitive environment is forcing European banks to improve their efficiency although banks in continental Europe still appear less efficient and less profitable than their UK and US counterparts. Within Europe, those banking systems that have been more market orientated are, on average, more profitable. In terms of standard accounting measures, it appears that the risk position of banks is at a historically low level. This is because they have low loan-losses, high profits and are generally operating at a healthy stage of the economic cycle.

Consequently, apart from the relatively buoyant macroeconomic scenario, there are alternative reasons to believe that European banking has become riskier. Increases in lending, declines in margins, increased volatility of banks' stocks and stronger competition are all indicators of potential greater risk. In addition, although the capital position of banks has improved since the period of economic crisis in the early 1990s, it has not changed substantially lately.

Overall, this analysis of structural trends in the European banking industry has intended to provide a background of the forces shaping capital and risk in Europe as well to serve as an introduction to the contents of Chapters 3 and 4. Chapter 3 will further explore the regulatory process by providing a more detailed analysis of the de-regulatory process that has taken place in Europe. It will also include an analysis of the rationale for capital adequacy regulations as well as the main results from selected studies on the theoretical literature on capital adequacy regulations and its relationship with bank risk-taking. Then Chapter 4 will explore the issue from a more applied perspective by revising the work aimed at empirically analysing the determinants of bank risk-taking and its relationship with banking capital.

CHAPTER 3

BANKING CAPITAL AND THE PRUDENTIAL REGULATORY FRAMEWORK

3.1 Introduction

This chapter aims to provide an overview of the regulation of bank capital. Section 3.2 begins by introducing the main arguments that justify the existence of financial regulation. The following section 3.3 focuses on the rationale for the regulation of bank capital and it also underlines selected theoretical articles on the impact of solvency regulations. Then, section 3.4 considers the potential negative externalities of prudential regulations. Section 3.5 presents and summarizes two major approaches aimed at modelling the impact of capital regulations on the risk positions of banks. Finally, an overview of the prudential regulatory framework at the international and European level is provided in Section 3.6.

3.2 Rationale for financial regulation

Traditionally, public regulation is justified by market failures such as negative externalities, the use of market power, and asymmetries of information between buyers and sellers. Unlike other industries, the financial services industry has been heavily regulated for centuries. As reported by Benston (1998), banks have probably been regulated earlier and more comprehensively than any other kind of enterprise, even compared to those firms producing goods and services that affect people's health and safety. This unusual amount of regulation is normally justified by the role banks play in the process of financial intermediation and the allocation of capital in an economy. Yet, in the case of the banking industry, there is neither consensus on whether banks need to be regulated[38] nor on how they should be regulated. This stems from the lack of consensus as to the crucial market failure that makes free banking non- optimal (see Santos 2000). The main criticism from the free banking school is that the range of costs imposed on society by regulation outweighs its benefits in solving market failures and imperfections.

Critics of the free banking school say that after an important process of deregulation and globalisation, banking crises can have a substantial impact on the domestic economy (as illustrated by the recent Asian and other crises), and this justifies the rationale for regulation. In addition, regulation can improve soundness of the system by maintaining banking sector stability. For instance, the severity of recent financial crises[39] suggests that in a period of financial deregulation, financial systems are prone to instability. The current chapter follows the traditional approach by outlining the case for financial regulation.

From a merely taxonomic perspective, three main kinds of financial regulations can be identified, namely, structural, conduct and prudential regulations (see Figure 3.1). Structural regulations are mainly concerned with whether institutions can undertake certain activities, whereas conduct regulations concern the normative set up of appropriate behaviour and business practices mainly when dealing with customers. As covered in the next section, the creation of these sets of regulations is closely related to the danger of negative externalities originating from banking failures. Yet, there is a third set of regulations, namely prudential regulations that tackle this issue specifically. As discussed in Section 2.2.1, and further considered in Section 3.4 of this chapter, deregulation has been mainly concerned with a liberalisation of structural and conduct rules. This process has been accompanied by reinforcement in prudential rules.

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[38] For a sceptical vision on financial regulation, see for instance Benston and Kaugman (1996), Dowd (1996), Kane (1997), Benston (1998). For empirical studies in free banking see White (1984), and Rolnick and Weber (1983). For theoretical views on free banking see Hayek (1978) and Fama (1980).

[39] Which are in part the result of 'poorly regulated and often distorted financial sectors in these countries 'Drage et. al. (1998).

Figure 3. 1: Classification of banking regulations

Structural Regulations	Conduct Regulations	Prudential Regulations
Functional separation of institutions	Regulations of bank's deposit and lending rates	Deposit insurance
Entry restrictions	Regulations of fees and commissions	Discount window (Lender-of-Last-Resort)
Discriminatory rules against foreign banks (and investors)	Credit quotas Branching limitations	Minimum capital requirements Solvency ratios
		Ownership restrictions
		Restrictions on asset concentrations (large exposure)
		Information disclosure requirements.

Source: Gardener, Molyneux, Moore and Winters (2000, pp. 201), from EC (1997).

An interesting approach to the rationale for financial regulation is provided by Dewatripont and Tirole (1994). Rather than emphasising the specific features of banks (such as the asset transformation function, participation in the payments system and high leverage), the authors focus on what motivated banking regulation in the first place.

In a simplified model, they show that financial institutions tend to be regulated when two major circumstances happen. Firstly, dispersed or unsophisticated agents who cannot monitor financial intermediaries properly hold claims. Besides, even if these agents could spend time and resources in monitoring banks, they would also be subject to free-riding problems. Secondly, no mechanism of private representation is set up which would dispense the claimholders from having to monitor, write covenants, and intervene for the agents involved. Consequently, the regulatory exercise is a 'natural monopoly' in that duplication by several parties is technically wasteful; so that these problems give rise to a need for a 'representative of claimholders'. This role of 'delegated monitor' does not necessarily always have to be performed by the government. If the government, as in the case of bank capital adequacy regulations, undertakes it, public regulation may be viewed as a situation in which the government supplies representation services to small investors. A summary of the argument in which the risk of claims, the dispersion of their holders and the lack of representatives govern the pattern of regulation of financial intermediaries is outlined in Figure3.2.

An illustrative conclusion of the Dewatripont and Tirole (1994) model is that motivations behind the regulation of several major classes of financial intermediaries are quite related. Also the model provides the simple and useful idea of a pyramid of delegated monitoring, in which non-financial firms monitor and select investment projects. Financial intermediaries, in turn, monitor and select non-financial firms. Finally, regulators, act as delegates from dispersed and unsophisticated depositors to monitor financial firms.

Returning to a practitioner's perspective, most financial regulators will probably base the existence of financial regulation on the following arguments[40]:

- To protect depositors who lack the time and expertise to monitor financial intermediaries;
- To establish rules and guidelines about appropriate behaviour and business practices in dealing with customers;
- To protect the economy against systemic risks;
- To protect society against crime;
- Protection against collusive behaviour;
- The pivotal position of banks in the financial system, particularly in the clearing and payments systems.

[40] See also Benston (1998) for a good overview of motivations behind financial market regulations.

In the case of prudential regulation, as we are to see in the next two sections, the first three arguments are particularly relevant. These reasons for regulation relate to the role of negative externalities and asymmetries of information in the financial intermediation process. Regulators are needed to protect consumers at the retail level and minimise systemic risk. Yet, as pinpointed by Lanoo (2000), this rationale should be qualified in light of the fact that risk factors differ for banks, investment firms and insurance companies. Whereas regulation aimed at to protecting retail clients is an issue for the three sectors, systemic issue considerations are mainly an issue for banks and to a lesser extent investment firms[41].

3.2.1 Reducing systemic risk

Regarding the systemic risk argument, the rationale for regulation is based on two complementary factors. The first is rooted in the role performed by banks as liquidity providers. The second is related to the 'special' role played by banks in screening and monitoring borrowers who cannot obtain monitoring from the financial markets. The combination of these two factors explains the financial structure of banks, which in turn explains the vulnerability of banks to systemic risk. These two factors make the liquidation value of banks' assets lower than the value of their liquid deposits because illiquid loans are financed through demand deposits (Diamond and Dybvig, 1983) and the redemption value of deposits is not linked to the performance of the banks' assets. The reason is that loans are valued more highly on 'a going concern' basis than on a liquidation or break-up basis, as the value of a bank's assets is based on inside information 'possessed by the bank that cannot be transferred with credibility in a secondary market or another institution' (Llewelyn, 2000, p. 14). In the case of solvent banks, there will not be liquidity problems as long as deposits are withdrawn randomly

[41] The case of the hedge fund LTCM (long term capital management) is a good example of potential systemic risk implications for investment firms. Another interesting example would be the case of dealers (sophisticated operators) in which the prudential requirements are also in place, the reason is that although they are sophisticated investors, important decisions on substantial leverage and potential externalities have to be rapidly taken. For retail investors, the Scandinavian banking crises are a good example of retail sector banking problems that could have derived from systemic risk.

over time and assets are held to term (Lanoo, 2000). Yet, since the expectation of depositors of the value of their contracts depends on their relative position in line at the time of withdrawal (that is depositors are paid on a first-come-first-served basis), depositors are faced with a classical prisoner's dilemma. Namely, while for the whole group of depositors, it is more convenient to refrain from withdrawing their deposits and allow the bank to realise its assets at maturity, the individual interest of depositors could force them to withdraw their deposits before other depositors while the bank is still able to pay. Hence, under these conditions, a bank run could happen even without the release of negative information regarding the assets quality of the bank[42], it is enough that depositors expect others depositors to withdraw their deposits[43]. Due to the interconnectedness of banks, the release of information indicating a lower than expected quality of assets or bank performance can also trigger a bank run (see Jackling and Bhattacharya, 1988) or at least influence investors' perception of the quality of bank's assets.

A deposit run could be extremely costly as it forces the premature liquidation of a bank's assets, thus severely disrupting the allocation of resources. In other words, the real importance of bank runs relates to the pivotal role that banks play in the economy as they manage the payments systems and they are the major source of credit for most borrowers. Hence, the failure of one bank could trigger a contagious effect, which may result in systemic failure. Such a failure would potentially have a far more deleterious effect on the economy compared with the failure of other sectors.

Concerns about the soundness of the banking sector have grown over the last two decades mainly as a result of widespread banking crises. A recent IMF study[44] notes that most countries (developed and underdeveloped countries alike) have experienced significant banking crises at some stage during the last twenty years or so. Compared with recent history, the amount of banking problems is worse than any other

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[42] A bank run is not necessarily a bad outcome, if a bank run happens because of the release of negative information regarding portfolio quality; the positive disciplining effect could outweigh the negative effects derived from the destruction of loans value and confidence.

[43] A possibility to avoid, at a cost, this would be narrow banking, see Friedman (1960).

[44] Bank Soundness and Macroeconomic Policy (IMF 1997,p.1).

period since the Great Depression in the 1920's. Besides, the macroeconomic impact of these banking problems is not negligible, as it has often amounted to an important percentage of the GDP of the affected nation[45]. Faced with a more competitive and unstable financial system, regulation attempts to find the right balance in the trade off between 'structure' aimed at promoting efficiency and competition, and 'stability' which tries to minimise the likelihood of financial crises, and protect both depositors and the strength of the deposit insurance scheme. Given the increased difficulties of achieving the right balance between efficiency and risk, establishing the appropriate regulatory framework which minimises the net cost that regulation imposes on society (see Kane 1996b) is becoming increasingly important.

3.2.2 Protecting depositors

The main reason for introducing regulations to provide protection at the retail level is due to substantial asymmetries of information between retail depositors and the institution[46]. The issue, which plays a major role in the Dewatripont and Tirole (1993,1994) rationale for banking regulation (see Figure 3.2), builds on two problems. The first relates to the problems that the separation of ownership from management rises for corporate governance, whereas the second derives from the inability of depositors to monitor banks due to the lack of time and knowledge of consumers.[47] Regarding the latter, as in other financial and non-financial companies, there are important incentives for adverse selection and moral hazard behaviour in banking[48], so

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[45] The connection between the financial sector and macroeconomic performance does not only operate through the negative effect of banking crises on economic performance. There is an interesting and growing branch of economics that underlines the link between the development of the financial system and economic growth from a theoretical and econometric perspective. See for instance Zingales (2000) and Allen and Gale (2000) for a literature review of the topic.

[46] A related point is made by Llewellyn (2000) when he mentioned that the ultimate rational for regulation designed to protect the consumer is to correct for market imperfections and failures, which would compromise consumer welfare in a regulation-free environment.

[47] A related point is connected to the fiduciary role played be the institution, under moral hazard problems the confidence function in the institution will clearly be lower, and the overall efficiency of the financial system channelling funds from savers to value adding investments would be severely affected.

[48] See Cole et al. (1993) for econometric evidence on the moral hazard problem in banking.

that the value of the contract between depositors and the bank is determined by the ex-post behaviour of the institution. However, unlike non-financial firms in which institutional or informed 'private investors' hold debt, in the case of the banking firm, creditors are also their customers and it would be difficult in practice for depositors to make sound judgements about the portfolio of their banks because of firstly, the lack of relevant information, secondly, the inability to assess available information, thirdly, the transaction costs involved and finally the possibility of free riding as there are substantial scale economies in monitoring. This would create the need for a 'delegated monitor', a role that can be fulfilled by financial regulation. That is, financial regulation ideally should act as a kind of corporate governance exerting the *'type of control depositors would exert if they were sophisticated and fully coordinated'* (Dewatripont and Tirole,1993, pg. 23).

The second reason for protecting depositors at the retail level, is due to the corporate governance problems derived from the conflicts of interest among the different stakeholders in the firm: a) between owners-managers and depositors as the former have a larger incentive to pursue a riskier investment strategy than the latter, and b) between managers and outside financiers (both depositors and stockholders)[49] which could create agency problems if their interests are not perfectly aligned. This theory of conflicts of interest regarding different stakeholders lies behind the incomplete contract approach to model financial regulation based on managerial incentives (this approach is discussed later in this chapter).

In most countries, there is a demand for financial regulation by consumers in order to be protected against systemic risk or to be protected against losing their savings because of fraud. Over time, the two most common regulatory features, which have evolved to protect retail customers, include deposit insurance schemes and/or the implicit provision of lender of last resort facilities. Clearly, the implementation of such regulatory measures helps to reduce the likelihood of bank runs as well as the possibility of depositors losing their funds. Both measures, however, are not socially costless, as governments have to raise revenue to provide such services to the economy.

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[49] See Jensen and Meckling (1976).

Besides, deposit insurance and lender of last resort devices may lead to moral hazard problems which would emerge as banks have limited liability and the cost of failure may be borne by the deposit insurance fund instead of depositors, especially as such protection means that depositors have lower incentive to monitor the activities of banks.

3.2.2.1 Risk-taking problems related to the existence of a lender of last resort and deposit insurance

Clearly the existence of lender of last resort facilities could trigger banks to take on higher risks, and lower the external rate of funding in the belief that in the case of substantial financial problems, the banks will be bailed out (see Stiglitz et al. 2000). With the existence of lender of last resort together with a deposit insurance regime with flat premiums, banks may also be induced to take on more risks and/or operate with lower capital levels (see Merton, 1977)[50], so in actual terms the deposit insurance fund and the taxpayer are subsidising higher risk-taking by banks. In addition, another negative incentive could operate in the form of depositors 'pouring' into high-risk banks, as they are likely to offer a higher rate return with virtually no risk (Llewellyn, 2000). Also as noted by Boot and Greenbaum (1993), apart from eliminating the benefits of monitoring and higher funding cost, a flat rate insurance premium eliminates the funding related benefits of reputation, as it fixes the bank's future funding costs.

The regulatory framework should take into account that incentives provided by the lender of last resort and the deposit insurance scheme tend to reinforce each other. A growing body of the theoretical literature interested in the determinants of bank risk-taking and the design of an optimal regulatory framework has focused on the construction of an adequate deposit insurance scheme.

3.2.2.1.1 Deposit insurance and bank risk-taking

Given the potential moral hazard problems derived from the implementation of a flat rate deposit insurance scheme, coupled with the work by Merton (1977) on modelling

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[50] Merton (1977), as in his model for valuing corporate debt, shows that deposit insurance can be viewed as a put option on the value of the bank's assets with a striking price equal to the promised maturity value of its debt.

the fair value of the premiums by using an option pricing framework, an array of studies have been prompted aimed at modelling the appropriate pricing policies for deposit insurance premiums within an option pricing framework (See among others Pennachi (1987), Acharya and Dreyfus (1989), Mullins and Pyle (1994), and Kerfriden and Rochet (1993)). The main caveat shared by these models is that the Merton pricing model assumes perfect financial markets in which the provider of deposit insurance can perfectly value banks' assets and moral hazard incentives. However, the emphasis of modern banking theory on asymmetries of information, seriously questions the conclusions of these studies.

In this regard, Chan, Greebaum and Thakor (1992) question whether, when asymmetric information is present, fairly priced deposit insurance is possible at all. The authors conclude that it is impossible to implement fairly priced deposit insurance in that setting[51]. Using a more general model that also allows for information asymmetries, Freixas and Rochet (1995) found that fairly priced deposit insurance may be feasible, but it is not desirable from a general welfare point of view. The reason is that it would entail a cross subsidisation of the least efficient banks from the most efficient ones. Finally, it is worthwhile mentioning the paper by Matutes and Vives (1996b), in which the effects of deposit insurance on the banking industry are analysed. The paper introduces market imperfections, which would make free banking inefficient; namely imperfect competition under a social cost of failure scheme is included. According to their results, a flat rate deposit insurance scheme would result in excessive competition and risk-taking.

All in all, the literature shows the importance of deposit insurance in terms of protection from bank runs and in terms of its incentives towards risk. More importantly, information asymmetries make the computation of flat rate and 'fairly' priced premiums problematic.

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[51] The two major shortcomings reasons would be information lags that may encourage 'gamble for resurrection' and adverse selection.

3.2.2.2 Protecting depositors and the capital positions of banks

Another factor concerning protection at the retail level arises when comparing the banking sector capital positions with other industry sectors. The most noticeable feature is that the banking sector has traditionally had *'the highest ratio of debt to equity and the lowest ratio of net worth to total assets of all industries'* (Benston, 1998, p.2, Berger et al., 1995, p.394). This is important because, as will be seen in the following section, capital structure plays a role in shaping the framework of risk-taking incentives of the institution.

The capital to total assets ratio for European banks has been declining over the last century (see Appendix II)[52], hence it is reasonable to assume that the financial system is nowadays less certain in guaranteeing the claims of investors against adverse economic shocks.

3.2 Main instruments of safety and soundness regulations

Once the main arguments for financial and, in particular, prudential regulation have been introduced, our attention can briefly turn towards one particular kind of financial regulation instrument, namely the regulation of bank capital. Yet, banking capital regulations are not the only type of regulatory instruments used by regulators in order to maintain safe and sound banking systems. The main prudential regulatory instruments utilised in the banking industry can be divided into 5 main broad categories:

- Capital requirements
- Deposit ceilings
- Portfolio restrictions.
- Deposit insurance:
- Regulatory monitoring.

[52] See Kaugman (1995), and Benston and Benik (1997).

Figure 3. 3 Main instruments of prudential regulations.

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All of the above have been used as a regulatory tool at one point or another in time, normally as a combination of instruments as regulatory responses to market developments. Naturally, the application and effectiveness of these tools have been changing over time and are largely dependent on economic and structural developments. It is also well understood that the effectiveness of a given regulatory tool is going to be very much linked to the rest of regulatory tools existing (or expected to be implemented) in a given market. Given the aim of this thesis, we will focus on the effects and incentives derived from the implementation of capital adequacy regulations. At the same time, it has to be kept in mind that the impact of capital adequacy regulations may also depend on the rest of prudential regulatory tools in place.

In any event, in relation to other regulatory instruments, capital adequacy regulations play a prominent role in bank prudential regulation nowadays. Indeed, market forces and technological advances in the 1980s and 1990s have eventually induced policy makers to relax and ultimately abandon deposit ceilings, portfolio restrictions as well as most product and geographic restrictions through Europe and the US. In place of such restrictions 'policymakers have gradually turned to regulating bank capital as the primary means for limiting risk-taking by banks' (see US Shadow Financial Regulatory Committee, 2000, No.160, p.7)[53]. Hence, the next section will deal with the regulation of this specific but prominent element of prudential regulation: the regulation of bank capital.

3.3 The regulation of bank capital

Once the main arguments for financial regulation, and particularly for prudential regulation have been introduced, we shall focus on the regulation of banks' capital. This section will address two issues. First, it considers the rationale for bank capital regulation in light of the Modigliani and Miller's (1958) work by understanding the main factors that make the capital structure of banks relevant. In addition, theoretical

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[53] See Greenbaum and Thakor (1995,p.519) which indicate that ' bank capital has become a focal point of bank regulation'. See also Vives (2000, pg. 15) 'the general trend is to introduce competition in banking and to check risk-taking with capital requirements and appropriate supervision'.

papers that concentrate on some possible consequences of bank capital requirements will be examined.

The first issue to be considered concerns whether financial structure affects the market value of banking firms. The initial point of all modern research dealing with this subject is the Modigliani and Miller's (M&M) pioneering work in this area[54]. According to Modigliani and Miller's theorem (M&M, 1958), with perfect markets, full information and complete markets, the value of a firm is not influenced by its capital structure. When some imperfections are introduced into this frictionless world of M&M, a number of additional variables will affect the relationship between capital and value of the firm. Several factors or frictions are normally considered in the corporate finance theory: 1) taxes, 2) costs of financial distress, 3) information asymmetries, 4) transaction costs, and 5) imperfection in the products markets. Three additional factors are more idiosyncratic of the banking industry, namely: 6) a highly regulated market (conduct and prudential rules), 7) the fact that most of its debt is held by small and unsophisticated investors and 8) access to the safety net.[55]

3.3.1 Taxes

The effect of taxes on making the financial structure of the firm relevant arises from the fact that whereas dividends are not tax deductible, interest payments can be deducted from taxes. Therefore, substituting debt for equity enables firms to enhance market value via paying greater returns to investors by reducing payments to the government. According to this argument, and other things been equal, a firm would be financed entirely by debt. However, this is not the case as it will increase the firm's probability of getting into financial distress, and in the absence of deposit insurance, it would increase exponentially its cost of funding after a certain leverage threshold.

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[54] For an update and a qualified opinion on this topic please see Miller (1995), where he tackles the question, '*Do the M&M proposition applies to banks?*'.

[55] Barrios (1998), tackles this issue.

3.3.2 Financial distress

The effect of financial distress[56] occurs when there is an increased likelihood that the bank will experience financial difficulties. The concept is different from economic distress. Economic distress relates to the asset side of the balance sheet independently of the financial structure of the bank, whereas financial distress would be the additional distress cost derived from a higher leverage. These costs would comprise not only the bankruptcy cost, but also the expected cost of bankruptcy. The former includes factors such as the cost of transferring the bank's ownership from shareholders to creditors, whereas the expected cost of bankruptcy would increase uncertainty so that *'the best employees would leave, suppliers would demand more timely payments, revenues from credit-risk-sensitive products such as long-term swaps and guarantees may decline, and conflict of interest between shareholders and creditors may lead to suboptimal operating investment, and financing decisions'* (Berger, Herring and Szego,1995, pg. 346). Under this hypothesis, the higher the cost of financial distress, the higher the optimal capital ratio demanded by the market. These costs may be quite substantial; using a sample of US banks from 1985 to 1989, supervised by the Federal Deposit Insurance Corporation, James (1991) evaluated the direct costs associated with bank failure. By measuring losses as the difference between the book value of assets and the recovery value net of the direct expenses associated with the failure, James found the loss of assets averaging 30% of the failed bank's assets. Direct expenses associated with bank closures average 10 percent of assets. Empirically, it is difficult to disentangle the effects of economic and financial distress.

[56] In the context of non-financial firms see the classical studies of the corporate finance theory i.e.: Bradley, Jarrel and Kim (1984), Castanias (1983), Chen (1978), Kim (1975,1978), Stiglitz (1969), Scott (1976,1977). The trade-off between liquidity creation and financial distress in the banking sector is analysed in Diamond and Rajan (2000).

The cost of financial distress can also be illustrated with a small model. For instance, Baltensperger (1982) and Dermine (1986), formulate insolvency costs as the product between the insolvency size of the entity multiplied by a constant unit cost. In order to obtain an actual value, these insolvency costs will be defined as expected discounted values. The reason is that it will not be appropriate to look at the insolvency cost as a fraction of the actual market value at insolvency time but rather as a mean of the potential insolvency cost over its market value at the time in which the firm originally made its financial decision. So it will be:

$$E[CPI(\tilde{X})]_0^B = \int_0^B q(B-\tilde{X})f(\tilde{X})d\tilde{X},$$

Where:

$E[CPI(\tilde{X})]_0^B$	is the expected bankruptcy cost.
q	unit constant cost of insolvency.
B	capital and interest payments to depositors.
$\tilde{X}$	revenues at the end of period.
$(B-\tilde{X})$	insolvency size of the entity.
$f(\tilde{X})$	density function of $\tilde{X}$.

Given that capital has become one of the focal points of prudential regulation, the effect of capital requirements on bank risk-taking has received attention in recent academic literature. In fact, an influential segment of the literature relating to financial regulations has specifically related capital regulation and systemic risks arguments, by linking the unfavourable risk shifting incentives coupled with the negative externalities associated with capital regulations. Rochet (1992) and Kim and Santomero (1988) note that the imposition of capital regulations may lead to an increase in the probability of bank failure due to a reconfiguration in the composition of banks' portfolio of risky assets. Yet, Furlong and Keeley (1989) and Keeley and Furlong (1990) argue that if the value of the flat rate deposit insurance scheme for the bank (modelled as in Merton's (1977) study as a put option) is taken into account, the bank would not increase portfolio risk as a result of increased capital standards.

3.3.3 Asymmetries of information

The next factor or friction is the existence of information asymmetries. As was shown earlier, information asymmetries play a key role in the modern theory of financial intermediation (Diamond 1984, Bhattacharya and Thakor, 1993, Allen and Santomero 1998), and the rationale for prudential regulation. As one of the main functions of banks is gathering, processing and using private information, this allows for the presence of asymmetries between the bank's private information and that available to the market. Information asymmetries are relevant in the context of bank regulation, as they compound adverse selection and moral hazard problems.

According to the 'signalling hypothesis' commercial banks specialise in lending to information problematic borrowers (Berger *et. al.*, 1995). Since bank managers usually have a stake in the capital of the bank, *'it will prove less costly for a 'good' bank to signal better quality through increased capital than for a 'bad' bank'* (Berger, 1995, pg.436). Therefore, banks can signal favourable information through capital augmentations indicating a positive correlation between capital and earnings (Acharya, 1988). Alternatively, Ross (1977) argues that lower rather than higher capital ratios signals positive information since signalling good quality through high leverage would be less onerous for a 'good' bank than for a 'bad' bank.

Another strand of the literature on the effects of capital adequacy regulations is based precisely on the specialness of banks under a setting in which there is asymmetries of information; that is that banks perform valuable services. Due to the screening and monitoring process, banks are able to reduce adverse selection and moral hazard problems by playing a role as delegated monitors. According to Gennotte and Pyle (1991) banks have social utility as they screen and monitor industrial projects which could not be directly financed by capital markets. According to their results, capital adequacy regulations would distort the banks' objective function in the direction of excessive risk-taking, although the impact on the bank's probability of insolvency is ambiguous. A key to the results is the assumption that banks can invest in projects that have a positive net present value. Santos (1999) considers a model where there is moral hazard and banks have private information under a flat rate deposit insurance deposit regime. According to his model, an increase in bank capital standards would reduce the bank's risk of insolvency. Based on incomplete contracts theory, capital standards can control a bank's risk shifting incentives resulting from a flat rate insurance premium because they alter what the bank has at stake in the event of bankruptcy. According to the Santos (1999) model, the optimal contract the bank uses to fund a firm involves a combination of a loan and equity position in that firm[57], so that following this model, an increase in capital standards would reduce the firm's risk of failure. As in the case of the literature mentioned earlier, these papers are subject to several limitations. Foremost among these limitations would be that they do not allow for agency problems that could take place, and the fact that they do not incorporate transaction costs derived from raising new capital.

These are likely to be important shortcomings. Regarding the first limitation, information asymmetries are likely to create two main kinds of agency problems; on the one hand between shareholders and debt creditors, and on the other hand between shareholders and managers. These two problems are presented in the Dewatripont and Tirole (1994) model, which given its practical insight and generality is summarised in Section 3.4.

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[57] According to Santos (1999) an increase in the capital standards leads the bank to adjust that contract in order to account for, first, the higher costs it will incur in the case of bankruptcy as it is forced to operate with a lower leverage and, second, the higher cost of funding as banks capital is more expensive than deposits. This encourages the bank to modify the debt and equity components of the optimal contact it uses to fund the firm in order to reduce this firm's risk of failure, which in turn reduces the bank's risk of insolvency.

Agency problems between shareholders and debt creditors would arise as their utility functions suggest a different attitude towards risk-taking. Under financial distress, and thanks to the existence of information asymmetries, shareholders would have incentives to steal value from debt holders by taking on higher risks that would be difficult to monitor or to verify without a substantial lag by debt holders, and it is reasonable to expect that these agency costs would be incorporated in the form of higher interest rates on the debt. Secondly, if managers and shareholders are different agents, as increasingly happens in the largest European banks, a different sort of agency problem between the interest of shareholders and managers arises. This conflict of interest could produce market failures such as *'expense preference behaviour'*, that is excessive perquisite consumption by managers. This will be particularly the case if indicators of performance can be manipulated by managers, and incentives such as stock options or performance based bonuses are only imperfect incentives not strong enough to align managers and stockholders' interests.

According to the corporate finance literature, shareholder/manager agency conflicts are reduced by increasing leverage. The reason is that leverage may increase pressure on bank managers to become more efficient due to short-term pressures derived from the needs of servicing the debt (see Jensen and Meckling 1986). In addition, it will also reduce the scope for managers to keep the firm going after the point at which shareholders would gain from liquidation (Berger et al. 1995). Given the nature of bank depositors, this argument is crucial to the work of several authors who have argued in favour of encouraging the issuance of subordinated debt by financial institutions as a way of reducing information asymmetries and reaping benefits in terms of more adequate behaviour from managers (see Calomiris and Kahn, 1991).

3.3.4 Transaction costs

Transaction costs are also significantly affected by the existence of information asymmetries. These costs are mainly related to the cost of changing the financing structure of the institution. Whereas banks have relatively low transaction costs associated with retaining earnings, or issuing deposits, raising external funds (as opposed to issuing deposits or retained earnings) is generally very costly and dependent on several contingencies. Raising capital, for example, includes costs such as underwriters' fees, preparation of external information and registration, and particularly the cost of the issuance being 'underpriced'. These factors, particularly the under pricing cost and underwriters fees can be very relevant in the case of the banking industry (see Calomiris 1999, and Ibbotson et al. 1988) due to the significant amount of private information held by managers. Other related factors that would affect transaction costs include:

- The existence of developed financial markets as well as the kind of accounting, and legal framework, particularly, if the regulatory emphasis is tilted towards transparency (lower transaction costs) or the prevention of systemic risk;

- Substantial economies of scale, as other things being equal, the larger the firm and previous issuances, the larger the market knowledge about it. Beside, more practitioners[58] agree that economies of scope would also play a role, as the issuance of subordinated debt would be substantially cheaper for quoted firms[59];

- Issuances would also be more expensive for regular issuers. According to the pecking order theory, transaction costs play a relevant role when a firm decides on its financial strategies (see Myers, 1984).

Besanko and Kanatas (1996), present a model that evaluates the effectiveness of capital adequacy regulations. Unlike in previous approaches, they incorporate the transaction cost of equity issuance and agency problems between managers and owners in their model. Incorporating these elements of agency problems, as suggested by Dewatripont and Tirole (1994), is useful in that normally bank managers usually own

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[58] See for instance Merrill Lynch (2001) on financial changes in the financial structure after the introduction of the euro.

[59] Due to better knowledge by underwriters, similar information requirements for equity and debt among other factors.

only a small portion of bank equity. The results show that an increase in capital would lead to a reduction in banks assets' risk, but it would also have a countervailing effect by diluting insiders' stake in the bank's capital. This latter effect will deteriorate banks' solvency. Yet, Gorton and Winton (1995) criticise this literature arguing that it does not consider the costs of capital increases to the overall economy.

3.3.5 Safety net

The next main market 'friction' that make the capital structure of the banking firm relevant would be the existence of deposit insurance and other, explicit or implicit, 'safety net' guarantees (such as the discount window in the US). Most recent theoretical and empirical studies underline the importance of deposit insurance and its role in determining capital decisions. The reason is that by isolating banks from market discipline, changes in the financial structure will not be translated into price mechanisms from the market. A branch of the literature, modelling solvency regulations, emphasises the link between capital requirements and deposit insurance. Unless risk is perfectly priced, deposit insurance could give rise to the existence of moral hazard. As we explained earlier in this chapter, however, information asymmetries play a distinctive role and recent theoretical papers are sceptical as to whether perfectly risk-related insurance premiums are possible. Flannery (1991), uses a model in which outsiders cannot verify the actual amount of risk taken and in which the objective function of the regulator tries to maximise the social value of the welfare function by taking into account both leverage and premiums. The optimal policy would require both minimum leverage and insurance premiums to be altered by the level of banking risk. Bond and Clocker (1993) also analyse this issue in a model in which banks attracts funds from risk averse depositors and invest them in industrial projects. The model is derived from the costly state verification paradigm of Townsend (1979), in which only the managers observe the return on a bank portfolio unless depositors pay an additional audit cost. Deposits are included in the model as a standard debt contract. As in Flannery's paper, Bond and Clocker (1993) show that deposit insurance premiums should be connected to bank leverage. Only flat deposit insurance premiums would not be appropriate, as this would avoid the incentive of requiring that banks' capital is used as partial insurance for deposits against fluctuations in banks' portfolio returns.

Another part of this literature (see Rochet 1992b, Giammarion, Lewis and Sappington, 1993, or Freixas and Gabillon, 1998) also assumes asymmetric information in a setting in which banks have more information than the regulator, and focuses on the agency problems between the bank and public insurance[60]. By using the incentive approach first developed by Laffont and Tirole (1986), these models try to maximise social welfare while maintaining deposit insurance. Hence, taking into account the cost of deposit insurance, the models aim to establish an optimal solution to the trade-off between the cost of insuring depositors including the social cost of financial distress, and the additional cost of raising new capital by banking institutions. As in other studies, Giammarino, Lewis and Sappington (1993) and Bensaid, Pages and Rochet (1993) found that there would be value added in designing jointly the capital standards and the deposit insurance premiums. Also, regulation should be risk adjusted, so that the capital weights should be dependent both on the quality of banks assets as measured for instance by external rating agencies and considering portfolio risk by kind of loan. A socially optimal deposit insurance premium needs also to be adjusted for the risk of the bank portfolio of loans. Freixas and Gabillon (1998), also use an incentive mechanism approach in which they study the optimal regulation that maximises social surplus by setting a model that combines the amount of risk free assets the bank is bound to hold, the amount of capital it is required to have and the deposit insurance premium it has to pay. By using Merton's (1977) formula for pricing the claims of the deposit insurance company to value the private information that the financial institutions has on the initial value of their portfolio of loans, the results suggest that capital ratios and deposit insurance should be set together. Namely they show that under the optimal regulation 'low quality' banks receive an implicit subsidy as although they have to pay higher premiums, they could resort to regulatory arbitrage and lower their capital standards, whereas 'high quality banks' are penalised as they pay lower premiums but have to meet minimum capital standards. *'Due to the existence of asymmetric information it will be more efficient to offer a regulation with a trade-off between capital standards and*

[60] So unlike in Dewatripont and Tirole (1994), the interest of shareholders and managers are considered to be aligned.

insurance premiums in order to extract information and to minimise the cost of inducing the low quality banks to mimic the high quality ones'. (see Freixas and Gabillon 1998).

Finally, Hellman, Murdock and Stiglitz (2000) use a dynamic model of moral hazard in banking to test whether capital requirements are enough to reduce moral hazard. Building on the work of Rochet (1992b) and Battacharya (1982), they show that capital requirements combat moral hazard but banks would be forced to hold an expensive and inefficient amount of capital. The reason is that in a dynamic setting, competition coupled with the price of capital would reduce the franchise value, which could, in turn, increase the incentives for gambling if capital requirements are not set high enough. According to their model, the combined use of capital requirements and deposit rate controls will provide efficient outcomes. According to Hellman et al. (2000), other prudential regulation tools could also be used in conjunction with capital requirements in order to efficiently reduce moral hazard. In this sense, Hellman et al. (2000) suggest that an obvious candidate would be a risk based deposit insurance scheme, but in accordance with the current literature, they point out the difficulty of defining and implementing such a policy.

3.3.6 Most of the debt is held by small and unsophisticated depositors

The final main friction which makes changes in banks' financial structure impact on its value derives from the fact that most of a bank's debt is held by small and unsophisticated investors. This is considered in the Dewatripont and Tirole (1994) model (see Section 3.5.2). According to this model, regulators would play a role as delegates of depositors. The reason is that given their small size and the dispersion of bank depositors, they lack the incentives and knowledge to monitor bank managers[61]. Hence, depositors will delegate monitoring to an external agent: the regulator. In this framework, the authors show the importance of banking capital as a mechanism to convey adequate incentives and avoid excessive risk-taking that could jeopardise the value of the depositor's claim. The most interesting result is that shareholders will interfere with managers mainly in the event of poor performance, the lower the bank

[61] Even if they did, they would be subject to free riding problems from other depositors.

solvency the stronger the shareholders' bias towards risk and the weaker the depositors bias against risk. Hence, a minimum solvency requirement would be helpful, as the results suggest that regulation should lead to an increase in interference when bank performance deteriorates, and it should have a credible mechanism to transfer control to the regulators when solvency is low.

This section has analysed the main frictions that explain why the financial structure of banking firms impact on the bank's value. In the light of these frictions, we have also reviewed selected theoretical articles dealing with bank capital regulation. Despite recent progress, the theoretical literature offers contradictory results as to the optimal design of capital adequacy regulation. According to several articles, under certain circumstances, bank capital regulation could be counterproductive and actually increase incentives for bank risk-taking. However, there is almost a consensus view that prudential regulation should be set up in conjunction with the other prudential regulatory instruments in order to create an optimal set of incentives. Finally, it is also clear from the literature that bank capital adequacy regulations can incur substantial costs, both from the micro and macroeconomic point of view.

3.4 Unintended Consequences of Financial Regulation

After analysing the rationale for financial regulation, it is also important to mention the main costs associated with financial regulation. These are negative outcomes mainly referring to the way financial regulation is applied and the institutional or social problems originating from their implementation. The costs associated with capital and banking sector regulation are often expressed in the context of the free banking literature.

A first concern frequently expressed when academics try to ascertain the costs of financial regulation relates to agency problems between regulators and taxpayers[62]. Within this framework, regulators can be considered as agents that have their own incentives that diverge from taxpayers, who can be regarded as their principals. On the

[62] See for instance Repullo (1993) or Santos (2001).

one hand, the amount of information that regulators have is difficult to monitor. On the other hand, the outcome of regulators' work is often not visible for society as a whole. Whereas negative outcomes such as bankruptcy will be noticed, positive outcomes from their work such as banking stability and a smooth functioning of the payments systems would hardly be noticed. More importantly, for the majority of consumers of financial services, financial stability and protection is wrongly considered a free good, as it is difficult to notice the cost of such outcomes. This is because the costs derived from financial regulation are not financed directly but via generic taxation or extra charges by financial institutions when selling their products. Hence, these asymmetries of information between regulators and the taxpayers could give rise to agency problems that could induce some negative outcomes that could be tangible or intangible.

A tangible outcome would have to do with the accusation of over-regulation in the financial services industry. From an economic point of view, it is difficult to undertake a cost benefit analysis of regulation; it is cumbersome to measure the costs derived from market imperfections and those derived from financial crises and lower consumer confidence, it is even more complicated to measure the benefits derived from financial regulation. Besides unless financial intermediaries feel they are in a disadvantageous position in comparison with other institutions, or a less regulated counterpart threatens the position of a financial centre, few elements would complain about the possible costs of over-regulation, as neither firms, nor government regulators, nor consumers would have strong incentives to avoid excessive regulation.

Two initially intangible outcomes derived from this excess of regulation are well known; namely, the so-called 'Regulatory Forbearance' and the 'Too Big to Fail' (TBTF) doctrine[63]. In the former case, regulators do not act at the time it would be socially optimal but wait, hoping that solvency problems would improve, as was the

[63] Consequently, the 'Too Big to Fail' (TBTF) doctrine asserts that the government cannot accept the failure of large banks. This is justified either by political reasons or by the fear of systemic risk (see Freixas, 1997). TBTF problems could induce 'Regulatory Forbearance', i.e. slowness to react to indications of problems by regulators. For a formal discussion of the 'Too Big to Fail' doctrine including its likely moral hazard consequences and the 'constructive ambiguity ' position normally adopted by supervisors in order to reduce moral hazard problems see Rochet and Tirole (1996).

case of financial difficulties experienced by Credit Lyonnais in France or in the well documented Savings and Loans crises in the US (see Vives, 2000 and Torrero, 1993). The 'Too Big to Fail' problem arises, if because of the disruptive effects of the failure of a large bank, a bank is allowed to continue operating in the market via subsidies, as was the case of Continental Illinois in the US (see Sinkey, 1997).

Finally, as in the case of monetary policy, there is a trade-off between independence and accountability. In order to avoid market presumption of 'Regulatory Forbearance' or 'Too Big to Fail', financial regulators will have to prove independence, credibility and have to be able to avoid time-inconsistency problems. This is notoriously difficult to accomplish, because for one thing, material incentives given to regulators will be lower that those in the private sector, and more importantly, financial regulators are often more dependent on political power than their monetary policy counterparts.

Consequently, financial regulation is going to be costly. On the one hand, it could lead to over-regulation, and due to agency problems, it could induce 'Too Big To Fail' and 'Regulatory Forbearance' problems. Finally, due to asymmetries of information, financial regulation is more dependent on political pressures than monetary policy. These general negative externalities derived from financial regulation are also likely to affect the capital position of banks. In this sense, if the market perceives that there is forbearance towards the largest institutions it will probably demand a lower capital to assets ratio from the largest institutions than from their smaller counterparts. Likewise, if the market considers that financial regulators are implicitly guaranteeing the solvency of certain institutions[64], they would also be granted a lower probability of failure than to similar non-guaranteed institutions. Finally, agency problems between regulators and the society as a whole will increase the likelihood of mechanical formulas be used for the implementation of capital adequacy regulations, as they are easier to measure than other regulatory actions, despite drawbacks derived from their rigidity.

64 This would be the case of the German Landesbanks.

In earlier sections, we considered the rationale and negative externalities, which maybe derived from financial regulation and more extensively from capital adequacy regulations. Before examining the institutional prudential regulatory framework in Section 3.6, and the applied literature in Chapter 4 the next section is going to follow the reviews by Freixas and Rochet (1997) and Dewatripont and Tirole (1994) in order to introduce two prominent approaches to theoretically modelling the impact of bank capital regulations in the risk position of banks. The aim is only to report a review of the models developed by Kim and Santomero (1988) and Dewatripont and Tirole (1994) respectively.

3.5 Solvency regulations: two different approaches to modelling the impact of capital requirements on the risk positions of banks

As seen in previous sections, recent developments in microeconomic and finance theory coupled with the recent recurrence of financial crises have increased interest in the application of theoretical approaches to optimise the financial regulatory framework and to review the effects of prudential regulations. (For good surveys of this literature see Barrios (1997), Rochet and Freixas (1997), Allen and Gale (2000) and Santos (2000)). Following the work and notation of Freixas Freixas and Rochet (1997), Barrios (1998)and Barriosand Dewatripont and Tirole (19984), the present section only aims to present a summary of two influential kinds of models used in the theoretical literature as presented the aforementioned authors, as a better understanding of these models, even on a simplified and selective basis, would probably be helpful to put into context the conclusions of the microeconomics literature as well as to think more rigorously about banking capital regulation and its likely consequences. The first half of this section will focus on models using the portfolio approach, it also includes a critical analysis of the limitations of these kinds of models. In the second half of this section, the model by Dewatripont and Tirole (1994), already widely mentioned, is introduced more formally. This is an interesting model to analyse before examining the applied econometrics approach outlined in later chapters. The generality of the Dewatripont and Tirole (1994) model as well as the fact that it incorporates major developments in the microeconomic theory of the banking firm (limited liability, asymmetries of information, agency problems) are important in helping us further understand the role of capital in banking.

3.5.1 Portfolio methods to model bank capital regulations

Pyle (1971) and Hart and Jaffe (1974) developed a banking behaviour model by applying modern portfolio theory advanced by Markowitz (1952), Sharpe (1964), and Litner (1965). Modern portfolio theory assumes that the problem of portfolio selection according to investors' preferences U would depend only on the first two moments μ (mean) σ^2 (variance) of the random liquidation value of their portfolio. Pyle (1971) and Hart and Jaffe (1974) bundle all assets and liabilities of the bank into securities, considering the bank as a large portfolio consisting of these securities.

We report the model by Kim and Santomero (1988), as it is going to be illustrative to understand the limitations of this type of approach for analysing the relationship between bank capital regulations and bank risk-taking. Hence according to Kim and Santomero (1988), the bank is modelled as a portfolio in which:

- At date 0

If we call $x_0,\dots,x_n$ the amount invested in $n+1$ securities, in which security 0 is riskless, taking as given the random returns $\bar{r}_i$. Security zero is assumed to be riskless, so that $\bar{r}_0$ is assumed to be riskless and normalised.

⇒ Assuming that liabilities are given for simplicity, so that we call:

$$\begin{cases} D & \textit{deposits} \\ K & \textit{equity capital} \end{cases}$$

Assuming that deposits are remunerated at riskles $\tilde{r}_0$

- At date 1, if the bank is liquidated, stockholders would obtain the difference between the value of bank's assets and deposits so that D would not be included.

$$\tilde{K}_1 = K + \sum_{i=1}^{n} x_i(\tilde{r}_i - \tilde{r}_0)$$

From a portfolio management perspective, the bank would seek to maximise according to its assets portfolio the following utility function depending on this k_1 real value of capital. Where:

$\Rightarrow u$ is defined a concave increasing Von Neuman Morgerstern utility function[65].

$\Phi(x) = Eu(\tilde{K}_1)$ where x is a vector

$\Rightarrow$ Assuming normality of the joint distribution with an invertible variance-covariance matrix V and naming ρ as the expected excess returns vector,

then

$\tilde{k}_1$ is a normal random variable characterised by[66]:

$$\begin{cases} E(K_1) = \mu = \tilde{K} + \langle x, \rho \rangle \\ \mathrm{var}(\tilde{K}_1) = \sigma^2 = < x, Vx \rangle \end{cases}$$

Hence:

$$\Phi(x) = U(K + < x, \rho >, < x, Vx >)$$

where by definition

$$U(\mu, \sigma^2) = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{+\infty} u(\mu + t\sigma) \exp - \frac{t^2}{2} dt$$

Under this setting the behaviour of the bank would be characterised by maximising the following programme:

$$(\mathrm{P}_1)\begin{cases} Max\Phi(x) \\ x \in \Re^n \end{cases}$$

So that the combination x falls within the realm of real numbers, which from a portfolio perspective would indicate that shortselling (so that negative values of x_i are possible) is possible and that investing in a very small quantity of a given security is possible.

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65 So unlike Kahane and Wallace (1978) and Crouhy and Galai (1986) who use a complete markets framework, Kim and Santomero introduce a proxy for incomplete markets (risk aversion in the bank objective function).

66 Where (a, b) denoted the scalar product of vectors.

This is a stochastic optimisation problem and the solution as noted by Freixas and Rochet (1997) would be equal to:

$$x_1^* = \lambda_1 V^{-1} \rho$$

Where V is the whole variance covariance matrix of its investment and

$$\lambda_1 = -\frac{\partial U}{\partial \mu} \Big/ \left(2 \frac{\partial U}{\partial \sigma^2} \right) > 0$$

As when the real value of capital is below zero $\tilde{K_1} \langle 0$ banking failure would occur. Given that $\tilde{K}_1$ follows a normal distribution (μ, σ^2). Then $\tilde{K}_1$ can be normalised and its cumulative distribution function is:

$$P(\tilde{K_1} < 0) = P\left(\frac{\tilde{K_1} - \mu}{\sigma} < -\frac{\mu}{\sigma} \right) = \Phi\left(-\frac{\mu}{\sigma} \right)$$

So that the probability of failure given an initial net worth K and a given asset portfolio x^* *is*[67]:

$$P(\tilde{K}_1) = \Phi\left[-\frac{K + < x^*, \rho >}{\sqrt{(< x^*, Vx^* >)}} \right]$$

In the presence of a solvency ratio which in the case of the Basle Accord (1988) would be the level of TIER I and TIER II ratio capital divided by a weighted sum of assets, we can introduce this ratio by calling α_i the weights used as proxy for credit risk. The capital ratio can be calculated as:

$$Capital \quad ratio = \frac{K}{< \alpha, x^* >}$$ where α is a vector accounting for the weights.

Under these restrictions the probability of bank's failure is a decreasing function of their capital ratio. In other words a capital ratio could be an indicator of the likelihood of failure of a bank. (See proof in Appendix I) Consequently, it would make sense to

67 $<x^*, \rho>$ and $<x^*, Vx^*>$ is just the scalar product of their components.

reduce the risk of bankruptcy by forcing banks to hold a minimum amount of this ratio, so that we could actually characterise the new programme as:

$$(P_2)\begin{cases} Max\Phi(x) \\ <\alpha,x>\leq K \end{cases}$$

In which k would be the given (non-stochastic) amount of regulatory capital (which is a constant). As the amount of capital would be greater than the risk weighted assets we could write:

$$CR = \frac{K}{\langle\alpha,x\rangle} \geq 1 \quad \text{So that } \langle\alpha,x\rangle \leq K$$

If we call v to the Lagrange multiplier associated with this constraint, the first order condition of P_2

$$\nabla\Phi(x_2^*) = \frac{\partial U}{\partial\mu}\rho + 2\frac{\partial U}{\partial\sigma^2}Vx_2^* = v\alpha$$

So $x_2^* = V^{-1}[\lambda_2\rho + v_2\alpha]$ where $\lambda_2 = -\frac{\partial U}{\partial\mu}/\left(2\frac{\partial U}{\partial\sigma^2}\right)$ and $v_2 = v/\left(2\frac{\partial U}{\partial\sigma^2}\right)$

If α (i.e. the weights) are not an accurate indicator of excess returns (if a is not collinear to ρ) and if the solvency constraint is binding, the bank will choose an *'inefficient'* portfolio from a regulatory point of view. Hence under the assumptions of the model, namely the utility function used, the introduction of a minimum weighted capital ratio will imply a reduction in the volume of the risky portfolio, but there would also be a portfolio effect, as the composition would be distorted towards riskier assets. Under the assumptions of the model by Kim and Santomero (1988), the introduction of the capital ratio could in some cases increase the probability of banking failure, as the increase in risk due to the asset re-composition effect towards riskier assets could outweigh the decline in risk brought about by the quantity effect.

Rochet (1992a) argues that under the model suggested by Santomero and Kim (1988), a simple way to avoid the recomposition effect (1988) would be to use a vector of weights α proportional to the systematic risk β_i of the risky assets, so that with correct weights capital ratios could become effective in limiting the probability of failure. Yet, this is notoriously difficult particularly in the case of credit risk, as recognised by the current Chairman of the Basle Committee: ' *In essence the Basel Accord created a dangerous gap between real economic risk, as perceived by the banks and the markets and regulatory risks as perceived by the regulatory risk as defined by the Basle Committee'*. (Mc Donought 2000).

Or

'The way the current 1988 Basel Accord was being applied, it was becoming counterproductive- pushing people in the direction of taking greater risk in order to economise in their use of capital and maintain their competitive edge'. (Prevost[68], 2000).

A major shortcoming of this model first criticised by Keeley and Furlong (1990) is that it does not take into account the limited liability clause by the banks' owners. In the context of the model, it would mean that when maximising the utility programme, banking capital is allowed to be negative. This would not be consistent, as it would mean allowing banking failure when establishing the portfolio, which in theory wold not be allowed by supervisors. Rochet (1992) addressed this problem by presenting an indirect liability function under limited liability. Rochet's results are interesting as he found that when using the optimal weights when designing the portfolio, the new defined utility function is not always decreasing with σ^2, so that under certain circumstances, moral hazard could be encouraged. Namely, banks with a low capital ratio could have incentives to choose a higher risk portfolio. This result is in accordance with recent empirical evidence (see Chapter 4), and regulatory proposals (see Benston 1997).

3.5.2 Incomplete contracts approach to model bank capital regulation

Recently, corporate finance models have used the incomplete contracts paradigm to include outside claimholders in the management of the firm. Dewatripont and Tirole (1994) justify the need to regulate banks because of the problems that separation of

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[68] Member of the Secretariat of the Basel Committee.

ownership from management causes for corporate governance. Given that there are frictions in the markets that will not allow participants to write complete contracts, and that incentives to align shareholders and managers interests are only imperfect substitutes for one another, the financial structure of the firm will be relevant as it determines the allocation of control rights of the firm. Also, financial structure would indicate how shareholders could intervene in management. Clearly for managers, the possibility of external intervention is not favoured as they enjoy private benefits from running the bank only if there is no interference. However the improvement in the quality of the banks' assets will have a cost in terms of managerial effort. Hence, shareholders will decide to intervene and influence the amount of effort undertaken by managers based on the imperfect information they receive about the managers' choice of effort. Finally, in the particular case of the banking firm, an efficient allocation of control rights will also have to take into account that banks have a large number of small and unsophisticated depositors so that a 'delegated monitor' (normally a public regulator) acts on their behalf.

Given the importance and applicability of this model, as in the case of the portfolio type models, we will incorporate the main characteristics of Dewatripont and Tirole's basic model using their notation:

We can define a simplified bank balance sheet and only three periods:

T= 0, 1, 2

Assets	Liabilities
Loans (L_t)	Deposits (D_t)
	Equity (E_t)

⇒ **Period 0 (T=0)**

- D_t Deposits.
- E_t Equity.
- L_t Loans.

So that, $L_t=E_t+D_t$

The quality of loans will be influenced by managers' effort

- $e \in \{\underline{e}, \overline{e}\}$ e is the quality of loans measured as the effort from the market, where $\underline{e} \langle \overline{e}$ and e is only observed by the manager. Assuming only two possible outcomes of $e = \bar{e}$ (correct amount of effort) or $e = \underline{e}$ (insufficient amount of effort)

- K is the cost of higher effort to improve loans or of not giving politically motivated loans.
- $\bar{f}(v)$ Density function[69] of v if $e = \bar{e}$, $\underline{f}(v)$ Density function of v if $e = \underline{e}$
- $\bar{g}(u)$ Density function of u if $e = \bar{e}$, $\underline{g}(u)$ Density function of u if $e = \underline{e}$

⇒ **At the end of period 1 (T=1):** two pieces of information regarding the quality of loans are disclosed to outsiders

- v is the verifiable first period performance, which is assumed to be reinvested in the riskless rate normalised to zero[70].
- u signal $u \in [\underline{u}, \bar{u}]$ about the realisation of η, where η is a random variable about the future liquidating value.
- $\pi = v + \eta$ Final performance of the bank.
- $\bar{\eta}(u)$ expectation of η at the end of period 1.
- $\bar{\eta}$ corresponding historical cost. (Value of loans' principals).

For simplicity, only two actions (A) are possible from the intervening party in period 1: vis-à-vis the manager:

- S Intervening and reorganise the management
- C Non intervening and continue

$A \in [C, S]$

[69] It is reasonable to assume that effort improves performance so that an increase in effort will be positively related to current earnings v and the signal of future earnings. This can be formalised as the standard monotone likelihood ratio property indicating that larger empirical realisations of u or v will indicate a larger likelihood of effort being at its larger value $\bar{e}$, in other words: $\bar{f}/\underline{f}$ is strictly increasing in v and $\bar{g}/\underline{g}$ is strictly increasing in u.

[70] This assumption could be easily relaxed.

An example of the economic meaning of S would be derived from the power of supervisors to intervene when they feel solvency is below a certain threshold.

⇒ **At the end of period 2,** the final profit is realised and the liquidation value $\pi = v + \eta$ is observed. So summarising we will have:

T=0	**T=1**	**T=2**
	(v, u)	$\pi = v + \eta$
	$\bar{\eta}(u)$	

The main point is the assumption that complete contracts between managers and shareholders cannot be written and the model focuses on external inference as a managerial disciplining device so the determination of the controlling party at t=1 will be fundamental. This is the role of the solvency regulations. Hence, the choice between C and S will be made by the controlling party according to the values of v and u observed. The argument then is that the model focuses on interference as the element of managerial discipline as it is assumed that the manager derives a private benefit from running the bank without external intervention. So that the manager will receive a private benefit B:

- $B>0$ Under C (no intervention)
- 0 Under S (intervention)

Being:

- $h_A(\eta/u), H_A(\eta/u)$ density and cumulative distributions functions of η conditioned on u

The predicted profit η at the end of period 2 will depend on the action taken after the signal is revealed at the end of period 1. Assuming that u and v are independent to one another[71], the expected profit from stopping instead of continuing at t=1 can be calculated, the aim is to find a threshold signal $\hat{u}$ that will be indifferent to both actions and will then provide the frontier to both actions.

$$\Delta(u) = \bar{\eta}(u,C) - \bar{\eta}(u,S) = \int_0^{+\infty} \eta[h_C(\eta/u) - h_S(\eta/u)]d\eta = \int_0^{+\infty} [H_S(\eta/u) - H_C(\eta/u)]d\eta$$

As the threshold is defined as $\Delta(\hat{u}) = 0$, there would not be intervention when $\Delta u > 0$ that is if $u > \hat{u}$ and there will be when $u < \hat{u}$

- Let $x(u,v)$ denote the probability of continuing when (u,v) is observed.

The second best decision rule is obtained by maximising the expected incremental profit from continuing

$$\iint x(u,v)\Delta u \bar{g}(u).\bar{f}(v)dudv$$

Under the incentive compatibility constraint:

$$B\iint x(u,v)\{\bar{g}(u)\bar{f}(v) - \underline{g}(u)\underline{f(v)}\}\ dudv \geq k$$

The Lagrangian of this problem would be[72]:

$$L = \iint x(u,v)\{(\Delta u + \mu B)\bar{g}(u)\bar{f}(v) - \mu B\underline{g}(u)\underline{f}(v)\}\ dudv - \mu K$$

Where

- μ is the multiplier of the incentive constraint.
- K as defined earlier was the managers valuation of a low-pressure job of selecting loans or the private benefit received by distributing loans to his or her friends rather than to the best borrowers.

71 Making the reasonable assumption that a higher signal of profits makes no intervention more desirable. $\frac{\delta(H_S - H_C)}{\delta u} > 0$

72 Note that in Freixas and Rochet (1998) when reporting on Dewatripont and Tirole (1994) there is a slight mistake in this step.

Pointwise maximisation of L with respect to $x(u,v) \in [0,1]$ where $x(u,v)=1$ under the choice of continuing and $x(u,v)=0$ under the choice of stop, would be:

$$\begin{cases} x(u,v)=1, if, \Delta(u)+\mu B \geq \mu B \dfrac{\underline{g}(u).\underline{f}(v)}{g(u).\bar{f}(v)} \\ x(u,v)=0 \quad \textit{otherwise} \end{cases}$$

So that continuing is optimal only under:

$$\frac{\bar{g}(u)}{\underline{g}(u)}\left\{ 1+\frac{\Delta(u)}{\mu B} \right\} \geq \frac{\underline{f}(v)}{f(v)}$$

This optimisation defines a threshold $u^*(v)$ in which the previous condition is satisfied and both parts of the expression are equal. Given that the left side of the previous equation is increasing in u, C would be optimal only if $u \geq u^*(v)$, the right side of the previous equation is decreasing in v, so that the threshold $u^*(v)$ decreases with v.

Let $\hat{v}$ be defined implicitly by:

$u^*(\hat{v})=\hat{u}$

So that there will be two areas of ex-post inefficiency, the two areas of ex-post inefficient interference and the area of ex-post inefficient passivity. In the case of $v>\hat{v}$, there will be cases in which the bank will be allowed to continue although ex-post efficiency would recommend intervening. Likewise for $v<\hat{v}$, there will be values below $u^*(v)$ for which the bank is not allowed to continue although ex-post efficiency would recommend continuing.

Then, Dewatripont and Tirole, focus on the investors' incentive scheme. Shareholders are biased towards risk because their payoff is a convex function of profits, while depositors are more conservative because their payoff is a concave function of profits. The main point would be that financial structure could provide an efficient structure for intervention when needed, by giving control to the depositors' representative when the verifiable performance is below the threshold and leaving it to managers when the performance is above the threshold. In addition, the lower the bank's solvency, the stronger the bias towards risk and the weaker the depositors' bias toward risk.

A main result from Dewatripont and Tirole (1994) model is that the optimal managerial incentive scheme can be implemented by giving control to the depositor's representative when the performance is poor $v < \hat{v}$, and stockholders should enjoy lack of interference when the performance is good. $v > \hat{v}$. Regulation should provide a credible mechanism to transfer control to the regulator when the bank's solvency is low. Minimum solvency regulations could be part of such regulations[73], if they can provide a threshold for the transfer of control. (see Figure 3.4)

An overall important criticism of the current regulation derived from this framework would be that it does not distinguish idiosyncratic and aggregate risks, and therefore can impose a heavier penalty on managers due to risks that are beyond their control. As Dewatripont and Tirole indicate, the normal approach undertaken by regulators, namely regulatory forbearance in lowering the solvency ratio would not be adequate because shareholders may have more incentives to take on larger risks when the bank is poorly capitalised.

Figure 3. 4 The optimal managerial incentive scheme

Source: Dewatripont and Tirole (1994), p. 140.

73 Dewatripont and Tirole suggest several means to the implementation of the second best optimal decision rule: composite claims, net worth adjustments, or voluntary re-capitalisations.

3.6 Prudential Regulation: Institutional overview

3.6.1 Introduction

As can be seen in Chapter 2, conduct and structural deregulatory trends appear to be overall consistent with improved capital allocative efficiency[74] and productive efficiency (from a cost savings perspective) and hence are aimed at increasing competition and therefore improving consumer's utility. However, attempts by banks to increase capital allocation efficiency might also give rise to harmful outcomes. These negative outcomes, are derived from market failures such as LLR (lender of last resort), TBTF (too big to fail), inadequate deposit insurance[75] and the lack of an effective market in bank corporate control which might give rise to agency and moral hazard problems. In this sense, experience shows that three main considerations should be taken into account in order to reduce financial crisis potential. First, financial de-regulation should be accompanied by the prescription and enforcement of prudential regulations such as capital requirements and information disclosure requirements[76]. Second, financial instability brought about by the deregulatory process may often be attributed to grave errors in the timing, sequencing and speed of financial reforms (Alawade and Ikhide 1997). Third, the implementation of financial deregulation should not be isolated from the wider institutional and macroeconomic framework (accounting standards, trade regulation, economic development, directed credit via the banking industry among others). This enhances further the need for prudential supervision during and in the aftermath of deregulation, and makes the bank supervisor's role more complicated[77]. These trade-offs between the positive effects of prudential regulation and

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[74] Referring essentially to the matching of a bank's internal capital to its corresponding risk exposures in order to maximise bank shareholder value (Altunbas, Carbo and Gardener 1997).

[75] Indeed in the Deposit Insurance Directive (1993), there is no requirement that the EU impose risk-adjusted premiums on banks to fund their respective schemes. This factor can contribute to creating moral hazard problems in European banking.

[76] Note that developed countries have been setting bad examples in their postures towards transparency, in the US as in Europe, mark to market accounting standards were turned down,

the negative externalities derived from their application are clearly going to underpin the regulatory set up at an international and a country level. The aim of the next section would be to provide an understanding of the prudential regulatory framework that exists at the international and EU level.

3.6.2 International prudential regulation

3.6.2.1 The Basle Accord (1988)

From an international perspective, the most important institution trying to harmonise and improve prudential regulation at an international level is the Basle Committee. The Committee was established in 1974 by the central bank governors of the G-10 as a forum for international cooperation in bank supervision. Although, according to its legal status, it issues no legally binding regulations, member countries are committed to implement rules which would be internationally accepted yardsticks for banking regulations. Its original mandate was twofold: it aimed to enhance financial system soundness and to establish a level playing field for international banking groups.

Although there has been earlier work concerned with the issue of cross-border banking[78], the Basle Accord (1988) can be regarded as the main international agreement dealing with the prudential regulation of banks. The Accord came in the aftermath of the US Savings and Loans crises, and started mainly due to widespread discontent on the part of regulators with the actual capital ratios of many banking institutions, particularly the larger ones after 1982 Mexican debt moratorium and the following LDC (less developed countries) crises due to incipient debt defaults. It proposed a minimum target risk weighted ratio in which capital is related to four categories of asset and off-balance-sheet exposure. Assets are broadly weighted according to 4 categories of relative credit risk and the definition of banking institutions subject to the Accord is very broad; namely institutions that accept deposits and grant loans.

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[77] But as indicated, watertight supervision could be counterproductive since the very economic function of banks is to take risks so that *'If the regulators minimise banks risk-taking, they will eliminate the purpose of the banking system'* (Greenspan 1997, pg3).

The definition of capital is hierarchically divided into two components:

- Tier I capital or 'core capital'. This includes stock issues[79] as well as disclosed reserves without any limit. There are no intangibles or goodwill in Tier I capital.

- Tier II or 'supplementary capital'. This includes elements like perpetual securities, undisclosed reserves, and subordinated debt with maturity exceeding five years, and shares redeemable at the option of the issuer.

The sum of Tier I core capital plus Tier II should be at least 8% of risk-adjusted assets (the weights are indicated in the next section); Tier I should be at least 4% of risk-adjusted assets. In addition, shares redeemable at the point of the issuer and subordinated debt cannot exceed 50% of Tier I capital.

The main element shared by all capital items is that they are not due in the short run and that they are subordinated to deposits and other traditional bank liabilities. Moreover, the main economic reason behind the distinction between Tier I or core capital and Tier II, derives from the fact that Tier I capital is more permanent and externally more accountable. In fact, modifying the accounting value of equity or official reserves is *'a delicate and public operation since it requires the approval at the shareholder meeting upon proposal of the boards of directors'* (Dewatripont and Tirole, 1994). In the case of Tier II, some of the items included are not externally disclosed, as they solely appear as such in the internal accounts, and could often be modified by the board of directors.

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[78] See Concordat (1975), revised Concordat (1983), and Supplement to the Concordat (1990).

[79] Equity capital includes common stock, plus non-cumulative perpetual preferred stocks.

The weights of on-balance-sheet assets are assigned according to the asset item they belong to (Greenbaum and Thakor, 1995):

0% Cash (including foreign currency), claims on Central bank, or public debt with a maturity of up to 91 days, claims on OECD central governments and banks, and loan commitments with maturities of less than one year.

10% Longer-term government debt, loans secured by government paper or deposits at the official lending institution and the Central Bank stock (at book value).

20% Claims on domestic depository institutions, short term claims on foreign banks in OECD countries, cash items in the collection process, obligations or claims guaranteed by federal entities, claims backed by the full faith and credit of regional or local governments, and the lowest-risk standby letters of credit.

50% For residential mortgage loans that are fully backed by the mortgaged asset, government obligations whose repayment is not backed by the full faith and credit of the issuing entity (revenue bonds and similar paper), unused loan commitments with maturities exceeding one year, note issuance facilities and medium-risk standby letters of credit.

100% Claims on corporations (including loans and bonds), guarantee-type instruments, sales subject to repurchase agreement and other credit for all other loans, in particular loans to non-banks, or equity holdings.

Off-balance sheet risk weights were also included in the BIS capital adequacy framework. These were assigned to each of the following categories:

- One for contingent guarantee contracts such as letters of credit, and loan commitments. Credit equivalents for the contingent commitment are obtained in order to reflect the value of the credit exposure, and then these quantities are multiplied by the risk weights that correspond to the credit risk of the underlying asset.

- Another OBS risk-weight was assigned for off-balance-sheet derivative instruments such as futures, options and swaps. These would be divided into those positions derived from derivative contracts that are traded on organised exchanges, and those that are traded over the counter. For those exposures derived from instruments traded in organised exchanges there will not be additional requirement of capital apart from that required from the market itself. For the case of over the counter instruments, another two-step procedure for determining additional capital charges will be followed. For the first step, the credit amount equivalent of the contract will be calculated, and for the second step that amount, is multiplied by the appropriate risk weight.

Furthermore, some of bank's assets must be also deducted from capital in order to avoid artificial infusions of capital through crossholdings[80].

The Capital Accord has several evident flaws (see for instance Benston, 1998, Karacadag and Taylor, 2000, or US and European Shadow Financial Regulatory Committee, 2000). Foremost among the most important limitations would be: the fact that it takes into account only credit risk, which is based on accounting values, and does not consider either the portfolio risk of the bank or the netting of contracts that can substantially alter the return-risk profile of the institution. The calculated risk-asset ratio also only incorporates a proxy measure of credit risk, and does not reflect the actual amount of underlying credit risk, but simply a linear weight in connection with the nature of the borrower. Consequently, the implementation of this mechanistic formula could produce perverse incentives for portfolio recomposition as the ratio is not able to marginally penalise investment in risky assets in proportion to their marginal contribution to the risk of the banks' portfolio.

[80] See Basel Committee (1999b) for a description of the initial accord and its subsequent amendments.

Despite the above criticisms, the creators of the scheme were well aware of possible shortcomings. For instance, The Chairman of the Committee Mr. Cooke (1988, introduction), clearly stated that *'there is no objective basis for ex-cathedra statements about levels of capital. There can be no certainty, no dogma about capital adequacy'*. According to Estrella, Park and Peristiani (2000), the logic of the scheme was based on the following assumptions[81]:

- Capital can help protect the safety and soundness of individual institutions;
- Capital can help protect the safety and soundness of the financial system;
- Supervisors play a useful role by monitoring the level of capital of financial institutions;
- A lower bound for a reasonable level of capital consistent with level playing field can be calculated mechanically.

In other words, in the determination of regulatory capital and regarding the trade-off between verifiability and accuracy of information, regulators opted for the former. Then, they increased the level of sophistication to include other issues such as OBS activities but they kept the overall structure and formula simple. All in all, the agreement increased the capitalisation levels of most banks[82]. Several authors in fact relate the implementation of the Basel Accord to the possibility of a credit crunch in the early 1990's (see Jackson et al., 1999) and although it was initially applicable only to

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81 See Estrella (1998), and Goodhart et al. (1998) for a historical based criticism of mechanical formulas, as well as possible alternatives.

82 According to most observers, the effectiveness and increase of capital standards was clear at the time. According to Larry Lindsey (1994,pg.4) and referring to the early 1990's banking problems and the implementation of the Basle Accord *'I would say* (banking problems) *they're mostly behind us. We have had tremendous success within the industry at reaching the capital standards that took effect in December. The overwhelming majority of banks and something on the order of 97 percent of all banking assets were in banks that were either adequately capitalized or well capitalized as of the end of the year. That is a tremendous success. While problems still exist, I think that the vast majority of the problems are behind us. And looking at the scope of the problems say from two years ago, I think the banking industry and the banking regulators really deserve some commendation. I think things worked out a lot better than anyone expected'*.

internationally active banks of the G10 countries, the Accord was subsequently adopted by many other countries and applied to other banks.

The increase in financial sophistication, risk measurement and the movement towards brokerage banking, however, during recent years is increasingly rendering the Basle weighting system obsolete especially given the over-emphasis on credit and the neglect of other important types of risk such as market risk.

3.6.2.2 The Basle Capital requirements for market risk

An obvious drawback of the initial Accord was that it did not consider the issue of the treatment of market risk. Due to the inadequacy of ratio type schemes for monitoring and controlling bank trading risk, coupled with an increase in the relative importance in the exposure to market risk in banks' portfolios during the early 1990's, the Basle Committee studied alternative ways of treating trading book positions. For some time, the Committee worked towards securing an international agreement on handling market risks assumed by banks. In April 1993, a consultative document with specific proposals for the measurement and assessment of market risks was published. After three years of consultation with the international financial community, particularly with industry practitioners, by the end of 1995 a definitive statement was issued. These new rules came into effect for all internationally active banks in the G10 countries at the start of 1998.

Among the main novelties included in this new agreement, the new rules incorporated the use of the so-called 'building block approach' or 'additive risk approach' in which open positions in debt, equity (held in the banks' trading portfolio), foreign exchange, and derivatives are subject to specific capital charges[83]. This approach is normally referred to as the standardised approach. Despite its relative simplicity, an important weakness of this approach is that it does not take into account

[83] See Saunders (1997) for a detailed explanation.

the diversification benefits of holding different risks in the same portfolio. Hence, it may yield excessive capital requirements for large diversified players.

Consequently, and in order to take into account this factor, and to accommodate reactions to the proposals from the banking industry, banks will have the opportunity (if an institution's supervisory authority approves[84]) of using their own in-house value-at-risk (VAR) models[85] in the evaluation of their market risk; this would be the so-called internal models approach (IMA). These models allow banks to employ their own internal models to assess market risk. To do this, the internal model approach calculates the value at risk (VaR) in its trading account. That is, the maximum loss that a portfolio is likely to experience due to fluctuations in interest rates, exchange rates, equity and commodity prices, over a target horizon within a given confidence interval.

When characterising a value at risk model[86], three inputs (parameters) are typically needed, Firstly, the holding period which would depend on the frequency of portfolio adjustments, in the case of most large banks VaR measures are calculated daily, whereas in the case of the Basle Accord it has been taken as a two weeks measure. The second input is the confidence interval, and more importantly, the frequency distribution of predicted portfolio returns (normally parametric, non parametric or semiparametric). Ceteris paribus, the wider the confidence, the lower the likelihood that a model will fail to predict extreme events. Again the Basle Committee was conservative by choosing a 99% confidence interval. The third input is the data window in which the historical distributions or variance-covariance risk factors are calculated. According to the Basle rules, the value at risk calculated or the average of the last 60 days, whichever larger is then multiplied by a scaling factor of three to find the capital charge.

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[84] This can be a demanding process (Elderfield 1996).

[85] Examples of these models could be Bankers Trust's 2000, Chase Manhattan's Charisma, CS First Boston's Prime Risk, Deutsche Bank's db-Analyst, JP Morgan Risk Metrics.

[86] Goodhart, Hartmann, Llewelyn, Rojas Suarez and Weisbrod (1998) divide VaR models into three main categories: the historical simulation approach, the variance covariance approach and the Monte Carlo simulation type of model. For a clear explanation of specificities and drawbacks of each of them coupled with a regulatory analysis see opus cit. pp.73-97.

Although they represent a substantial improvement from previous models, Value at Risk methods are also subject to substantial criticisms. Regular criticisms have arisen regarding the statistical properties of the distributions (among them the fat tails problem[87]), or regarding concerns about the arbitrariness of the scaling factor or the holding period. Danielson, Casper, Vries and Jorgersen (1998) and Jackson (1997) offer a good literature review of the main criticisms from a statistical, financial, and regulatory perspective.

The Pre-Commitment Approach

From a regulatory point of view, an important shortcoming of VaR models is that regulators are external observers of the banking firm so that they may lack knowledge of the institution as well as technical expertise, as assessing the precision and merits of a model is notoriously difficult. A solution to this problem has been proposed in the 'pre-commitment of capital' approach[88] (PCA). Put forward by Kupiec and O'Brien (1997a). Under the PCA, a bank announces the appropriate level of capital that covers the maximum value of expected loss that might arise in its trading account. If the actual loss after a certain time exceeds the announced value, the bank is penalised. Under this approach, the bank would chose the level of capital that minimises total cost, which will include both the cost of raising capital and the expected cost of the penalty[89]. Hence, the model is intended to align the incentives of the regulator with those of the bank in having an amount of capital in accordance with its real market risk position. The main drawback of this approach concerns the structure of penalty rates, and more specifically

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[87] Greenspan (1997) stated 'the biggest problems we now have with the whole equation of risk is the fat tailed problem, which is creating very large conceptual difficulties'.

[88] See Estrella (1998) and Shepheard-Walwyn and Litterman (1998) for alternative proposals.

[89] See Kupiec and O'Brien (1995) and Jackson, Varotto and Daripa (1997) for a discussion of the pre-commitment approach.

the practical implementation of the approach particularly when the bank has experienced substantial losses[90].

3.6.2.4 The new Basle Committee proposals

In order to address criticisms of its current Capital Adequacy regulatory framework, the Basle Committee is working on new capital adequacy rules. An important part of its recent work recognises the importance of other kinds of risk apart from market and credit risk, which are considered too important not to be treated separately from the capital framework. Hence the consideration of operational, interest, liquidity, legal, and reputation risk could also be taken into account in the near future. In addition, a consultative paper was issued in June 1999 in order to introduce a new Capital Accord. This new Accord will be based on three interspersed pillars:

Pillar I: Minimum capital requirements: The proposals include a more comprehensive approach to address risks, a more refined assessment of credit risk, as well as a better recognition of risk mitigation techniques. Regarding this first pillar, three possible approaches are possible:

- A standardised approach that uses external rating agencies and can be defined as a basic modified current approach in which the weaknesses of the current accord have been addressed.

- An internal rating-based approach that can be interpreted as an improved risk-bucketing approach.

- A full credit models approach.[91]

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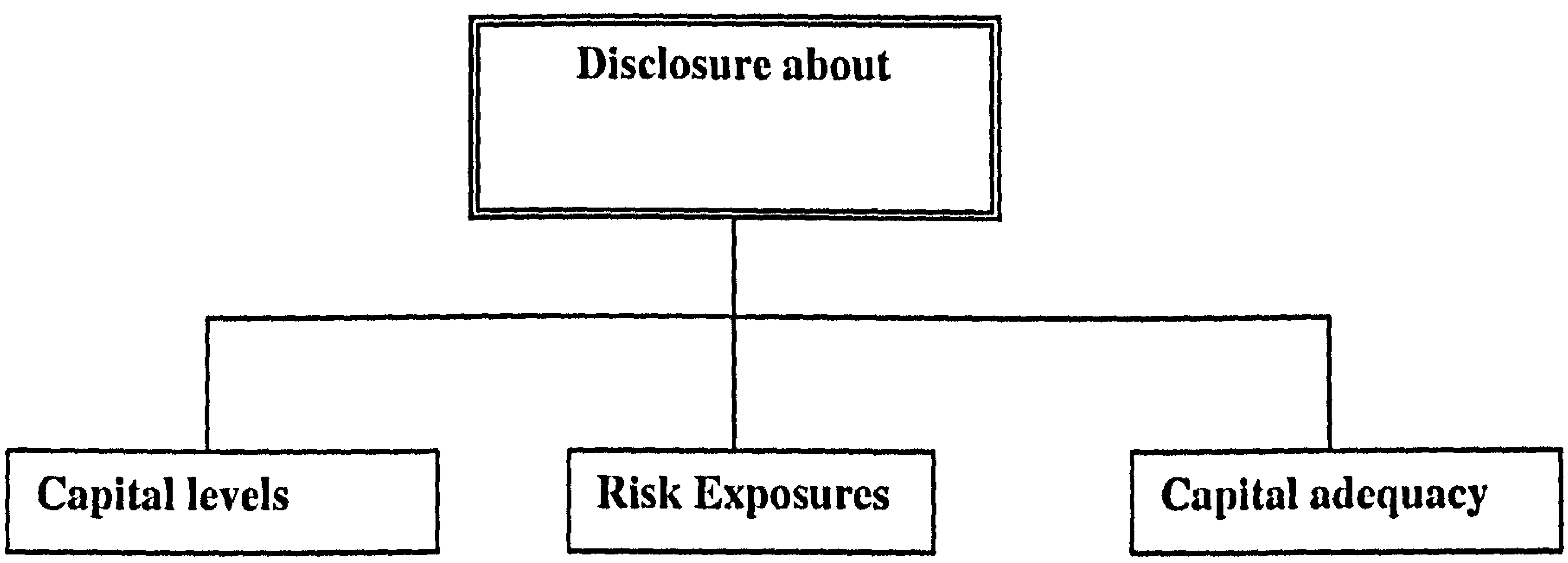
[90] See Kobayakawa (1998) for an incentive-compatible regulation model applied to the PCA, and the possibility of moral hazard under this model.

[91] Note that it is still not well known how long will it take to finalise options 2 and 3. In particular the credit risk modelling based on portfolio performance still has data availability and model validation problems (Basle 1999).

Pillar II: To assess capital adequacy in relation to a bank's true risk profile by the introduction of a supervisory review process, including consideration of the banks' own risk management processes.

Pillar III: Market discipline requirements, by a disclosure of banks' own risk management processes. The main target of pillar three will be to improve market discipline mainly through regular disclosure of relevant quantitative and qualitative information (see Figure 3.5).

Figure 3. 5 The Basle Committee Proposal Pillar III



The new approach will provide a more comprehensive way to tackle risks and enhance market discipline that will also try to promote soundness and enhance fair competition while at least maintaining the current overall amount of capital in the system.

The latest proposals for a new Capital Accord have also been severely criticised. Among other criticisms, the use of credit ratings in constructing the weights assumes two conditions, first that rating agencies produce adequate measures of risk and second that there are no agency problems between rating agencies and borrowers. Moreover, greater reliance on self-measurement of risk by banks could create problems if penalties imposed by regulators are not credible and it could also encourage regulatory forbearance. More importantly, the new proposals, if accepted, are not likely to raise the total capital level in the banking industry, which is deemed low by historical standards by many observers. For comprehensive criticism of the Basle proposals from different professional angle see Bennink (2000), Norgren (2000), Karacadag and Taylor (2000), Bennik and Wihlborg (2000), Linnell (2000), US Shadow Financial Regulatory Committee (2000), Santos (2000) and the European Shadow Financial Regulatory Committee (2000).

Prudential regulation in the European Union

In Europe, there has been an EC-inspired process of integration aimed at creating a common EU-wide competitive and regulatory environment that started with the Treaty of Rome (1957) and the establishment of the European Community. This integration has accelerated noticeably during the 1980s and 1990s, especially the moves to create a single European, in recent years with the introduction of the 'single or internal market' in 1993, as a result of the Single European Act of 1986. This Act defined the EC market as '*an area without internal frontiers in which the free movement of goods, services, persons and capital is ensured*'. The creation of a European Monetary Union is representative of the importance and continuity of this process. In general, it has increased the economic convergence of European countries, and also cross-border operations and has increased the presence of European firms in the markets of their European counterparts.

In the financial services sector industry the two most important EU wide pieces of legislation were the First Banking Directive (1977) and the Second Banking Directive (1988).

The First Banking Directive (1977) sets the rules for expansion across national boundaries within the EC and established the basic rules relating to bank authorisation and supervision. An important output of this Directive is the concept of 'host country rule'. Under this regime, banks involved in cross-border expansions were regulated by each country's regulatory agency. As a result these banks had to operate under multiple regulatory standards. In general it can be concluded that the First Banking Directive was an important stride in the right direction but, as Dixon (1991) argues, it did not create a free internal market.

The Second Banking Directive (1988), passed in 1989 (and implemented in 1993), can be considered the most important legislative measure adopted by the EU concerning the removal of barriers to the provision of banking services in the EU. The main aspect of this Directive was the creation of a single market or single passport of financial services to operate through the Union. Among the key changes derived from the creation of a single market are:

1) The harmonisation across EU countries of minimum standards for prudential supervision of financial institutions directed to create a comparable competitive environment across the EU.

2) The 'mutual recognition' of a single banking licence which eliminates the need to get a local banking charter from the host country for branches and bank products that are permitted by their home country.

3) Home country control, by which bank branches from other member states are primarily subject to their own home country's regulatory supervisory control instead of being subject to the host country's regulators. However, the host country retains control, related to operationalisation of its monetary policy, and has primary responsibility for supervising liquidity.

Between 1986 and 1995, ten main additional banking directives were passed by the EU related to a comprehensive array of issues. This process of deregulation and harmonisation has according to EC (1997) altered the strategies of European banks, enhancing competition in general. The main additional directives mentioned would be:

1) **Directive on the Annual Accounts and Consolidated Accounts of Banks and Other Financial Institutions** (1986). Sets the requirements for banks' and other financial institutions reporting balance sheet and profit and loss statement, special provisions, and valuation rules.

2) **Own Funds Directive** (1989). (Effective 1 January 1993). Define common rules to harmonise the definition of core capital and supplementary capital for all credit

institutions in the European Union. Those requirements are consistent with the standards set by the Basle Committee and the Group of Ten.

3) **Solvency Ratio Directive:** (1989). (Effective 1 January 1993). This is designed to harmonise minimum solvency requirements for credit institutions in the EU, compatible with the standards set by the Basle Committee.

4) **Directive on the Publication of Annual Accounting Documents** (1989). It allows branches to publish separate annual reports as long as the parent organisations publish annual reporting documents.

5) **Directive on Money Laundering** (1991), (effective 1 January 1993). Imposes certain obligations on credit and financial institutions in order to eliminate activities associated with illegal money laundering.

6) **Directive on the Monitoring and Controlling of Large Exposures of Credit Institutions** (1992). (effective 1 January 1994). Introduced to avoid excessive risk concentration by categories of borrowers.

7) **Directive on Supervision of Credit Institutions on a Consolidated Basis** (1992). (Effective 1 January 1993). Requires the supervision of credit institutions on a consolidated basis.

8) **Directive on Deposit Guarantee Schemes** (1994). This directive is aimed at improving the soundness of the financial system by ensuring that EU depositors are covered by deposit-insurance compensation schemes. It sets minimum standards on the extent and level of coverage. As indicated by Gropp and Vessala (2000) and Lanoo (2000), virtually all European countries have a flat-rate deposit insurance scheme.

9) **Directive on the Capital Adequacy of Investment Firms and Credit Institutions** (1993). (Effective January 1996). Complements the Solvency Ratio Directive by setting capital standards that take into account the exposure to market risk as well as credit risk. The directive has also required prudential capital for banks' securities firms.

10) **The Investment Services Directive** (effective January 1996) gave the same passport to (EU incorporated) non-bank investment service firms as the Second Banking Directive provided for banks.

Paramount among this multi-step legislative process (See Table 3.1) were the two initial key banking directives (the First Banking Directive 1977 and the Second Banking Directive, 1988), which set up the framework to promote for the financial integration across the EU banking market. As a result of the implementation of the Single Market Programme (SMP) in 1993, these two directives were followed by eight additional banking directives, which aimed at eliminating competitive barriers and creating a level playing field in the financial services industry in Europe, while preserving financial stability.

Two main prudential directives came into effect in 1993, the Own Funds Directive (1989/299/EEC) and the attendant Solvency Ratio Directive (1989/647/EEC). These directives were consistent with the Basle Accord, but unlike the latter, they applied to all deposit institutions in the EU and are legally enforceable in the EU. These capital-related regulatory measures were perceived by market participants to have had the most important impact of all the SMP-related legislation on banks' organisations and practices (EC 1997).

The directive on the Capital Adequacy of Investment Firms and Credit Institutions (CAD, 93/6/EEC) came into effect in January 1996. This directive considered trading exposures derived from investment business, and equates the supervisory framework for investment firms to that of credit institutions. The CAD follows the building block approach to measuring market risk, so that risk in equity and interest rate instruments is added to counterpart and settlement risk for the total risk exposure calculation. However, two important differences from the Basle approach shall be highlighted. The first arises from the fact that banks were not allowed to use their own internal Value-at-Risk (VaR) models instead of the supervisory rules in force to calculate capital charges. The second is that the CAD allows for better consideration of reductions in market risk in situations where long and short positions offset one another.

Accordingly, the EU revised the CAD in order to harmonise its regulatory framework with the latest Basle rules on market risk and this has allowed for a broader use of VaR models. The EU Capital Adequacy proposal[92] (CAD II) brings the EU's capital adequacy rules into line with the latest amendment to the BIS (Bank for International Settlements) rules as it allows institutions to only use internal Value-at-Risk (VaR) models to determine the capital to be set aside against market risk and to incorporate the effects of correlation between broader asset classes. This was accepted in the Ecofin Council on 17 November 1997, so that the amendment became operative from 1998 onwards.

From the above discussion, it becomes clear that European banks are moving from the traditional approach based on a formula, which is applied to all financial institutions, towards VaR approaches, and more sophisticated models of risk management, (See Fig 3.6) and towards giving a more important role to market discipline. This trend towards the new Basle-type capital approach has increasingly been recognised by practitioners and the market, due to the emphasis that has been placed upon capital allocation in recent years. This direction was recognised by Llewellyn (1995, pg 14), who argues that '*the ethos of banking is likely to change yet further in the direction of focusing upon capital and profitability as the central strategic business, a major imperative will be to develop risk analysis systems to allocate potentially scarce capital to different risk areas*'.

[92] Proposal for a Parliament and Council Directive amending Council Directive 93/6/EEC, on the capital adequacy of investment firms and credit institutions and Council Directive 93/22/EEC on investment services in the securities field. OJC 132, 28.4.1997. See COM (97)71 as well.

Figure 3. 6 Capital regulation and risk

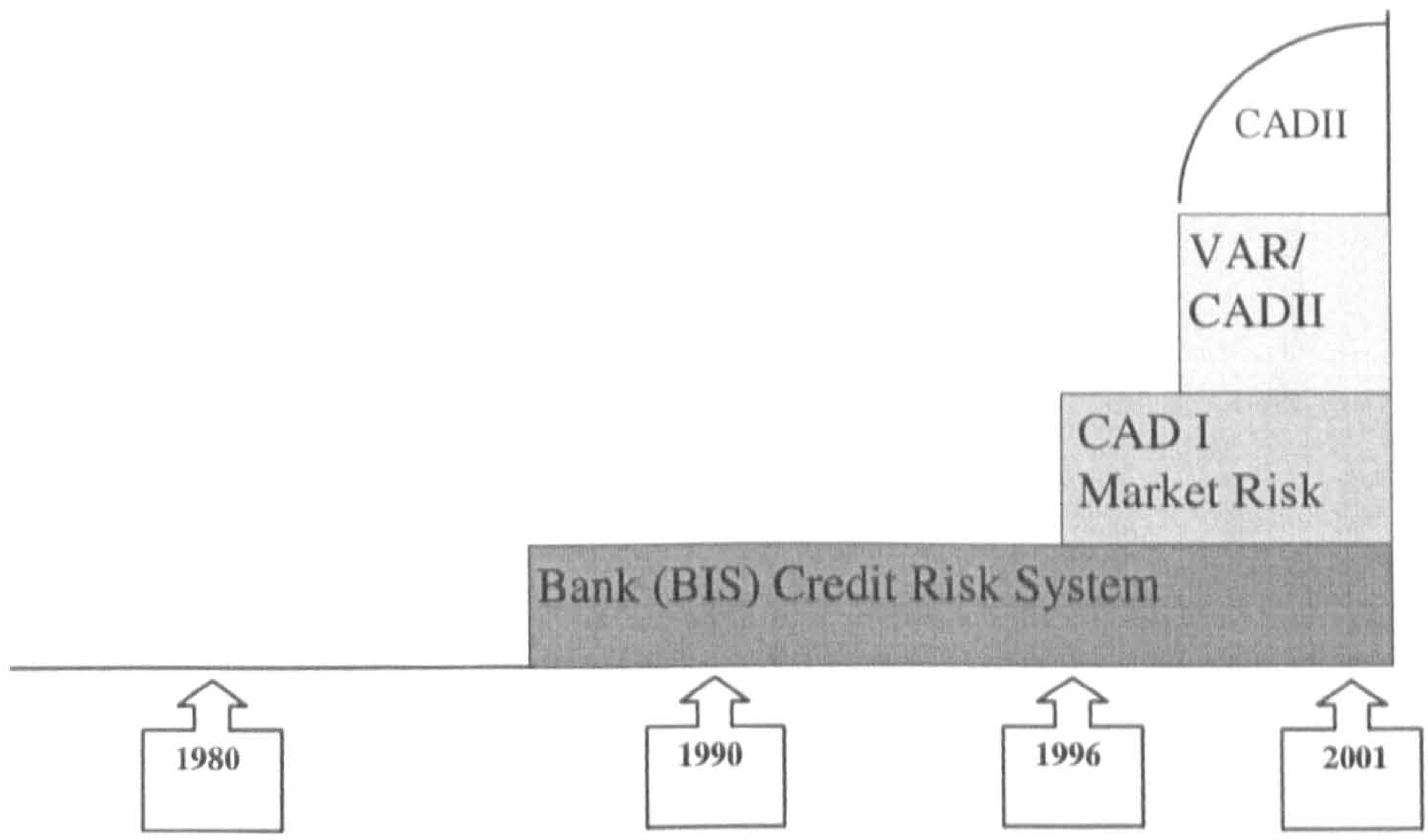


Table 3. 1 Regulatory framework for provision of financial services

	Banking	Investment services	Non-Life Insurance	Life Insurance
Key Directives	- Second banking directive - Own funds directive - Solvency ratios directive or CAD/CAD II for trading book	- Investment services directive (ISD) - Capital adequacy directive (CAD) - Value at risk models (CAD II) - UCITS	- Third non-life insurance directive - Second non-life insurance directive	- Third life insurance directive - Second life insurance directive - Pension funds
Supplementary Directives	- Deposit insurance directive - Large exposures directive	- Investor compensation schemes	- Car liability insurance	
Other measures	- Money laundering directive - Cross borders payments - Settlement finality	- Public offer prospectus	- Insurance intermediaries	
Annual accounts	- Annual accounts of banks	- Listing particulars	- Annual accounts of insurance companies	
Consolidation	- Consolidated supervision	- Insider trading - Major holdings	- Supervision of insurance groups	
Co-operation between supervisors winding up	- Banking advisory committee of banks	- Securities committee	- Insurance committee	
Winding up	- Of banks		- Of insurance companies - Draft interpretative communication	
General Good	- Interpretative communication		- Draft interpretative communication	

Source: Adapted from Lanoo (1998 and 2000)

3.6.4 Remaining barriers to integration in EU banking markets

Once the institutional framework of prudential regulation in the EU has been highlighted, it is important to identify the remaining barriers that 'de facto' do not allow for the existence of a truly single market for financial services in the EU. We could identify two main kinds of barriers, those affecting all industries or *'horizontal barriers'* and those affecting the banking industry only or *'vertical barriers'*[93].

Barriers to trade in the financial area may take many forms. Four important areas can be pointed out in which there are various legal differences prone to creating competitive regulatory advantage for some countries:

- Reserve requirement differences;
- Taxation differences;
- Freedom for national governments to act in derogation of parts of the Single Market by using the concept of the *'general good'* allowed to member states;
- Supervisory differences.

In addition, there are remaining horizontal barriers, namely barriers that are not specific to the banking sector. Foremost among these barriers highlighted by EC (1997) are:

- Collusive behaviour in some countries;
- Labour markets and employment regulation;
- The role of state subsidies;

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93 See a study of the effectiveness and impact of internal market interaction on the banking and credit sector, Economic Research Europe Ltd in collaboration with Public and Economic Consultants (PACEC) and the Institute of European Finance (IEF) for a detailed description of the remaining barriers and the rate of implementation of the directives.

- Corporate law differences;
- Accounting differences.

All in all, we could say that the de-regulatory process has been quite profound in the European Union over the last decade[94], yet the process is less advanced than it could be partly because the EU's Single Market directives have not been fully effective in practice, particularly at the retail level. The aforementioned barriers to creating a single market have limited integration. While the introduction of a single currency in January 1999 helped elevate one of the major barriers to trade (eleven separate currencies disappeared), it has been widely recognised that further work needs to be done on promoting integration and reducing barriers. This fact has been recognised by the European Union by approving at the Cologne summit on 3-4 June 1999, proposals from the Commission known as the 'Action Plan' (AP), or 'Implementing the Framework for Financial Markets: Action Plan'. This suggests relative priorities and time-scales for key proposed EU measures relating to three key areas: the completion of a single market for wholesale financial services, the development of open and secure markets for retail financial services and ensuring the continued stability of EU financial markets and the elimination of tax obstacles to financial market integration.

The AP discusses the following EU initiatives aimed at developing open and secure markets for retail financial services. These initiatives are aimed at:

- Promoting enhanced information, transparency and security for cross-border provision of retail financial services. (Directive on Distance Selling of Financial Services and Other Measures);
- Expediting faster resolution of consumer disputes through effective extra judicial procedures;

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[94] In fact, the role of the EC as responsible for competition policies in Europe has been enhanced in recent years. In this sense, the role of state subsides to banking firms or the promotion of national champions has increasingly been questioned. The number of cases under scrutiny and the activity of the Commission in this field have been rising over the last 4 years using probably a more activist policy than the US.

- Creating a proper balance between consumer protection and the need from sophisticated investors to be able to engage in sophisticated financial transactions.

Regarding the initiatives aimed at completing a single wholesale market in financial services the key points relate to:

- Removing the remaining barriers to raising capital on a EU wide basis, (update the Directive on Reporting Requirements and Prospectus);
- Establishing a common legal framework for integrated securities and derivatives markets (Updating the Investment Services Directive);
- Further progress towards a single set of financial statements for listed companies;
- Provide a reliable, secure and transparent market for cross borders Mergers and Acquisitions (M&A);
- Provide a legal framework for cross border securities trades (Directive on cross border use of collateral), and a framework in which asset managers can optimise the performance of their portfolios in the interest of their customers;

Finally, there is a group of initiatives targeted at ensuring the continued stability of EU financial markets. These include policies aimed at:

- Improving banking, securities and insurance legislation up to the highest standards, collaborating in the implementation of the work of existing international bodies such as IOSCO (International Organisation of Securities Commissions), Basle, FESCO (The Forum of European of Securities Commissions);
- Improving the prudential supervision of financial conglomerates;
- Increasing cross-sectoral discussion and cooperation between authorities;

- Co-ordinating taxation policies.

The implementation of the AP is likely to have a substantial impact on the capital positions of European banks, for one thing it will enhance competition among institutions, which according to the theoretical models is likely to affect capital decisions of institutions (see Matutes and Vives, 1993). It will also improve accountability and market value reducing transaction costs in raising new capital. This is also likely to be beneficial for consumers and the most efficient operators but may deepen regulatory imbalances between savings and private institutions particularly in the years following the implementation of the PA. In this environment, the issue of shareholder value creation is likely to become more prominent. Hence banks' capital positions as measured in terms of market value, are likely to gain importance both for financial operators and regulators alike (see Flannery, 2000).

3.7 Conclusion

Although financial regulation maybe costly, the protection of depositors and the reduction of systemic risk are two major arguments supporting the existence of financial regulation. The process of deregulation and the recurrence of banking crises have increased concerns regarding the financial stability of the system. Under this process, several authors have focused on the negative effects that a generous safety net may have in terms of incentives for bank risk-taking and hence, on the need for a more stringent prudential regulation. Among the different tools used by regulators for prudential purposes, capital adequacy regulations have played an increasingly prominent role. However, the theoretical literature offers contradictory results as to the optimal design of capital adequacy regulation and to the effects of capital requirements on bank risk-taking incentives. However, there is almost a consensus that capital adequacy regulations should be set up in conjunction with other prudential regulatory instruments in order to create an optimal set of incentives. Finally, it is also clear from the literature that bank capital adequacy regulations are likely to be costly, both from a micro and macroeconomic point of view.

Mainly as a response to external factors, and the developments of new regulatory tools, the institutional regulatory landscape has been changing quite drastically in Europe. The main institutional drivers of this unprecedented change would be the process of financial integration inside the European Union, as well as the role of further cooperation and the standardisation of prudential regulatory rules spearheaded by the Basle Committee.

CHAPTER 4

CAPITAL, RISK AND PERFORMANCE IN BANKING: A REVIEW OF THE EMPIRICAL LITERATURE

4.1 Introduction

This chapter analyses the empirical literature that models the relationship between banks' capital strength, risk and performance. Although the bulk of the empirical literature focuses on the US market, this chapter also outlines some recent European studies. The chapter starts by outlining how the relationship between banking risk and capital adequacy are evaluated, and reviews the literature, which aims to analyse the effectiveness of banking capital regulation. The main focus of this literature is on the determinants of capital augmentations. An important aim of this literature is to analyse whether financial regulation has been effective in increasing capital and reducing overall risk. Recent studies have started to relate the issue of bank capital to more refined measures of risk and of efficiency more directly. Section 4.3.2 considers how the issue of bank' risk has been considered in the empirical literature, and Section 4.3.3 focuses on how the concept of bank efficiency has been tackled in recent empirical studies.

4.2 Literature review: The relationship between capital and risk

As noted in the previous chapter, the theoretical issue of how higher capital ratios reduces overall banking risk has largely been unresolved in the literature. That is one reason why the empirical literature has aimed at disentangling various factors that may influence the relationship between capital and risk.

The earliest empirical studies originated from United States concerns about whether the existence of flat rate deposit insurance created incentives for excessive risk-taking by bankers at the expense of the Federal Deposit Insurance Corporation (FDIC). In order to avoid the transfer of value to the FDIC, financial regulation was expected to force financial institutions to hold an amount of capital adequate to the amount of risk that individual institutions were taking. Hence the main objective of the earlier literature was to analyse the effectiveness of financial regulation.

4.2.1 The effectiveness of banking capital regulations: the relationship between capital and risk

The main rationale underpinning these earlier papers was to see whether banking capital regulation is efficient in reducing the substitution between the subsidy provided by flat (or quasi flat) risk premiums, and capital leverage. As mentioned in Chapter 3, the deposit insurance subsidy is a growing function of the capital and risk level of the institution. Consequently, if an entity aims to maximise the value of the subsidy provided by the deposit insurance corporation (or in general by the safety net), it will increase its leverage by reducing the amount of capital held. Starting from this point, most the earlier empirical work attempted to ascertain whether this process had occurred in practise. Consequently, these earlier studies focused their attentions on the effectiveness of bank capital regulation in which changes in expected capital were regressed against a set of explanatory variables including one or more variables accounting for risk and another variable accounting for the effect of financial regulation. Underlying these studies, there is a preponderant emphasis on the trade off between bank capital and risk-taking. According to Peltzman (1970, pg.3) *'more adequate capital and a less risky assets portfolio are substitutes in the eyes of the regulator, and their examination activities are geared to achieving an appropriate mix of the two. However, the preponderant emphasis is placed on regulating bank capital rather than the details of the assets portfolio to the regulatory agencies, capital adequacy is probably the most important single indicator of a bank's condition, and it occupies their greatest efforts in the examination-portfolio regulation process'*.

4.2.1.1 Peltzman's model

One of the earliest models that systematically examined the issue of capital and risk was developed by Pelzman (1970). Peltzman's main goal was to analyse whether capital adequacy regulation has been effective. That was to study whether capital adequacy regulation in the US had in fact caused the bankers to behave in the same way in terms of capital investment than they would have in the absence of banking capital regulation. Besides, the author also explores whether regulators managed to avoid substitution between capital and the deposit insurance scheme. Finally the author also examines the determinants of capital changes including the risk-taking position of banks.

Under the assumption that there is an optimal target capital ratio in the minds of both managers and regulators, Peltzman constructs a capital investment model in which actual changes in capital are seen as a response between a target and an existing capital. The model would then determine how the target capital is set up.

According to Pelzman's (1970) model[95], the flow of capital into banking is regarded as a response to a discrepancy between the desired or long-run equilibrium stock (C^*) and the currently existing stock (C).

$$(dC/dt)^* = f(C^* - C)$$

The model focuses on the determinants of the desired stock of capital (C^*). Empirically, Peltzman models this by a series of cross section regressions that use state aggregate data as the unit of observation covering the years 1963-1965. The data is used to estimate the following equation:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, u)$$

Where:

Y = percentage change in bank capital (in a state) in a year;

X_1 = expected rate of return in banking, in the form of the current rate of return on capital or the market to book value;

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[95] See Pelzman (1970) pg. 10-11 for a development of the model. The model is an application to banking from a model used discussed for other industries by Friedman (1962, pp. 246-244).

X_2 = rate of return on alternative uses for bank capital;

X_3 = default risk of bank portfolios, measured as the ratio of US bonds to deposits net of cash assets;

X_4 = capital deposit ratio;

X_5 = expected annual rate of growth of bank deposits;

X_6 = percentage growth of capital desired by regulators estimated from a formula used by them in bank examinations, and by the percentage of deposits insured by the FDIC;

u = random variable.

The independent variable of primary importance would be the regulatory variable (X_6). A negative or non-significant value for X_6 indicates that regulation has been ineffective in setting the capital standards required by regulators. Peltzman found the regulatory variable of desired capital (X_6) as measured by several proxies to be negative. The author concluded that capital regulation had not been effective in any important way, as it could not improve on the explanation provided by the other set of factors in explaining bank investment behaviour. Consequently, regulators had failed, according to this author, to prevent banks from substituting deposit insurance for capital.

4.2.1.2 Mayne (1972) and Mingo (1975) models

Mayne (1972) aims also to test whether the bank supervisory influence appears to be significant for bank capital positions. Building on the model developed by Peltzman, Mayne's approach is slightly different. Her main assumption is that although different regulatory authorities share the goal of seeking to maintain a sound financial system, there are marked differences in the capital standards of each of the US regulatory agencies (Federal Deposit Insurance Corporation, Board of Governors and Office of the

Comptroller of the Currency).

Unlike Peltzman, Mayne's model uses individual bank data and the dependent variable utilised is the average level of total capital funds rather than changes in capital. This variable is regressed against a set of qualitative and quantitative explanatory variables likely to affect capital levels[96]. The main variables of interest in the Mayne's model are the regulatory agency dummy variables that indicate the kind of institution that supervises each bank. The significance of any of these dummies would indicate that there exist significant differences in the amount of capital funds held by the different institutions that are not explained by the rest of the explanatory variables but rather by regulatory action.

Among the rest of the explanatory variables, it is interesting to see that the author includes a proxy for qualitative variables such as the quality of the management[97], and two proxies directly accounting for the effect of bank risk on the amount of capital held by the supervisor. Mayne's model is as follows:

$$C= \alpha + \beta_1 NA + \beta_2 SM + \beta_3 AS + \beta_4 TD + \beta_5 EG + \beta_6 EL + \beta_7 AG + \beta_8 CA + \beta_9 MR + \beta_{10} LO + \beta_{11} CO$$

Where:

Dependent variable

C = average total capital funds in year t to average total assets in year t

Regulatory variables

NA	= 1	for national banks in year t
	= 0	for all other banks in year t
SM	= 1	for state chartered banks in year t

[96] See Appendix IVa for an overall revision on the explanatory variables included as determinants of bank capital changes by the literature.

[97] This can be probably seen as a recognition of the importance of X-efficiency included in recent models.

= 0 for all other banks in year t

Control variables

AS = (SIZE) total assets;

TD = (DEPOSIT STRUCTURE) ratio of average time deposits to total deposits;

EG = (EARNINGS GROWTH) ratio of earnings to previous year earnings;

EL = (EARNINGS LEVEL) operating earnings to total assets;

CA = (LIQUIDITY) liquid assets to total assets;

CO = (ECONOMIC ENVIRONMENT) integer constructed as a weighted average ranging from 1 (negative) to 5 (positive) according to the macroeconomic condition;

Risk variables

MR = (PORTFOLIO RISK) minimum risk assets to total assets;

LO = (LOSS EXPERIENCE) loan charge-offs and other losses to income from loans.

The author uses a multivariate regression and factor analysis for each cross-section year, and finds that the evidence does not appear to support the hypothesis that there exist significant differences in the amount of capital funds held by the different bank classes subject to different regulators, when the influence of other factors is held constant.

Overall, Mayne's (1972) results are in accordance with those of Peltzman's in that financial regulation does not appear to be effective. Besides, the use of individual bank data and a more systematic use of the independent improve considerably the previous model.

Mingo (1975)[98] responds to the results obtained by Peltzman (1970) and Mayne (1972), by using a model very similar to that used by Peltzman, as he also regresses capital changes against a set of explanatory variables, but unlike Peltzman, he corrects for two apparent errors. First, like Mayne (1972), Mingo (1975) uses individual bank data instead of aggregate State- wide data. This is important as aggregated state data can be misleading as two states with identical values for a given variable could have vastly different distributions of this variable within the state. Besides, the use of individual data allows for the inclusion of other explanatory variables, which may not be appropriate when aggregate data are used. Secondly, the model allows for a non-linear relationship between regulatory pressure and changes in capital.

Mingo's model regresses changes in capital against the same subset of variables used by Peltzman, but also includes a regulatory variable defined as the inverse of the capital adequacy ratio (ABC ratio). This ratio indicates the ratio of actual capital to total assets desired by the appropriate regulator. By calculating the inverse of this ratio, this variable indicates that the larger the desired capital is from the actual capital target the larger the effect of the regulatory pressure would be. Finally the model incorporates an interaction term linking the regulatory pressure variable to one including the percentage of depositors insured by the FDIC.

The methodology employed is again an OLS regression analysis of a sample of 323 banks drawn randomly in 32 States during a single year: 1970. The results conform to Peltzman's conclusion that bankers treat deposit insurance as a substitute for bank capital. Yet, unlike in Peltzman and Mayne's results, Mingo finds that regulators' desires affect bank capital investment. Moreover, the effect of regulatory demands on bank capital is non linear and regulators place greater pressure on banks with the more

98 Heggestad and Mingo (1975), use both Peltzman and Mayne methodology (see Table 4.1), to determine whether bank holding companies kept a higher risk level than their counterparts when other explanatory factors were taken into account. The results of the research confirm this hypothesis.

inadequate capital so that these undercapitalised banks experienced the greatest investment rates.

4.2.1.3 Dietrich and James (1983) and Marcus (1983)

In 1983, two studies responded to the contradictory results found in earlier studies, pointing out the possible limitations in previous models. Dietrich and James (1983) emphasise that earlier models had two important limitations. First, the inappropriate use of aggregate data in the case of Peltzman's model. Second, these models did not take into account the effect of deposit interest rate ceilings on banks' capital structure. According to these authors, the period analysed by Mingo (using individual data) was not appropriate as, in 1970, American banks were limited in increasing interest rate payments in order to compete for depositors by interest rate ceiling regulations. Dietrich and James (1983) also point out that according to theoretical models (see Taggart and Greebaum, 1978), deposit interest rate ceilings are bound to have an important effect on the capital levels of banks as certain banks may be competing for depositors by increasing capital positions.

By replicating exactly the model of Mingo (1975), Dietrich and James (1983) utilise the period 1971 to 1975, running a series of cross-sectional regressions over an extended sample of about 10000 banks. According to the authors, the choice of the period is important, as over that period, interest rate ceilings on large depositors were not binding so this factor is not likely to affect the results. In contrast to the results of Mingo (1975) and in accordance with the results of Petzman (1970) and Mayne (1972), Dietrich and James (1983) find no evidence to support the view that regulators influence bank capital.

Contemporaneously to this work by Dietrich and James (1983), Marcus (1983) criticises earlier work on different grounds. Marcus' (1983) starting point is that the decline in the amount of capital observed in the US in the late 1970's and early 1980's could be put down to two main factors. Firstly, the existence of a flat rate structure charged for deposit insurance and secondly, the tax advantage of debt finance through the treatment of interest payments as a tax-deductible expense. According to Marcus

(1983), previous studies overlook the fact that the higher the nominal interest rates, the larger would be the incentive to increase leverage for banking institutions.

Marcus (1983) estimates a model that differs from previous studies in three main ways. First, a panel data procedure is employed, rather than simple cross sectional estimations. This is important as it could help to explain changes in capital-to-assets ratios over time. Secondly, unlike previous studies using individual bank data, Marcus focuses on market rather than book value, as market values are more likely to provide better estimation of the protection provided by capital. Third, the model uses different measures of capital according to their relative importance in terms of providing soundness to the institution.

Marcus (1983) uses a restricted sample of 115 banks traded in the equity markets over the period 1965 to 1977. Regarding the dependent variables, two innovations are worth mentioning. On the one hand, there is the inclusion of nominal market interest rates, which are expected to be negatively related to the desired capital to total assets ratio. On the other hand, a proxy for the tax advantage of deposit insurance relative to equity finance as proposed by Miller (1977) is also included. In addition, as a result of the use of panel data, Marcus uses a partial adjustment model as suggested by Pelzman (1970) in the theoretical section of his paper. According to this specification, the ratio of target capital to total assets C*, which is unknown to the external observer is assumed to depend linearly upon a set of exogenous variables, X and a stochastic disturbance u.

$$C^* = Xb + u$$

Where b is a vector of coefficients. The actual change in capital can be seen as[99]:

$$C_t - C_{t-1} = \beta_1 (C_t{}^* - C_{t-1}) + (1 - \beta_2) I_t$$

[99] See Marcus (1983), pg 1220 for further details. See also Appendix IV.

Where $C_t - C_{t-1}$ indicates the actual change in the capital ratio and I denote the unanticipated innovation to the capital ratio, which arises from unforeseen capital gains and income and deposit fluctuations. This is proxied with the actual levels of these variables. So that the equation becomes:

$$C_{i,t} = \alpha_i + (1-\beta_1)C_{i,t-1} + \beta_1 X_{i,t} b + (1-\beta_2)I_{i,t} + \beta_1 u_{i,t}$$

So finally Marcus (1983) regresses levels of capital against a set of explanatory variables of target capital, the level of capital lagged one period and two variables (the income to total assets ratio and percentage change in deposits) which are meant to proxy for innovations in capital levels not derived from the target capital.

Marcus' results show that regulatory influences on bank capital seem limited in that there is a strong incentive to exert regulatory pressure mainly by comparing a bank's capital to that of its peers rather than on actual levels (which might not be well defined), so that regulators exert little influence on the response to economy-wide shocks to capitalisation in terms of the total amount of capital. His results also corroborate the hypothesis that the increase in leverage might be a response by banks to increases in the interest rate and the tax disadvantage of equity finance.

4.2.1.4 Wall and Peterson (1987), Dahl and Shrieves (1990), Carbo (1993), Barrios (1998) and De Bondt And Prast (2000)

Five further studies, that try to ascertain whether capital adequacy regulation has been effective of Wall and Peterson (1987), Dahl and Shrieves (1990), Carbo (1993), Barrios (1998) and De Bondt And Prast (2000), deserve attention. The studies by Wall and Peterson (1987) and Dahl and Shrieves (1990) are interesting because of the improved methodology which they use, in the case of Carbo (1993), Barrios (1998) and De Bondt and Prast (2000), the research is relevant because theirs are among the few studies tackling this question outside the US. Wall and Peterson (1987, 1995) extended Marcus' (1983) approach, by setting up two different partial adjustment models: One for those banks whose capital ratio lies below the minimum regulatory requirements and a different model for those institutions whose ratio is above the minimum regulatory threshold. The econometric estimation procedure[100] allocates individual observations either to one model or the other. This econometric estimation involves a maximum likelihood model in which both specifications are estimated contemporaneously. Unlike the majority of previous studies with the exception of Mingo (1975), the results suggest a strong impact of regulation on bank capital changes.

The paper by Dahl and Shrieves (1990) focuses on the impact of capital standards using a similar approach to the one used by Mingo (1975) and Dietrich and James (1983), but they apply this model only to external equity infusions by banks instead of applying the model to any change in capital. This isolates the sample from changes in capital that could be due to previous decisions not incorporated in the explanatory variables. The results suggest that regulatory minimum capital constraints are important in influencing the financing decisions made by a significant subset of banks.

We are aware of only three European studies that tackle the question of the effectiveness of bank capital. Carbo (1993) uses Dietrich and James (1983) methodology with a sample of Spanish banks for the period 1987-1990, but adjusts the independent variables to account for the specific features of the Spanish financial system. Carbo (1993) finds that regulation has come to be a more influential factor in explaining capital augmentations of savings rather than commercial banks. Barrios (1998) also looks at the determinants of capital changes for a sample of 152 Spanish banks using a model similar to that used by Marcus (1983), and using a dynamic panel data estimation procedure. As in the case of Carbo's study, his results also indicate that regulation has been effective in boosting capital ratios particularly in the case of savings banks.

De Bondt and Prast (2000) assess empirically the determinants of changes in bank capital ratios in the 1990's and whether banks' responses are consistent across countries. The authors have an unbalanced panel of 448 banks from Germany, France, Italy, the Netherlands, the UK and the US for the years 1990 to 1997. The model is

[100] The author uses the Goldfeld and Quandt (1975) disequilibrium econometric model.

calculated by multivariate linear regression in which changes in the Tier 1 and total capital to total assets ratios are regressed against a series of individual bank and industry variables as shown below. The individual bank explanatory variables included are: 1) Loan to total assets ratio, 2) OBS items to total assets ratio, 3) assets growth, and the industry variables incorporated include: 1) a bank sentiment index derived from the stock market, 2) and linear trend dummy. A capitalisation dummy variable is also included in the model to account for the effects of regulatory pressure.

$$\Delta RAC_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 X_{it-1} + \beta_3 t + \beta_4 capitalisation \quad dummy_{t-1} + \varepsilon_{i,t}$$

Where:

Dependent variable

RAC = Tier 1 ratio in year t; Δ indicate changes;

Explanatory variables affecting at the bank level

X_{it} = Cost of capital (net income/ total equity), loan ratio (loans/total assets), OBS ratio (OBS/total assets), asset growth (total asset growth);

Explanatory variables affecting at the industry level

X_{it-1} = Explanatory variables which are lagged to avoid endogeneity bias.Bank sentiment (bank share index minus total market index in %), trend (linear trend, 1 in 1990);

Dummy capital = 1 if RACR is below the median, 0 otherwise.

The authors conclude that the increased competition in the 1990's led to a small decline in the capital to total assets ratio in recent years, factors both at the bank level and at industry level are relevant in explaining this decline. Interestingly, the authors' also present anecdotal evidence that there has been an increased amount of banking risk taken in relation to the amount of capital held in several of the studied countries and indicate that a growing importance of shareholder value could lead to lower capital ratios.

4.2.2 Capital and Risk: Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwaland Jacques (1998), Editz, Michael and Perraudin (1998) and Rime (2001)

As seen in Chapter 3, in the early 1990's, international capital adequacy regulations were introduced in most countries as a response to the decline in capital ratios and to establish a level playing field for international banking competition. This shifted the focus of the literature analyzing the effects of banking capital regulations towards bank risk. This is a variable, which had not received excessive attention previously, apart from being a necessary explanatory variable, in earlier models. Consequently, the emphasis of these studies is on the relationship between changes in capital and changes in risk.

This empirical literature aims to disentangle the different theoretical appraches that can explain the relationship between adjustments in capital and risk. According to Shrieves and Dahl, 1992, pp 442-443), the most relevant of these theories underpinning a negative relation between capital and risk would be:

- The effect of Deposit Insurance: Under flat-rate deposit insurance schemes, the marginal benefit from increasing asset risk goes up as capital declines because banks will not have to pay a bankruptcy premium for issuing insured deposits.

Also the following theories would imply a positive association between adjustments in capital and risk.

- Regulatory pressure. As indicated by Peltzman (1970) and Kreps (1966), the bank is given a '*Hobson's choice*': more capital or fewer risk assets so that more capital and fewer risky assets are seen as substitutes in the eyes of the regulator.

- Unintended effects of regulation (see Kim and Santomero, 1988, and Charter 3). If, due to regulatory pressure, banks are forced to hold more capital, they could react by taking on an increased amount of risk in order to maintain the previous amount of capital to risk level.

- Bankruptcy costs (see Orgler and Taggart, 1983). The value of bankruptcy related costs would increase as capital declines so that an increase in leverage would be accompanied by a decline in asset risk and more asset risk would be accompanied by a reduction of leverage.

- Agency problems between managers and shareholders. Managers as agents of shareholders may have an incentive to have an optimal risk level below that of shareholders as they cannot diversify their human capital so that their costs may be greater in the case of insolvency (See Saunders et al. 1990). Consequently, managers experiencing an increase in portfolio risk may compensate for it by increasing capital more than the optimal level desired by shareholders.

The first empirical model in this direction was developed by Shrieves and Dahl (1992) who use a partial adjustment model similar to that proposed by Peltzman (1970) and used by Marcus (1983) for modelling bank capital decisions. Shieves and Dahl (1992) improve this earlier model by considering that both changes in capital and changes in risk are both endogenous variables and both the results of 'exogenous shocks' as well as discretionary behaviour.

So that changes in capital can be modelled as:

$$\Delta CAP_{j,t} = \Delta CAP_{j,t}^{M} + E_{j,t}$$

Then,

$$\Delta CAP_{j,t} = \alpha\left(CAP_{j,t}^{*} - CAP_{j,t-1}\right) + E_{j,t}$$

Where:

$\Delta CAP_{j,t}$:	Is the total change in the capital level for bank j during period t;
$\Delta CAP^{M}_{j,t}$:	Represents discretionary adjustments in capital;
$E_{j,t}$:	Represents exogenous determined factors;
$CAP_{j,t-1}$:	Is the beginning of period capital ratio;
$CAP^{*}_{j,t}$:	Is bank j's target capital ratio.

In addition, changes in risk are modelled as:

$$\Delta RISK_{j,t} = \Delta RISK^{M}_{j,t} + U_{j,t}$$

And,

$\Delta RISK_{j,t}$:	Is the total change in risk for bank j during period t;
$\Delta RISK^{M}_{j,t}$:	Represents discretionary adjustments in capital;
$E_{j,t}$:	Represents exogenous determined factors;
$RISK_{j,t-1}$:	Is the beginning of period capital ratio;
$RISK^{*}_{j,t}$:	Is bank j's target capital ratio.

Both changes in capital and risk are regressed against a set of explanatory variables. Among the explanatory variables likely to have an effect on capital and risk include:

LNSIZE = (SIZE) Natural logarithm of total assets, as size may have an effect on bank capital and risk due to its relationship to bank diversification;

RISK = (RISK) risk in measure calculated as the Basle risk weighted capital to total assets;

NON = (NON PERFORMING LOANS) accounting measure of risk;

BHC = (HOLDING) dummy variable indicating whether the bank belongs to a holding company, it could have an effect on capital and risk due to different behaviour because of differences in regulation, bankruptcy costs, risk aversion, or due to different mechanisms of monitoring/controlling managerial performance if the company forms part of a holding company;

REG = (REGULATION) dummy regulatory variable for banks with capital below a threshold. This variable is meant to account for regulatory pressure. The authors also included the interaction effect of regulation and changes in capital in the capital equation as regulation may affect the speed of adjustment;

BIN = (MACROECONOMIC and REGULATORY FACTORS) these are accounted for by using binary variables;

NON = (NON PERFORMING LOANS) risk measure.

So the estimated model would be:

$$\Delta RISK_{j,t} = \beta\left(RISK^{*}_{j,t} - RISK_{j,t}\right) + u_{j,t}$$

$$\begin{aligned}\Delta CAP_{j,t} = {} & \alpha_0 + \alpha_1 LNSIZE_{j,t} + \alpha_2 BHC_{j,t} + \alpha_3 REG_{j,t} + \alpha_4 \Delta NON_{j,t} + \\ & \alpha_5 \Delta RISK_{j,t} - (a_0 + a_1 REG_{j,t}) CAP_{j,t-1} + u_{j,t}\end{aligned}$$

$$\begin{aligned}\Delta RISK_{j,t} = {} & \beta_0 + \beta_1 LNSIZE_{j,t} + \beta_2 BHC_{j,t} + \beta_3 REG_{j,t} + \beta_4 \Delta CAP_{j,t} + \\ & \alpha_5 \Delta NON_{j,t} - b_{j,t} RISK_{j,t-1} + u_{j,t}\end{aligned}$$

Shrieves and Dahl run a Two Stage Least Squares (TSLS) estimation on a panel - of 1800 US banks over the years 1983 to 1987. Their results found a positive relationship between changes in capital and risk indicating that capital changes have been risk based. The authors argue that this result holds both for undercapitalized and overcapitalized banks. This indicates that regulation was partially effective and is also consistent with the view that managers have private incentives to limit risk-taking. Overall, as Shrieves and Dahl summarise *'the results indicate that managers will tend to offset regulatory induced capital increases with increases in asset risk unless constrained from doing so by regulators'* (Shrieves and Dahl, 1992, pg. 546). So they deduce that the effectiveness of bank capital adequacy standards would depend on how well the standards reflect the true risk exposure of the bank

With the introduction in 1993 of the Basle capital adequacy standards, several papers have built on the aforementioned model to measure the effectiveness of capital adequacy regulation, particularly focusing on whether the capital standards have increased banks' risk or produced negative incentives in terms of balance sheet adjustment towards risky assets. Jacques and Nigro (1997) use Shrieves and Dahl's (1992) approach in a model that includes a more sophisticated set of regulatory pressure variables and is applied to data in which the risk based capital standards were already in effect in the US. Apart from the variables accounting for regulatory pressure their explanatory variables are similar to those of earlier studies. Regarding the empirical estimation, Jacques and Nigro (1997) use a Three Stage Least Squares estimation[101] and a sample of 2570 FDIC insured US banks from 1991. Their results suggest that risk based capital standards were effective in increasing capital ratios and reducing portfolio risk, although the strength of the response of undercapitalized banks offers surprising results, as they are not related to the degree to which they fell short of the minimum capital standards.

In a 1998 document from the Federal Reserve Bank of New York devoted to the issue of capital adequacy in banking, there were two studies building on the work by Shrives and Dahl (1992) and Jacques and Nigro (1997) by Aggarwal and Jacques (1998) and Editz, Michael and Perraudin (1998).

Argarwal and Jacques (1998) evaluate the impact of the 1991 US laws (FIDICIA) that forced prompt corrective action by regulators on troubled banks, as a deterrent from moral hazard behaviour. The Shrieves and Dahl (1992) model is used for a sample of 2500 Federal Deposit Insurance Corporation insured banks over the period 1990 to 1993. A dummy variable is also included to distinguish between adequately capitalised banks and undercapitalised banks, which are more likely to be under pressure after the introduction of the Federal Deposit Insurance Company Improvement. As in Shrieves and Dahl (1992), Argarwal and Jacques found that the new regulation exerted pressure by positively affecting the capital ratios of undercapitalised banks to a larger extent that other banks with lower leverage.

Building on the Jacques and Nigro (1998) model, Editz, Michael and Perraudin (1998) aimed at answering two main questions: 1) Does pressure from regulators affect bank capital dynamics when capital ratios approach their regulatory minimum? and 2) by adjusting which items in their balance sheets do banks increase their capital ratios when subjected to regulatory pressure.

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[101] See Zellner and Theil (1993). As we are to mention in Chapter 5 this method could provide more efficient estimators if the model is perfectly identified. Otherwise it will have important consistency problems as all parameters are calculated simultaneously via a maximum likelihood procedure (see Green 1997).

The sample consists of quarterly data of 94 UK banks from 1989 to 1995. They use a partial adjustment model in which they regress the ratio of risk-weighted capital to total assets against a set of explanatory variables of target capital (similar to those used by Dietrich and James (1983)) and a lagged value of the dependent variable. The estimation is done by using random effects panel estimation in which the residuals are AR(1), instrumental variables as suggested by Hatanaka (1976) are utilised for obtaining unbiased estimations.

An interesting improvement in the literature by Editz, Michael and Perraudin (1998) is the inclusion of a variable incorporating a gap or range in which different degrees of regulatory pressure are exercised. This gap starts at point B in Figure 4.1 in which regulatory pressure starts and intensifies until it gets to a minimum level A. Point A would represent the point at which it is no longer viable to proceed with a bank's operations and an early intervention should be required from regulators. Points B to C represents the range of capital that will neither call for regulatory intervention for being scarcely capitalised or drastic market punishment by the market for being too capitalised so the cost of having such a high capital base outweighs its benefits (from C to D). More interestingly, this gap varies between banks and is taken to be proportional to the time-series standard deviation of the bank's own capital ratio. This would reflect the fact that most banks would favour maintaining a level of capital above the minimum standards among other things to have a convenient capital buffer to protect the institution from unpredicted shocks. Furthermore, this *'excess capital'* is very likely to be proportional to the past variability of the banks' capital ratio.

Figure 4. 1 Capital ratio

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Source: Estrella, Park, and Peristiani (2000), p.3.

The results show that *'capital requirements do seem to affect bank behaviour over and above the influence of the banks' own generated capital targets'* (See Editz et al, 1998, pg.21). Furthermore, banks appear to achieve adjustments in their capital ratios primarily by directly boosting their capital rather than through systematic substitution away from assets penalised with high-risk weights in the calculation of risk weighted assets ratios.

Rime (2001), uses the Shrieves and Dahl (1992) model for a sample of 154 Swiss banks from 1989 to 1995, the definition of their variables is almost identical to that of Shrieves and Dahl (1992). As with Shrives and Dahl (1992), they find that regulatory pressure induces banks to increase their capital. Yet unlike previous studies, this increase in capital is not accompanied by an increase in risk, which the authors put down to the effect of regulatory costs derived by the institutions, which are incurred by excessive risk-taking.

From the early studies examined from Section 4.2.1.1 to this section, the main objective of the empirical literature has changed from analysing whether financial regulation is effective to seeing whether imposed capital requirements create incentives to increase bank risk-taking. Hence, as financial de-regulation has increased and banking capital is playing an increasingly important regulatory role, the issue of banking risk has received growing academic attention. Given that the issue of how to measure banking risk is problematic, in Section 4.3.2 we look at previous empirical studies dealing with different research questions to see how they have tackled this problem. For our purposes, it is interesting to briefly mention the studies by Furlong (1988) and Sheldon (1996) that, unlike previous studies that use accounting measures of risk, use a more sophisticated measure of risk to test whether bank capital requirements have increased bank risk-taking. By using volatilities derived from stock market prices of banks, both studies found that volatility increased after the introduction of the Basle Accord (1988). Yet, the fact that volatility rose both for banks, which were adequately capitalised, and for those that were not, provides little evidence that the implementation of the Basle Accord (1988) had an effect on banks' portfolios. The main problem of these studies is that they do not account for other influences that affect risk-taking over the period of study so their conclusions could be distorted by these omissions.

4.2.3 Two additional models on capital levels: Berger (1995) and Estrella, Park and Peristiani (2000)

Two studies have analysed the relationship between capital levels and banking risk using a different methodology from the previous literature.

Berger (1995) analyses the relationship between capital levels and return on equity in US banks. Theoretically, other things being equal, this relationship should be negative for three main reasons:

- Increased capital tends to reduce bankruptcy risk so that it would lower the equilibrium expected return by investors;
- Lower leverage reduces the tax shield for banks derived from the

deductibility of interest rates payments;

- Reduced leverage may depress earnings by lowering the value of access to flat-rate deposit insurance.

However, Berger found the relationship between capital and ROE in the US to be positive in the late 1980's. Hence, the author runs several econometric tests to ascertain which possible hypothesis can explained these results. First the author runs Granger causality tests between ROE and capital including a series of control variables likely to affect earnings: concentration, size, individual bank dummies, time dummies, efficiency, growth of deposits and risk. Then they run the causation from capital to the different components in earnings to try to determine through which channel capital is associated with higher earnings. Finally, three measures of portfolio risk-taking are regressed against capital, earnings and the previous explanatory variables.

The Granger causality tests showed that that the main reason for the positive relationship found between capital and earnings was the so-called bankruptcy hypothesis. In other words, because of factors making banks riskier during the late 1980s, a large majority of banks were undercapitalized. Those banks that reacted quickly and raised capital were rewarded with a lower cost of funding and higher ROE. A by-product result of the model is the finding that banks that increased their capital ratio also tended to reduce their portfolio risk. Hence, in a period of increased risk, the relationship between capital and risk is negative. Finally, these results were more evident for those banks with the lower amount of capital.

Estrella, Park and Peristiani (2000), investigate whether there is any informational content in terms of risk of failure, derived from the simple capital to total assets ratio as opposed to risk weighted capital ratios so they construct an empirical model to be applied to a sample including all US FDIC banks that failed or stayed in business from 1989 to 1993. Tables of frequency analysis and descriptive statistics and Probit regressions were used. Regarding the Probit model, the probability of failure is regressed against the leverage ratio, gross revenue ratio and risk weighted ratio to total assets on a yearly basis. Their results show that capital to assets ratios (simple leverage ratios) and gross revenue ratios predict failure much better than more complex risk weighted ratios over the short term (one or two years).

4.2.4 Capital levels and operative efficiency: Efficiency literature, Berger and De Young (1997) and Kwan and Eisenbeis (1997)

Recently, two studies by Berger and De Young (1997) and Kwan and Eisenbeis (1997), have tried to supplement the established literature by looking at the determinants of bank capital and risk by taking into account bank efficiency. Although some of the previous models had incorporated an accounting proxy for bank efficiency[102] among the determinants of capital augmentation and risk-taking, Berger and De Young (1997) and Kwan and Eisenbeis (1997) specifically include more sophisticated indicators of efficiency in their models (see Section 4.3.3).

In the empirical bank efficiency literature, (briefly outlined in the following section) a large number of studies estimate X-efficiency and then regress these efficiency indices against a set of explanatory variables that typically incorporate the capital positions of the institutions, and generally also include a proxy for banking risk (see Berger and Humphrey, 1997 for a review of this literature). This literature tends to find that lower capitalised banks with lower asset quality also tend to operate inefficiently compared to their counterparts. Furthermore, cost efficiency tends to be related to management quality and negatively related to the likelihood of failure.

Also, a recent branch of the efficiency literature incorporates risk and capital as explanatory variables inside the production function equations (introduced by Hughes and Mester, 1993), as both variables are expected to have a substantial impact on the calculation of the cost/profit efficiency values. According to Berger and De Young (1997), if we consider that risk is an exogenous factor to efficiency, say because of a regional downturn (see Berger and Humphrey, 1997), then it would make sense to include the variables in the production function when calculating efficiency indicators.

[102] Normally operating costs to total assets see for instance Berger (1995), or Mayne (1972).

Yet in the case where risk can be considered an endogenous factor, it would not be appropriate to include risk in efficiency calculations.

The main research question of Berger and De Young (1997) is to see whether operating efficiency could be an early indicator of excessive bank risk-taking as previous studies found that, firstly, failing banks tended to be inefficient (See De Young and Whalen, 1994, and Wheelock and Wilson, 1995) and secondly, that cost efficiency tends to be related to examiners' rating of bank management quality (see Peristiani, 1996). Given that it is becoming increasingly clear in the literature that efficiency, risk and capital are strongly related[103], Berger and DeYoung (1997), use the Granger causality on a panel of US commercial banks from 1985 to 1994 to distinguish between four mutually non-exclusive hypotheses which are likely to affect the relationship between banking risk and efficiency:

- Under the *'bad luck hypothesis'* ($\Delta NPL \rightarrow \nabla EFF$), an external event (for instance, default of a particular sector to which the bank had lent strongly) produces an increase in non-performing loans and a decline in efficiency simultaneously. Under this hypothesis, it is expected that increases in non-performing loans precede decreases in cost efficiency;

- Under the *'bad management hypothesis'* ($\nabla EFF \rightarrow \Delta NPL$), it could be that managers are bad both at controlling operating expenses and, at the same time, at controlling and managing the banks' portfolio;

- Under the *'skimping hypothesis'* ($\Delta EFF \rightarrow \Delta NPL$), banks devote fewer resources to monitoring and underwriting loans so that the institution appears to be initially more cost efficient but eventually a higher proportion of loans become non-performing; and

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103 See Gorton and Rosen (1995), Hughes and Moon (1995), Jensen (1986) and Stultz (1990) and Kwan and Eisenbeis (1997). This argument is developed further in the presentation of our model in the next chapter.

- Under the *'moral hazard hypothesis'* ($\nabla CAP \rightarrow \Delta NPL$), banks with low capital have incentives to increase bank risk-taking. Under this hypothesis low financial capital is expected to precede bank risk-taking.

In order to test for the above mentioned hypotheses Berger and DeYoung (1997) ran the following system of equations:

$$NPL_{i,t} = f_1(NPL_{lag}, X-EFF_{i,lag}, CAP_{i,lag}, RWA_{i,lag}, YEAR_t, REGION_i, YEAR_t * REGION_i) + \in_{1,I,t}$$

$$X-EFF_{i,t} = f_2(NPL_{lag}, X-EFF_{i,lag}, CAP_{i,lag}, RWA_{i,lag}, YEAR_t, REGION_i, YEAR_t * REGION_i) + \in_{2,I,T}$$

$$CAP_{i,t} = f_3(NPL_{lag}, X-EFF_{i,lag}, CAP_{i,lag}, RWA_{i,lag}, YEAR_t, REGION_i, YEAR_t * REGION_i) + \in_{3,I,T}$$

Where the dependent variables are:

NPL = (RISK) Non-performing loans to total loans ratio;

X-EFF = (EFFICIENCY) cost efficiency of the bank, that is how close the bank is to the estimated industry best-practice cost frontier in that year;

CAP = (CAPITAL) capital to total assets ratio;

Control variables

RWA = (BASLE RATIO) Risk weighted assets to total assets ratio that aims to account for regulatory induced portfolio composition;

YEAR = (DUMMY FOR YEAR) Accounting for the macroeconomic environment;

REGION = (DUMMY FOR REGION).

The subscript lag indicates that four lagged values of all dependent variables are included in the equation.

Their results suggest that declines in bank capital generally precede increases in non-performing loans, indicating that thinly capitalised banks may respond to moral hazard incentives by taking increased portfolio risk. According to the authors, this event will be particularly relevant if there is an overall macroeconomic shock which can leave an important proportion of banks below their optimal capital level (as found in Berger 1995), maybe because of a sharp macroeconomic contraction. Regarding the relationship between efficiency and risk, Berger and DeYoung (1997) found that problem loans precede reductions in measured cost efficiency. Hence cost efficiency could be a leading indicator of problem loans.

Finally, Kwan and Eisenbeis (1997) use a simultaneous equation framework to investigate the relationship between bank leverage, and the incentives for managers towards risk-taking and engaging in inefficient behaviour. As in Berger and De Young (1997), the authors argue that there are important theoretical reasons in the literature to believe that these three variables might be endogenously dependent. The endogeneity arises from three key factors, namely moral hazard, agency theory and information asymmetries, which are likely to affect the tradeoffs between capital, risk and efficiency and might explain the heterogeneous reactions to changes in one of the variables (in terms of the other variables) by different institutions. Given that this model provides the basis for the empirical analysis presented later in this thesis, the following chapter presents a detailed analysis of the Kwan and Eisenbeis (1997) model.

Kwan and Eisenbeis (1997), use a US sample of 352 banking organisations from 1986 to 1995, which are divided into four size classes based on total assets. Regarding the dependent variables, cost X-efficiencies are obtained as in Berger and De Young (1997) by using the stochastic efficient frontier methodology. To specify the cost function, five outputs and three measures of input prices are included. Interestingly, and unlike most efficiency studies, an output representing non-interest income is also included, recognising the increasing importance of this item in the profit and loss accounts. Credit and interest rate risk are measured via accounting items. The item representing banking capital is represented by the ratio of book value of capital to total assets. Hence, risk, efficiency and capital represented endogenous variables in the simultaneous equation system. The equations are estimated by using pooled time-series observations of a panel of 325 US holding companies, using the two-stage least squares method separately for each of the four size classes of banks. The main features of the Kwan and Eisenbeis (1997) model are presented below:

(1) $BADLOAN = f(GAP, CAPITAL, C\_INEFFICIENCY, RELOAN, CILOAN, GROWTH, GROWTHSQ, TIME\_EFFECT\_DUMMIES)$

(2) $GAP = g(BADLOAN, CAPITAL, C\_INEFFICIENCY, SLOPE, VOLATILITY)$

(3) $CAPITAL = h(BADLOAN, GAP, C\_INEFFICIENCY, ROA, SIZE, TIME\_EFFECT\_DUMMIES)$

(4) $C\_INEFFICIENCY = k(BADLOAN, GAP, CAPITAL, GROWTH, GROWTHSQ)$

Where the endogenous variables would be:

BADLOAN	=	proxy for credit risk (past due and non-accrual loans to total loans);
GAP	=	proxy for interest rate risks (difference between assets and liabilities with outstanding maturity below one year to total assets in absolute value);
CAPITAL	=	ratio of total equity to total assets;
C_INEFFICIENCY	=	estimate of firm-specific cost or operating inefficiency from the stochastic cost frontier.

And the exogenous variables:

RELOAN	=	proxy for portfolio composition (ratio of real estate loans to total assets);

CILOAN	=	proxy for portfolio composition (ratio of commercial loans to total assets);
GROWTH	=	proxy intended to capture linear features in the amount of loan growth (one-year rate growth of total loans);
GROWTHDQ	=	proxy intended to capture exponential features in the amount of loan growth square of one rate growth of total loans;
SLOPE	=	slope of the yield curve derived from 30 year constant maturity and three month treasury securities;
VOLATILITY	=	standard deviation of the 30-year constant maturity treasury yield over the preceding three months;
ROA	=	earnings (Return on total assets);
SIZE	=	size (log of total assets);
TIME_DUMMIES	=	Macroeconomic regulatory effects (time effects dummies).

Kwan and Eisenbeis (1997) found a positive effect of inefficiency on risk-taking, supporting the moral hazard hypothesis under which poor performers are more vulnerable to risk-taking than high performance organisations. Furthermore a significant positive relationship between equity and efficiency is also found. This result was expected, as if we consider capital more costly than debt, then a rise in capital (particularly if it is precipitated by the regulators), might raise pressure on banks to reduce operating costs in order to offset higher financial costs. Interestingly, a U-shaped relationship between inefficiency and loan growth is also found, indicating that operating efficiency improves at a decreasing rate as loan growth increases. Hence, a sustainable loan growth probably improves efficiency whereas excessive growth rates reduces bank cost efficiency.

4.2.5 Summary of the empirical literature on bank capital and risk

From an econometric point of view, it is clear that the different techniques used in the empirical literature have become increasingly complex and probably more accurate and reliable over time. The first wave of empirical work employed OLS estimators over cross sectional data, the analysis has been evolving towards the use of more sophisticated techniques such as panel data, logit models, simultaneous equations, partial equilibrium and time series econometrics models. This has allowed the researcher to solve problems that were presented in the early literature such as the existence of endogeneity problems among variables (first solved by the work by Marcus, 1983) in the case of cross sectional data, or of volatility clustering in the case of the financial time series. In addition, the use of more accurate techniques have allowed for a better estimation of the elasticities of the different factors when determining capital changes.

This improvement in model estimation has also allowed for the specification of more comprehensive models in which several interactions could be calculated simultaneously, or the impact of specific variables could be detected more clearly. Moreover, the explanatory variables (see Appendix VIa) included in the models have become sophisticated and they probably reflect better the economic concepts that these explanatory variables are aiming to capture.

Regarding, the results, we have seen that earlier studies were sceptical about the effectiveness of banking capital regulation on affecting bank managers' target ratios (see Peltzman, 1970, Mayne, 1973, or Dietrich and James 1983) These earlier studies also emphasised the need to control for other factors to limit risk-taking such as the influence of a deposit insurance flat fee rate or the effect of high nominal interest rates (see Marcus, 1983). More recent empirical studies analysing the effectiveness of capital adequacy regulations and the relationship between increases in banking capital and risk tend to find that capital regulation in banking has been effective in increasing capital ratios without substantially shifting their portfolio and OBS exposure towards riskier assets (see for instance Shrieves and Dahl, 1990 and 1992, Editz et al. 1997 and Rime, 2001). Interestingly, these articles express concerns as to whether these results would still hold in recent years given that financial innovation has made the Basle 1988 risk weights less meaningful (see Appendix IVb). Also, increased competition and more expensive cost of capital would make risk-taking incentives (in order to make up for the lost returns needed to increase capital ratios) more compelling.

Based on this criticism and on the theoretical work of several authors (see for instance Benston, 1998), Berger (1995) and Estrella et. al, (2000) look only at capital levels and find that under certain conditions simple capital to total assets ratios could be important indicators of lower probability of bankruptcy (Estrella et al., 2000) or higher profits under a macroeconomic situation that leaves most banks undercapitalised (Berger, 1995). Finally, Berger and De Young (1997) and Kwan and Eisenbeis (1997) also use capital levels but also emphasize the importance of including operating efficiency in their empirical models. Their results show that efficiency could be an important indicator of bank risk-taking and moral hazard incentives. Table 4.1 provides a tabulated overview of the empirical literature.

Table 4. 1 Selected empirical models analysing the relationship between capital and risk

Author and goal of the study	Methodology	Results	Comments
Rime (2001) analyses the relationship between capital and risk in Swiss banking. The main research question is to see whether capital adequacy regulations have been effective in Switzerland.	Identical model to Shrieves and Dahl (1992) for a sample of 154 Swiss banks from 1989 to 1995. Three stage least squares estimator is employed.	Capital adequacy requirements are effective in inducing banks to increase their capital but they do not affect the level of risk.	It is probably the first continental European study applying this methodology. Yet, the definition of banking risk is probably subject to criticism.
Estrella, Park and Peristiani (2000), To see whether there is any informational content in terms of risk of failure, derived from simple ratios.	A database with all US FDIC banks that failed or stayed in business from 1989 to 1993. They use Frequency analysis, and probit regressions.	The simple leverage ratio and gross revenue ratio predict failure as well as more complex risk weighted ratios over the short-term horizon (one or two years), so they may deserve to be included in the new revised Basle framework.	Although the model is simple it serves its purpose of finding not only the determinants of failure but also the variables associated with it and showing the importance of relatively simple measures.
De Bondt And Prast (2000). The study aims to assess empirically the determinants of changes in bank capital ratios in the 1990's and to see whether banks' responses are consistent across countries.	The authors have an unbalanced panel of 448 banks from Germany, France, Italy, the Netherlands, UK and the US for the years 1990 to 1997. The model is calculated by multivariate linear regression in an empirical equation of the change in the Tier 1 ratio and total adequacy ratio against a series of individual bank and industry variables. Endogeneity problems are avoided by lagging bank specific variables in one period. A capitalisation dummy is also incorporated into the model.	The main conclusions are: 1) the increasing competition in the 1990's have led to small decline in the capital to total assets ratio in recent years, 2) Although in Europe, there has been an increase in OBS activities next to an increase in the capital to total assets ratio, this trend is expected to be reversed as the continental European system becomes more similar to the US system. Besides the increased concern towards shareholder value in continental Europe could lead to a decline in the capital ratios as the cost of capital becomes higher in line with their Anglo-Saxons counterparts. 3) The author's present anecdotic evidence that there has been an increased amount of banking risk taken in relation to the amount of capital held in several of the studied countries.	Interesting paper, as it modified techniques used for the US into a multicountry and mainly European data set. The conclusions in terms of the relationship between capital positions, OBS activity and competition are interesting as they are bound to become more acute with the full implementation of the Single Market for Financial Services, that could lead to banks having less than the socially optimal of a socially optimal amount of capital at least in the short term.

Author and goal of the study	Methodology	Results	Comments
Wagster (1999). Assuming that there was a credit crunch in the early 1990's in the US, (see Wessel, 1992). This author looks at capital and risk developments to distinguish among the main possible supply side arguments cited by Berger and Udell (1994) for this development. The four supply side non-mutually exclusive hypothesis are: 1) The credit crunch was a voluntary reaction by banks that intended to reduce risk, 2) The higher regulatory scrutiny by regulators was the main incentive for banks to replace high risk loans by government securities, 3) The Basle Accord was the main factor responsible for this switch toward less riskier securities, 4) absolute (unweighted) capital to total assets ratios are behind the credit crunch.	Two parts: from a sample of 52 large Canadian, German, Japanese, UK and US banks over the period 1986-1992 and 1990 to 1992. Changes in different measures of capital (tier I and total capital against risk weighted assets and against total assets) are analysed by simply comparing accounting ratios over time. Then, the analysis of banking risk is undertaking using a modified version of the Kane and Unal (1987) two-index model using a switching regression technique to identify changes in the systematic and unsystematic risks of asset portfolios.	Both demand and supply considerations are required to explain the early 1990's credit crunch. As expected, in most countries the early 1990s credit crunch is explained by a combination of several factors, the exception is the UK for which the higher regulatory scrutiny is the really relevant hypothesis. For the rest of the countries, and although combined with other hypotheses, this would be the hypothesis carrying most weight. More importantly for some of the countries, there was an increase in the capital ratios coupled with an increase in systematic risk in the banking sector, supporting the Kane (1991) arguments that indicated that the Accord could actually foster financial instability as shown by some of the theoretical models in Chapter 3. (See for instance Kim and Santomero (1988), Keeley and Furlong (1990), and Rochet(1992).	Interesting literature review, as although there was a substantial literature on the early 1990s credit crunch in the US, its application at the international level is a useful exercise as the literature was virtually non-existent. However, the existence of several institutional factors affecting the non US are not considered, namely the introduction of the single market, German unification and a lag in the economic cycle. The first part of the paper could also be improved with an econometric analysis.
Aggarwal and Jacques (1998). Evaluate the impact of the new laws (FIDICIA) promoting prompt corrective action in 1991, as a deterrent of moral hazard behaviour.	The Shrieves and Dahl (1992) model is used for a sample of 2500 Federal Deposit Insurance Corporation insured banks over the period 1990 to 1993. A dummy variable is also included to distinguish between adequately capitalised banks and undercapitalised banks that are more likely to be under pressure after the introduction of the Federal Deposit Insurance Company Improvement.	As in Shrieves and Dahl (1992), they found that the new regulation exerted pressure by positively affecting the capital ratios of undercapitalised banks to a larger extent than other banks with higher capital ratios.	Possible improvements in the model could be interesting particularly in the case of the explanatory variables. Also, there were other important factors that occurred in the early 1990's that are not taken into account such as the acute economic crisis and the effect of the Basle Accord.

Author and goal of the study	Methodology	Results	Comments
Editz, Michael and Perraudin (1998). Attempt to answer two main questions: 1) Does pressure from regulators affects bank capital dynamics when capital ratios approach their regulatory minimum? and 2) By adjusting which items in their balance sheets do banks increase their capital ratios when subjected to regulatory pressure?.	The authors use quarterly data for 94 banks from the supervisors' database from 1989 to 1995. They start by defining a segment in which regulatory pressure is exerted upon the bank. The buffer is limited by a trigger ratio (minimum that a bank must comply) and a target ratio, the closer the value to the trigger ratio, the stronger the regulatory pressure would be on banks. The model used is a dynamic multivariate panel regression model in which changes in capital ratios depend on the lagged level of the capital ratio and a number of variables reflecting the nature of the bank's business and its current financial health that proxied for the bank's internal capital target. The estimation is done by using random effects panel estimation in which the residuals are AR (1), instrumental variables as suggested by Hatanaka (1976) are utilised for obtained unbiased estimations. Switching regressions according to the values of the regulatory dummy.	According to the authors, *'capital requirements do seem to affect bank behaviour over and above the influence of the banks' own generated capital targets'*. Furthermore, banks appear to achieve adjustments in their capital ratios primarily by directly boosting their capital rather than through systematic substitution away from assets penalised with high-risk weights in the calculation of risk weighted assets ratios.	Interesting study with rigorous single equation econometrics. The definitions of accounting risk are not convincingly included in the model. In addition, their sophisticated econometric analysis has an important flaw as their results show that their estimated adjustment rate exceeding one, meaning that the banks are overshooting the target every year.
Barrios (1998). Analyses the effectiveness of the capital adequacy regulation on the Spanish banking sector.	Sample of an unbalanced panel of 152 Spanish commercial and saving banks from 1985 to 1991. Dynamic panel data estimation of an integrated market and regulatory model by using instrumental variables GMM (Arellano and Bond 1988), by looking at the determinants of changes in capital.	Despite changes and an overall trend towards the convergence in the capital positions of commercial banks, the effect of regulation has been very limited, and both market pressures and strategic factors were the main causes of capital changes in banks. In the case of the saving banks, regulation has been clearly effective in boosting capital ratios.	Rigorous development of the empirical model from the theoretical models recently developed in the literature. The variable operative cost could probably be further improved by a more sophisticated measure.

Author and goal of the study	Methodology	Results	Comments
Kwan and Eisenbeis (1997). The study tests several hypotheses about the interrelationships among bank risk, capitalisation and operative efficiency.	The authors use TSLS (two stage least squares) with efficiency, bank risk and capital as dependent variables regressed against various other dependent variables and a set of exogenous variables. Efficiency scores are calculated from a stochastic frontier. The model is applied to a panel of 325 US bank holding companies from 1987 to 1995.	A positive effect of inefficiency on risk-taking is found. This finding supports the moral hazard hypothesis as it indicates that poor performers are more likely to engage in risk-taking. Also excessive loan growth is found to be counterproductive as it is conducive to more inefficiency. Finally firms with higher capital are found to operate more efficiently than less well-capitalised institutions.	The definition of efficiency could be improved by considering also a profit measure of efficiency. Also, the use of a market measure of banking risk is economically more meaningful than accounting measures of risk.
Berger and De Young (1997). Test several hypotheses regarding the relationships among loan quality, operating efficiency and bank capital.	The authors use Granger-causality techniques and OLS estimators to a sample of more than 5000 US banks (69742 observations) over the period 1985 to 1994.	Cost efficiency may be an important indicator of problem banks. Also reductions in capital at thinly capitalised banks precede increases in problem loans.	The issue of possible simultaneity is not considered. Also, as in Kwan and Eisenbeis (1997), only accounting measures of credit risk are supposed to proxy for overall bank risk. Finally, loan growth is not included among the exogenous variables.
Carbo (1993). Tries to analyse the effects of regulators' capital requirements on Spanish banks.	Two methods are used, an estimation process accompanied by a survey methodology among different managers of the main Spanish banks. The estimation procedure is similar to that of Dietrich and James, but the period of study would be 1987-1990, and there were other variables included such as, access to capital markets and liquidity, specific features of the Spanish financial system are also considered,	The model seems to fit Spanish savings banks better than private banks and the regulatory variable does not seem to explain the behaviour of private banks. In the case of savings banks, it seems that the regulatory variables have been effective. Besides, there are not clear signs regarding the effect of deposit insurance on capital flows.	Interesting combination of two different sets of procedures to the same problem. Also, it is one of the first works to apply this framework to a non-US dataset.
Haubrich and Wachtel (1993). Under the assumption that there has been a portfolio shift by US banks after 1989 towards government securities, the authors investigate to what extent is this shift due to regulation, macroeconomic developments, losses, or larger supply on government securities.	The authors utilised US bank data from the 1973-1993 period. Their sample includes a comprehensive panel of microeconomic and also macroeconomic data to account for possible effects due to the economic cycle.	Regulation has been a major determinant for the shift towards government securities. Hence, regulation is likely to have influenced a credit crunch in the US in the very early 1990's.	There are substantial difficulties in distinguishing among the different hypothesis, and between target, and exogenous shocks particularly during that period.

Author and goal of the study	Methodology	Results	Comments
Dahl and Shrieves (1992). They try to analyse the relation between capital and risk position. In addition, they also look at whether capital changes are a consequence of banking regulation or other factors.	The authors use a simultaneous equations model (capital variations and risk variations), which includes two variables that account for the impact of capital adequacy regulations. The first one is a dummy variable that is equal to one for banks that have a larger capital position than that required by the regulators and zero otherwise. The second is an interactive variable that accounts for the effect that the regulation will have on the speed of adjustment in the institution capital position.	Target capital levels and speed of adjustment were higher for entities with lower capital levels, indicating that capital regulations were effective at least partially. Yet, also in banks with high capital levels the market pressure on capital demands can also be observed.	As the authors consider a pool of data instead of a panel, they do not take into account that capital decisions can be influenced by factors that are specific to each banking institution, such as risk adversity.
Dahl and Shrieves (1990) aim to answer the question of whether capital levels are a direct consequence of the market pressure, or the result of regulations external to the firm. Specifically the variables studied are the volume of capital augmentations via shares issuance.	The analysis is undertaken using a multi step procedure. First, the authors separate the sample between those institutions subject to regulations and those which are not (practically between those institutions undercapitalised and those adequately capitalised), then the model parameters that predict the likelihood of capital augmentations in banks that are not subject to regulatory interference. Secondly, the former model is utilised for banks subject to capital regulations, and the results to estimate the aggregate proportion of banks that would receive capital flows in absence of regulation. Thirdly, comparing the actual proportion of capital augmentations against previous results also tests the hypothesis that the regulation has been effective. The econometric procedure is a binary logit model.	For banks with capital levels larger than those demanded by the regulation, the results are consistent with the existence of market pressures that force the banks to keep capital levels above regulatory minimum. Also, banks with lower capital levels had a higher probability of issuing capital than adequately capitalised banks. The logit analysis indicates that the proportions of capital augmentations realised were higher to that which would have occurred in absence of regulation.	An element that the authors do not consider is that many institutions may present capital levels above the required level just to have an important cushion against potential punishment costs derived from having a ratio below the required level.

Author and goal of the study	Methodology	Results	Comments
Wall and Peterson (1987). The authors try to answer the question whether capital levels are a consequence of market requirements or a result of the capital adequacy regulation.	Two models are constructed: one in which market pressure is predominant incorporating the entities with optimal capital ratios above from those of the regulators, and a regulatory model for firms that have a lower optimal capital ratio below that demanded by the regulation.	A maximum likelihood model, and a partial adjustment procedure are utilised. The results show that most bank holding companies were satisfied with their capital ratios in 1989. However, the regulators appear to have been placing effective pressure in the early 1990s.	The variables selection is to an important extent ad-hoc, as although they are based on existing literature or on intuition, they do not come from a model that considers them in a comprehensive manner.
Dietrich and James (1983). The authors try to analyse whether the regulatory effort regarding capital adequacy is effective.	The authors replicate the analysis of Mingo (1975), but with a different sample, so that they could avoid the effects that regulation Q (that affected interest rates paid to US depositors) could have had on Mingo's results.	The regulation was not effective in any of the years studied.	Endonegeity among the variables appears in the definition of the accounting proxies for banking capital. The justification of the results regarding the insurance deposit variable also appears to be excessively cumbersome.
Marcus (1983). Analysis of the factors determining capital decisions by banks.	The author includes two alternative variables accounting for capital regulation. Panel data methodology within the framework of a model of partial adjustment is utilised. The model endogeneity is corrected by the use of instrumental variables from the model.	The capital adequacy regulation variables offer, in the first case, a different sign to that expected and the second variable is not significant. The author argues that the regulatory variables may not be correct, he also deduces from the model results that the regulators do not judge banks according to their capital level but rather on their capital level in relation to other banks.	There is no explanation given as regards why individual effects should be included in the model. Besides the second regulatory variable that compares the ratio average capital for the sample of banks and individual capital in each period is probably not adequate, as the average sector ratio does not necessarily incorporate the regulators objective capital ratio.

Author and goal of the study	Methodology	Results	Comments
Mingo (1975). Studies whether regulators have been capable of incrementing banking capital when it was considered insufficient and the substitution of capital for the deposit insurance scheme.	Modified analysis from the Peltzman methodology, but with individual banking observations incorporated. The regulatory variable is not linear as it is defined as the inverse relationship of current capital over regulatory capital. The variable for the insurance deposit guarantee is defined as the ratio actual capital over regulatory capital. The method of estimation is a multivariate linear regression model with 1970 cross-sectional data.	The regulatory variable is significant and has the expected result, indicating that the results support the hypothesis that the regulator influences banks' capital decisions. Hence banks capital regulation has been effective. Yet, it has not avoided some substitution of capital for deposit insurance. Banks with the lowest actual capital over regulatory capital are those more successful in substituting capital for subsidy.	The proxy representing deposit insurance is not completely appropriate as it also incorporates the concept of risk. The concept of endogeneity appears as the regulatory variable depends on the dependent variable and instrumental variables are not employed.
Heggestestad and Mingo (1975). Try to determine whether bank holding companies keep lower capital positions, other things being equal than other banks apart from keeping a higher risk levels.	Two multivariate equations are utilised for cross sectional data in the years 1970 to 1972. The equation regresses the level of the capital/assets ratio against a set of explanatory variables. The second equation analyses changes in banking capital, as well as the speed of adjustment at which this process takes place. Finally, the author tests whether this final result is the product of the affiliation to a bank holding company, and or due to the fact that banks had a deficit of capital before forming the holding company.	Bank holding companies have lower capital ratios than independent banks and accumulate capital at a lower rate. Despite the fact that the coefficient of the banks affiliated to a bank holding company is lower than the independent banks in the first equation, this does not explain the important capital reduction after the bank joins the holding company. Consequently the authors relate this problem to the creation of the bank holding company.	The regulatory variable is defined as a dummy variable that takes a value of one if the banking institution belongs to the Federal Reserve, so that it could assess the regulatory pressure. Yet, there could be other characteristics common to institutions which belong to the Federal Reserve that influence their capital position apart from regulatory pressure to those institutions that do not belong to the Federal Reserve.

Author and goal of the study	Methodology	Results	Comments
Mayne (1972). Determines whether regulators influence capital decisions by the banks. The author focuses on the study of the impact of the differential American regulators on the banks demand for capital.	Both econometric and survey methodologies methods are employed. The econometric methodology involves a cross section multivariate linear regression. The data comes from financial institutions operating in the fourth district of the Federal Reserve from 1962 to 1968. As regulatory proxies, the author used dummy variables that indicate the kind of institution to which the observation is referred to, which in turn would reflect the regulatory agency supervising their operations.	Regulation is not effective, as the coefficients of the regulatory variables are not significant and are inconsistent over the time. According to the author different regulators have different capital requirements, but they have a limited effect on the capital due to the resistance of the banking managers to additional pressure for capital.	The variables employed as regulatory proxies are not very appropriate as it is not clear that they can only and exclusively assess the impact of regulation.
Peltzman (1970). Analyses whether capital adequacy regulation has been effective. Namely, the author studies whether capital volumes would be different to those existing if there were no capital regulation. In addition, the author also explores whether regulators managed to avoid the substitution between capital and the deposit insurance scheme.	Banking capital investment model in which the differences between goal capital and actual capital are included. The dependent variable is defined as the percentage change in banking capital in a state within the US, the independent variables subject to attention are the lagged values of regulatory capital ratios. By using statewide data, the method of estimation is a multivariate linear regression model with 1963-1965 cross-sectional data.	The regulatory variable coefficient is negative. So according to the model, capital regulation is not effective. Also, capital regulation has not prevented banking institutions substituting capital for deposit insurance.	The sampling is not correct as it assumes one state observation represents all the banks from the state. The definition of a linear relationship between the variation of capital and the regulatory variable that assumes a constant regulatory pressure independent of the capital level of the entity may not be appropriate. There is also an endogeneity problem as the regulatory variable depends on the dependent variable.

4.3 Measurement of the variables capital, efficiency and risk in the empirical banking literature

Once the empirical literature dealing with banking capital and its relation with banking risk and efficiency has been reviewed, before introducing our empirical model in Chapter 5, it is also necessary to provide a brief literature review concerning how the empirical literature has calculated proxies accounting for capital, risk and efficiency. We will start this review by indicating the arguments for using accounting or market values for capital (Section, 4.3.1) and risk (Section, 4.3.2) measures, and then, in the last section (Section, 4.3.3) we turn our attention at the issue of how bank efficiency proxies are now calculated in the empirical literature.

4.3.1 Capital measurement: accounting or market values

Clearly, in order to be useful, capital should be measured with reasonable accuracy. Equity capital can be defined as the residual claim of the bank (see Berger et. al, 1995) that is its value would be equal to the economic value of all assets minus the economic value of other liabilities[104]. Hence, the calculation of its value is a difficult task as its measurement depends on how all other claims are measured.

The issue of whether to use accounting or market values for the capital variable in empirical models of bank behaviour has been prominently debated in the literature (see Keeton 1988, Peterson 1987 or Yenetani and Katsuo, 1998). Overall, the main results of this literature indicate that whenever possible the impact of bank capital regulation should be evaluated using market values. Yet, these market values should discount the value of the option provided to bank managers by the Deposit Insurance Scheme. The main advantages of using regulatory modified market values as opposed to market values would be:

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[104] Net of the value of limited liability, as factors such as the access to the safety net do affect the actual value of the bank.

- Accounting measures often fail to recognise the real value of the different items as they reflect historical values;
- Another related flaw from accounting figures is that they do not include either risk positions or future expected income from items; and
- Accounting valuations also offer some room to manoeuvre to managers to modify or delay the reporting of the accurate value of items. In addition, until the incorporation of off-balance-sheet (OBS) exposures into the accounts of banking capital charges, banks could incur regulatory arbitrage simply by increasing their OBS exposure without increasing their capital accordingly.

In practise, almost all[105] the studies in the empirical banking literature include capital by using accounting values for two main reasons (see for instance Kwan and Eisenbeis, 1997, Berger and De Young, 1997, Rime 2001, Shrieves and Dahl, 1992, Jacques and Nigro, 1998). First, and due to the asymmetries of information between managers and external agents, to obtain market valuation for banks not quoted on the stock markets is complex as only a few of the bank's assets and liabilities are traded on well-organised secondary markets. Secondly, market value changes would not only reflect changes in the solvency of the institution but also its attitude towards risk which, in turn, would be affected by other factors such as the fiscal treatment of debt or strategic considerations of the institution. For these two reasons, as can be seen in the next chapter, our model will incorporate accounting values of capital.

[105] Marcus (1983) provides an exception.

4.3.2 The issue of banking risk in the empirical banking literature

4.3.2.1 Introduction

The purpose of this section is to look briefly at how the issue of banking risk has been modelled in the empirical literature. Although all the studies that deal with the topic of capital and risk and the effectiveness of financial regulation that we are aware of use accounting measures of banking risk, Section 4.3.2.2 looks at the advantages and disadvantages of using measures of risk derived from the financial accounts of the firm or constructed measures of banks risk derived from market indicators. Then, Section 4.3.2.3 looks at a diverse literature that has modelled banking risk. Finally, (although this kind of literature is not precisely related to our research question) two articles that analyse the issue of banking risk empirically in Europe, will serve as an illustration.

The issue of banking risk in the empirical banking literature

As noted in previous chapters, concerns about risk in the banking industry have played a major role in the development of bank capital regulation. This case has been stronger in countries or regions that have gone through substantial financial deregulation. As we have seen earlier, banking regulators are permanently trying to strike a balance between efficiency and stability. This balance is important in light of the nature of the banking firm and is largely based on the role played by information asymmetries. Clearly, information asymmetries make the riskness and capital positions of banks difficult to discern by external observers. In fact, despite the importance of the concept of banking risks, both for regulators and for researchers, there are only a limited number of academic studies that deal specifically with the issue of banking risk from an applied perspective. Among these studies, for our purposes, we could distinguish among those studies that incorporate into their empirical estimation a market proxy of risk and those studies that use an accounting measure.

All the studies analysed in the literature reviewed in the previous section use accounting data such as non-performing loans (see for instance Berger and De Young, 1997), loan loss reserves or loan loss provisions (see for instance Berger, 1995), or

Basle-type capital to risk weighted total assets ratios (see for instance Shrives and Dahl, 1992). However a main limitation of these measures is that they consider only credit risk. Other studies also attempt to complement these indicators with accounting proxies for liquidity such as the amount of liquid assets to redeemable deposits (see for instance Mayne, 1972) or interest rate risk by calculating an accounting related proxy for the interest rate gap or the duration position of the bank (see for instance Kwan and Eisenbeis, 1997). Yet, all accounting variables have a series of disadvantages derived from the fact that:

- They represent past actions of the firm. Moreover, the accounting lag would be to an important extent dependent on the firms' management who have some timing discretion over these lags;

- Another problem will be derived from the actual representativeness of accounting data and particularly data regarding portfolio quality in European banking, as accounting standards and conventions still could differ from one country to another. This is particularly the case for the accounting of provisions and non-performing loans.

However, the obvious advantages of using accounting data stem from the fact that:

- An important amount of commercial banks are not quoted on the stock market (most savings and cooperatives and credit institutions are not quoted) as some of them are not large enough, are privately owned, or have belonged until recently to the public sector. Hence by using accounting data we could access a larger sample size of banks for empirical investigation;

- The use of accounting data allows us, to a certain extent, to focus on specific aspects of risk and to distinguish between accounting leverage, credit, liquidity or interest rate risk.

As with accounting indicators of banking risk, the use of market indicators, is also subject to asymmetries of information between bank managers and external observers but has several major advantages:

- Market indicators of banking risk reflect all information available to the market place and cannot be altered by managers of a firm;
- Unlike accounting indicators, market prices are forward looking; and
- They will reflect a more comprehensive measure of banking risk than accounting values, as they will incorporate all aspects of risk.

Indicators of banking risk derived from stock market prices would also have certain disadvantages. Firstly, there is a problem of sample size and how representative of the overall population our sample would be, as the large majority of banks are not rated or quoted on the stock market. Secondly, market prices, incorporate other influences not strictly derived from the risk position of the banking institution but also other factors such as changes in the overall market, or liquidity factors of a given stock.

How the applied banking literature has considered the issue of banking risk by extracting information from market indicators

Although none of the studies in our literature review incorporate measures of bank risk derived from information on market indicators (see Table 4.2), there are other branches of the applied banking literature which have constructed different measures of banking risk derived from such indicators. Our main interest is not to offer a detailed analysis of this literature but just to consider briefly how the issue of calculating these proxies of banking risk is tackled by other empirical banking studies (see Table 4.3).

Table 4. 2 Empirical literature on the relationship between capital and risk- Measures of banking risk

Author	Type of data	Frequency	Aim to measure	How the risk proxy is calculated
Rime (2001)	Accounting	Yearly	Portfolio risk	-Risk weighted assets to total assets. -Provisions to total assets.
Editz, Michael and Perraudin (1998)	Accounting	Quarterly	Portfolio risk	-Total provisions to risk weighted assets. -Risk weighted assets to total assets.
Jacques and Nigro (1997)	Accounting	Yearly	Portfolio risk	-Risk weighted assets to total assets.
Kwan and Eisenbeis (1997)	Accounting	Yearly	Portfolio risk Interest rate risk	-Past due loans and non accrual loans to total loans -One-year maturity GAP: ratio of the difference between assets and liabilities that mature within one year to total assets.
Berger and De Young (1997)	Accounting	Quarterly	Portfolio risk	Non performing loans to total loans
Berger (1995)	Accounting	Annual	Portfolio	-Risk weighted assets to total assets. -Non-performing loans to total assets. -Net charge-offs to total assets.
Carbo (1993)	Accounting	Yearly	Portfolio risk	- Public sector securities to total assets. -Non-performing loans to total loans.
Shrieves and Dahl (1992)	Accounting	Yearly	Portfolio risk	-Capital to risk weighted assets -Non performing loans
Dietrich and James (1983)	Accounting	Yearly	Portfolio risk	Treasury securities to total deposits
Marcus (1983)	Accounting	Yearly	Portfolio risk	Government bonds to total assets
Heggestad and Mingo (1975)	Accounting	Yearly	Portfolio risk	Government securities to total assets.
Mayne (1972)	Accounting	Yearly	Portfolio risk	-Ratio of US government bonds to total assets and -Net charge offs to loan income
Peltzman (1970)	Accounting	Yearly	Portfolio risk	Ratio of US government bonds to total assets.

We can distinguish two types of indicators of risk constructed from financial markets information according to the source of the data. First, there are studies that use stock market prices to calculate a proxy for risk and studies that use other sources such as rating agency information or information from bond prices. The studies included in the first group use stock prices to calculate:

1. Descriptive statistics: normally the annual standard deviation of weekly or monthly returns of individual institutions (see Gropp and Vessala, 2000);

2. The problem with descriptive figures is that they also incorporate other influences such as volatility due to the overall stock market. Hence, a large number of studies use different variations of the CAPM (capital asset pricing model) in which typically stock market returns of individual banks are regressed against returns of the overall stock market minus bond yield returns. This allows the researcher to obtain measures of the beta and intrinsic risk of the company, which are normally used as proxies for banking risk. This basic model is usually extended in two ways:

    i. By using two/three index models where bank returns are regressed against stock market returns and generally other variables, normally to account for interest rate risk. For example Saunders et al. 1990 include the slope of the yield curve. Other studies also add other items such as a proxy for duration (Kwan, 1991) or for basis risk (measured as the difference between the prime rate and the interbank rate as in Wetmore and Brick, 1998) to take account of interest rate risk.

    ii. By making the econometric procedure more sophisticated various studies use GARCH (General autoregressive conditional heteroskedasticity models), or switching regression models, to control for volatility clustering and structural changes in the parameters respectively. (See Hyytinen, 1999, and Neuberger, 1991). Other models have used econometric techniques such as SURE (seemingly unrelated estimators, See Chong, Liu, Altunbas 1995) or Factor Analysis (see Demtsetz and Strahan, 1995).

iii. Other models also use the market value to book value indicators. The assumption is that riskier banks are likely to have a low market to book value as they will be penalised by the markets to a larger degree than banks with less risk. Although this is a reasonable assumption, it will not always hold. As shown in Figure 3.4 there will be a threshold at which if the bank is sufficiently undercapitalised for the amount of risk which it has taken, shareholders will favour a *'go for broke'* strategy at the expense of depositors and bondholders. Moreover, there will be a point at which the economic value of the portfolio in relationship with its capital will be that low that the interest of the bondholders will be aligned with those of shareholders so that incentives for taking additional risk will be even higher.

Finally, various studies rely on data provided by rating agencies (see Morgan 1997, or Poon, Firth and Fung, 1999), or on corporate bonds spreads (see Calomiris, 1993) to measure banks' risk. These two indices have obvious advantages, among them, the fact that they are measures of risk in which the interest of bondholders and regulators will be aligned to a large extent. In the case of ratings, a main drawback is that they are categorical data and the fact they may not be fully accurate as rating agencies may also reflect agency problems of their own. An obvious problem from spreads arises from the fact that only a very limited amount of financial institutions issue subordinated debt particularly in Europe.

Table 4. 3 Measures of banking risk using market data

Author	Type of data	Frequency	How the risk proxy is calculated
Gropp and Vesala (2000)	Accounting Market	Daily converted into Annual	Yearly standard deviation of stock returns.
Poon, Firth and Fung (1999)	Market	Variable	Bank ratings are used.
Hyytinen (1999)	Market	Weekly	Bank sector returns modelled with GARCH effects, and break defined by banking crises.
Weltmore and Brick (1998)	Market	Weekly	Bank returns are regressed against market returns, interest rate returns, returns on the foreign exchange index and change in spread between the prime rate and an average between the FED funds rate and LIBOR. Chow tests are used to account for possible structural breaks.
Galloway, Lee and Roden (1997)	Market	Weekly converted to yearly	Standard deviation of individual bank returns.
Morgan (1997)	Market	Annual	Rating agencies data, which is transformed into an ordinal scale that accounts for individual bank risk.
Dewenter and Hess (1997)	Market and macroeconomic	Monthly	Bank returns are regressed against the market returns, a variable accounting for country default, a variable accounting for interest rate risk and a final variable accounting for macroeconomic factors. SURE estimators are used in the regression.
Chong, Liu, Altunbas (1995)	Market	Weekly (converted from daily)	Bank returns are regressed against the overall market returns changes in the yield curve and several dummies. SURE estimators are used in the regression.
Demtsetz and Strahan (1995)	Market	Weekly	Use Factor Analysis to calculate two proxies one accounting for systematic and another accounting for firm-specific risk.
Bruni and Paterno (1995)	Market	One observation per bank	Spreads between the yield to maturity from major banks minus yield to maturity from government bonds.
Neuberger (1991)	Market	Monthly	CAPM model incorporating a second variable accounting for interest rate risk.

Author	Type of data	Frequency	How the risk proxy is calculated
Kwan (1991)	Market	Monthly	Bank index regressed against the market and interest rate index in which a proxy of duration is incorporated SURE methodology is used to calculate the model.
Cooper, Kolari and Wagster (1991)	Market	Weekly	Two index mode in which bank returns are regressed against the all market returns and changes in interest rates.
Saunders, Strock and Travlos (1990)	Market	Daily into yearly	- Deviation of returns -CAPM model incorporating short term and long term interest rates to calculate also an interest rate risk proxy.

4.3.2.3.1 Banking risk in Europe-Some empirical evidence

Although not directly linked with our literature review on capital and risk, the present section aims to consider briefly two studies that deal indirectly with the topic. Hyytinen (1999) that models conditional volatility of banking stocks in Scandinavian countries. The author uses a symmetric GARCH model in which he shows that there has been a regime shift in volatility as a consequence of the recent (1991-1992) Scandinavian banking crises. He also finds evidence for volatility spillovers across countries during banking crises.

The second study by Gropp and Vessala (2000) is also interesting as it incorporates into an empirical framework some of the conclusions derived from models developed in the theoretical literature. Their paper focuses on the relationship between the introduction of an explicit deposit insurance regulation in the EU and its possible implications on the risk-taking strategy of European banks. The main underlying hypothesis is that the introduction of deposit insurance has in fact reduced the extension of the safety net. This in turn has reduced incentives for moral hazard and risk-taking.

By using several proxies to account for banking risk (namely non-performing loans, market value to book value and stock market volatility), the authors improve the consistency of their results.

More interestingly, the role of moral hazard as well as the different incentives of shareholders and stockholders are incorporated by considering the charter value and the amount of subordinated debt of the institution under the hypothesis that lower charter value and more subordinated debt will reduce risk-taking incentives as they will mitigate moral hazard. In the case of subordinated debt, it is clear that an increase of subordinated debt will reduce moral hazard for managers as they are going to be penalised more readily by uninsured debt holders. In the case of charter value, the authors (given that only the largest banks are considered) relate large charter value with the existence of *'too big too fail'* problems.

Overall, they find that the introduction of an explicit deposit insurance scheme reduces risk-taking by banks and, as expected, banks with lower charter values and a larger proportion of subordinated debt will reduce risk-taking to a larger degree than other banks. Finally, the introduction of deposit insurance does not mitigate 'too-big-to-fail' problems, as larger institutions do not change their risk-taking policies in response to the introduction of deposit insurance.

Consequently, both studies suggest that there could be incentives for risk-taking in European banks, derived either from excessive lending after deregulation (Hyytinen ,1999), or the existence of a flat rate deposit insurance (Gropp and Vessala, 2000).

4.3.3 The measurement of banking performance: Efficiency

Section 4.2.1 of this chapter dealt with the literature concerning the impact of banking capital regulation and that examines the determinants of the capital and risk relationship. Most of these studies do not consider the issue of operating efficiency directly but typically include an accounting ratio, (such as a cost to income or cost to total assets ratio) which is used as a proxy for bank efficiency (this variable has been included as explanatory variable in various studies such as Mayne, 1972, Carbo, 1993, or Berger, 1995). However, some recent studies have recognised the likely importance that the concept of bank efficiency plays affecting the different hypotheses (namely moral hazard, agency problems, regulatory action and charter values) relating the capital and risk-taking positions of financial institutions (see Kwan and Eisenbeis, 1997, Berger and De Young, 1997, and Hughes and Mester, 1998). Consequently, as mentioned earlier in this chapter, the studies by Berger and De Young (1997) and Kwan and Eisenbeis (1997) have incorporated in their models a proxy of bank efficiency derived from the productive efficiency literature. Rather than offer a detailed explanation of the efficiency studies, this section only aims to give a brief overview of how the current efficiency literature calculates estimates of bank efficiency.

The literature that focuses on bank efficiency measurement is another important branch of the empirical banking literature. This has developed in parallel to the literature evaluating the potential impact of capital adequacy regulation. The main goal of the efficiency literature is to measure more accurately the performance of financial institutions, normally by using methods first utilised in the fields of agricultural and industrial economics. However, although the business of banking involves assessing and managing risks, and the issue of bank capital is also likely to affect bank behaviour, most bank efficiency studies have typically ignored risk and bank capital issues (see Hughes and Mester, 1998). A brief overview of the bank efficiency literature is provided in the following section.

4.3.3.1 Introduction to bank efficiency

As we have seen in Chapter 2, the intensive process of transformation and deregulation that has taken place in the banking industry has forced bank managers and regulators to concentrate on the efficiency of the financial institutions to ensure their competitive viability. As a result, there has been a significant academic effort directed towards the measurement of financial firm efficiency (see Berger and Humphrey, 1997).

Although the concept of efficiency is intuitively clear, namely to produce in an optimal manner, it is not straightforward to ascertain how to obtain a quantitative meaningful measure representing that concept. In the microeconomics literature, producers will be characterised as efficient if they have produced as much as possible with the inputs they have actually employed and if they have produced at the minimal cost. Moreover, the concept of efficiency used is relative so by efficiency, the authors try to characterise the relationship between observed production and some ideal or potential production. Overall, researchers have identified three main kinds of efficiencies: scale, scope and X-efficiencies.

- Scale efficiencies refer to the potential benefits derived from banking size, defined by the relationship between firm's average cost curve and its marginal cost curve. Thus, economies of scale exist if, assuming a constant product mix, a bank faces declining average costs as size expands;

- Scope economies are referred to as the savings obtained from producing multiple goods and services jointly by the same organisation rather than by different firms. Thus, the sharing of inputs such as personnel, technology, and marketing costs across multiple outputs constitutes the major source of such potential savings;

- The concept of X-efficiencies is usually defined by exclusion and referred to the efficiency differences that do not arise from scale and scope economies. The concept is not straightforward, not only because it is not easy to distinguish its effects from the scale and scope ones (i.e. to hold constant size and product mix), but also because there is an array of factors that can be considered when an objective measure of this factor is to be obtained. In general, it implies the optimisation of technical and allocative behaviour, which usually arises from technological and managerial factors. In the case of technical efficiency, it reflects the ability of the firm to obtain maximum output from a given sets of inputs, and allocative efficiency which indicates the ability of a firm to use the inputs in optimal proportions given their respective prices and the production technology. Both components combined provide a measure of total economic efficiency, and when cost instead of production is considered, it would provide a measure of cost efficiency.

Although economies of scale (and to a lesser extend economies of scope[106]) have been extensively studied over the last forty years, (from the pioneering work of Benston, 1965, to the most recent work of Hughes, 1999), the literature does not seem to provide conclusive evidence on the economic significance of these factors (Kwan 1996). In fact, in their review of the efficiency studies in banking, Berger, Hunter and Timme (1993) documented that X-efficiencies appeared to be greater than the effects of scale and scope economies, indicating that X-efficiencies accounted for 20% or more of the costs in banking, while scale economies are found to account for less than 5% of the costs. Consequently, in our later analysis we will only consider X-efficiency when we look at capital and risk in European banks. Therefore in the next section we shall only consider briefly the different methods that are available to calculate banking X-efficiencies.

4.3.3.2 Estimating X-Efficiencies for banking firms

As there is no consensus regarding the best method for determining the best practice frontier against which relative efficiencies are measured, we shall briefly indicate the main methods as well as their main advantages and limitations. Then, we will examine in greater detail the method chosen and the reasons for choosing this approach.

The methods differ mainly in terms of:

- The functional form of the best practice frontier;
- Whether or not a random error is taking into account;
- Regarding the distribution of the random error (if a random error is taken into account).

According to our first criterion, we can divide the techniques into two main approaches, namely parametric and non-parametric techniques. In parametric techniques, an explicit form for the cost/profit/production function is assumed, whereas

[106] See Molyneux, Altunbas and Gardener (1996) for a wide review of the literature in Europe.

in non-parametric approach, no functional form is assumed apart from line interpolation between certain data points. According to these latter methods, deviations of an observation from the theoretical maximum or minimum are attributed solely to the inefficiency of the firm. Conversely, in the case of the parametric techniques, the specification of the frontier is assumed to be determined both by the production function and by random external factors such as luck or unexpected disturbances in a related market.

Among the most common estimation techniques are: Data Envelopment Analysis (DEA), and Free Disposal Hull (FDH). The DEA is based on Farrel's (1957) theory of production frontiers and production probability sets. Technically, DEA is a deterministic mathematical programming method based on linear programming in which the efficient frontier (either cost, profit or production function) is approximated through an envelope of hyperplanes in the input/output space. The distance between the value for each firm and the frontier is used as the efficient or best practice frontier. The free disposal hull, (FDH), is a special case of DEA in which the points on lines connecting the DEA vertices are not included in the frontier.[107] The main advantage of these non-parametric methods is that they do not impose any constraint regarding the specific form of the underlying production function. Yet, an important shortcoming of these techniques is that they generally assume that there is no random error in the data so measurement errors and others factors, which were present in an individual banking data, may be reflected in the efficiency estimators. In others words in DEA the best practise frontier is defined by outlier rather than the whole sample, hence it the approach is sensitive to extreme observations and to sampling and measurement errors.

The three main parametric approaches are the stochastic frontier approach (SFA), the distribution free approach (DFA) and the thick frontier approach (TFA). All of them are based on econometric tools, in which a best practice frontier is established and the efficiency levels are determined after removing random errors that might affect the institution positions. These methods differ mainly in the assumed distributions of the errors, rather than the functional form estimated. The thick frontier approach (TFA)

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[107] Instead, the FDH production possibilities set is composed only of the DEA vertices and the free disposal hull of the points interior to these vertices (Humphrey and Berger, 1997).

assumes that deviations from predicted performance values within the highest and lowest performance quartiles of observations represent random errors, while deviations in predicted performance between the highest and lowest quartiles represent inefficiencies (Berger and Mester, 1996). Hence, the efficiency estimates are obtained against the most cost /profit efficient 25% of firms, rather than against the single most profitable firm. This method is, therefore, not useful when we aim to obtain single efficiency estimates for individual firms, but rather it can provide a firm basis for determining the efficiency of an industry. Unlike the thick frontier approach, the distribution free (DFA) estimates of efficiency can provide the researcher with individual firm-level estimates of efficiency. The main advantage of the DFA is that it does not impose '*a priori*' assumptions on the distributions of efficiency and random error in order to separate one from the other, yet it assumes that cost differences owing to X-efficiencies are persistent while random errors tend to average out over time. Consequently, only one efficiency estimation can be obtained for each firm over the period analysed. Moreover, this method would not be useful if a firm's efficiency is changing within the period studied due to regulatory reform, technical changes, or any other factors such as general macroeconomic factors.

As in the distribution free approach, the stochastic frontier approach (SFA), applies a functional form for the cost, profit and production function (which could include environmental factors), and incorporates a random error term. This error term is divided into two independent components. The first one is a random error, which is assumed to follow a symmetric distribution. The second part will be the inefficiencies, which are assumed to follow an asymmetric distribution (the most commonly utilised distributions are the half normal, the exponential, the gamma and the truncated normal). Despite its limitations regarding the distribution of the random errors, the SFA provides the efficiency level of each firm for each given point in time. For this reason, we chose to use the SFA in our later empirical analysis linking banks capital, risk and efficiency. More detail on the SFA approach is outlined below.

4.3.3.3 The Stochastic Frontier Approach (SFA)

Aigner, Lovell and Schmidt (1977) and Van den Broeck (1977) independently proposed the stochastic frontier production function, in which a banking firm's observed total costs (or profits) are modelled to derive from the cost (profit) efficient frontier due to random noise and X-inefficiency. The production frontier can be modelled as follows:

$$ln(y_i) = x_i\beta + \varepsilon_i \qquad i = 1,2,3,\ldots,N.$$

Where:

lnY_i	is the dependent variable, normally cost or profit, in the case of the cost frontier, $lnY_i=lnTC$;
$X_i\beta$	is a production function, in which Xi is a (K)-vector including the variables, whose first element is 1, in our case $X_i\beta=f(lnQ_i+lnP_j)$. Where Q_i are measures of banking output, and lnP_j are input prices, β is a (K) vector of unknown parameters;
$\varepsilon_i= v_i - u_i$	is a two-component disturbance term

Following Aigner et. al. (1977) we could assume that the error of the production is distributed as follows:

$$\varepsilon_i= v_i - u_i$$

Where V_i represents a random uncontrollable factor and u_i is the controllable component of the error term. The underlying idea is that deviations from the production "frontier" might not be entirely under the control of the agent being studied. As in Aigner et al. (1977), V_{is} assumed to be independent and identically distributed (i.i.d.) normal random variables with zero mean and constant variance σ_v^2 independent of the u_is which were assumed to be i.i.d. exponential or half normal random variables. As we mentioned before, the imposition of a particular statistical distribution (such as the exponential or half normal) are important limitations of the model. Several researchers have attempted to overcome this limitation by specifying more general distributional forms, such as the truncated- normal (Stevenson, 1980) and the two parameter gamma (Greene, 1990), which allow for a wider range of distributional -shapes.

Regarding the production function, recent empirical studies (see Berger and Humphrey, 1997) use the Translog (transcendental logarithmic functional form), which is a member of the so-called flexible functional forms[108]. These provide a second-order local approximation to any functional form. Originally developed by Christensen, Jorgenson and Lau (1971), and extended to the multiple output case by Burguess (1974) and Diewert (1974), the translog is a second-order Taylor series approximation of an arbitrary function at a point, which required that the own and cross price elasticities of demand be free to attain any set of theoretically consistent values.

According to Molyneux et. al. (1996)[109], to estimate the translog cost function the following properties should be met if production and cost function theories are to be fully integrated:

a) *Homegeneity.* The cost function is homogeneous of degree one in input prices;

b) *Cost exhaustion.* The sum of cost shares is equal to unity. Cost exhaustion requires that the value of the i inputs is equal to total cost;

c) *Symmetry.* Second order outputs and inputs parameters must be symmetric;

d) *Non*-negativity. The cost shares and the cost elasticities must be non-negative;

e) *Monoticity.* The cost function is increasing in the input prices and in the level of output.

[108] "In these functions there the common characteristics of linearity in parameters and the ability to provide second-order approximations to arbitrary functions" (Molyneux, Altunbas and Gardener. 1996)
[109] Following (Jorgenson (1986).

Mitchell and Onvural (1996) and Berger, Leusner and Mingo (1994), use, Gallant's (1981) Fourier-Flexible non-parametric form for the cost function to create the X-efficient frontier. The Fourier Flexible form represents a semi-nonparametric approach to the problem of using data to infer relationships among variables when the true functional form of the relationships is unknown[110]. The Fourier Flexible form consists of a linear combination of the sine and cosine function that allows the function to overcome some serious limitations of the translog functional form. Firstly, as Mitchell and Onvural (1996) indicate, when using a parametric method, as one does with the translog, the hypothesis that the bank industry's true cost function has the translog form is maintained. If this hypothesis were false, misspecification errors can occur affecting our statistical tests. By using the Fourier Flexible, we attempt to avoid holding any maintained hypothesis by getting the data to reveal the true cost function's form through a large number of fitted parameters. Increasing the number of parameters reduces approximation error while increasing the variance of test statistics used in hypothesis tests. Secondly, this semi-nonparametric approach secures the advantage of being the conjunction of close mathematical approximation and desirable statistical properties (Gallant 1982). This combination is not found with flexible functional forms based on Taylor series approximations such as the Translog.

In most banking efficiency studies incorporating the Fourier Flexible, the production specification, incorporates both a standard translog and pure Fourier trigonometric terms, following Gallant's (1981) suggestion to combine Taylor and Fourier series approximations. Furthermore, this specification allows also for testing of the possibility that the translog is a superior specification.

Before the calculation of the efficiency scores, the researcher has to decide which outputs and inputs to include in the model. The identification of inputs and outputs is a more difficult problem in the banking industry than in other industries. The

[110] Gallant (1981,1982), Elbadawi, Gallant, and Souza (1983) and Gallant and Souza (1991), describes the Fourier Flexible comprehensively, see for instance Altunbas, Evans and Molyneux (1997), for an application of this function to European banking.

main conceptual difficulty would be the definition and measurement of what constitutes banks' output given the wide range of services that a banking institution provides to its customers. According to this criterion, the bulk of empirical studies can be broadly divided into two categories, according to whether they follow the production or the intermediation approach. The main practical difference between the two approaches lays in the different treatment given to deposits, which is treated as an output in the production approach and an input in the intermediary approach.

Table 4.4 offers an overview of how European cross-country studies have estimated bank efficiency and how they have selected inputs and outputs as well as the modelling approach used. A better understanding of how previous studies have modelled the issue of bank efficiency in Europe, is necessary for the construction of our model outlined in the next chapter. This following chapter explains the methodological and econometric aspects of the modelling approach to be adopted in our study.

Table 4. 4 Selected empirical European models calculating efficiency measures from a cross-country perspective using SFA or DFA methodologies[111]

	MODEL	AREA	Y1	Y2	Y3	Y4	Y5	P1	P2	P3	TC/PROFIT	Z1
			LOANS	DEPOSITS	NON-INTEREST INCOME	OTHER EARNING ASSETS	OBS/ OTHER	PRICE LABOUR	PRICE OF CAPITAL	PRICE OF BORROWED FUNDS		
Goldberg and Rai (1996)	SFA	European countries	All loans – (reserves for credit losses + unearned income)			All others earnings assets		(Staff wages and salaries)/ (Number of employees)	Capital and occupancy expenses/ Fixed capital	Total interest expenses/ Total bearing liabilities	Total operating and interest cost	
Allen and Rai (1996)	SFA DFA	14 OECD countries	Traditional banking assets.					(Staff wages and salaries)/ (employees)	Capital and occupancy expenses/ capital	Total interest expenses/ liabilities	Total operating and interest cost	Time du-mmies
Altunbas (1997)	SFA	European Union	Total aggregated loans			The dollar value of aggregate securities	The dollar value of OBS activities	Salaries and employee benefits/ Total assets	Occupancy and fixed assets expenditures/ Net premises and fixed assets	Interest paid on total funds/ Total funds	Total operating and financial cost	
EC (1997)	SFA	European Union	Total loans	Customer and short term funding		Total securities		Average annual wage per employee	Total capital expenses/ Total assets		Total operating and financial cost	Dummy variable of size
Vennet (1998)	SFA	European Union	Loans		Non interest revenues	Securities		Salaries and other personnel expenses/numbe r of employees	Depreciation and occupancy expenses/net fixed assets	Interest deposits/interest bearing liabilities	Total operating and financial cost Profit= all interest and non-interest earnings minus interest and operating cost.	Financial capital
Dietsch, Ferrier, and Weill (1998)	Fourier with DFA	European Union	Loans	Demand deposits		Other earning assets	Time deposits	Personnel expenses/ (All deposits+ All loans)	Other non interest expenses/Total assets	Interest paid/All funding	Total operating and financial cost	
Pastor et al. (2000)	DFA SFA	European Union	Loans	All deposits		Other earning assets		Personnel cost/total assets	Plant and equipment expenditure/ K	Financial costs/ financial liabilities	TC=financial and operatingo	Time effects

111 SFA indicates Stochastic Frontier Approach, DEA indicates Data Envelopment Analysis and DFA indicates Distribution Free Approach. TC or Profit indicates whether the model calculates a cost or profit efficiency function, and Z1 indicates whether the model incorporates other explanatory variables when calculating the efficiency scores.

Table 4.4. (continued) Selected empirical European models calculating efficiency measures from a cross-country perspective using nonparametric methodologies.

	Model	Area	Output 1	Output 2	Output 3	Output 4	Input 1	Input 2	Input 3	Input 4	Z1
Brown (1996)	DEA	European Union	Non interest income	Gross interest income			Cost of labour	Other operating cost	Tier 1 capital	Interest paid	
Perez et al. (1995)	DEA Malquist Indices	5 Largest EU countries and US	Loan nominal values	Deposit=customers and short term funding (demand, savings, interbank, other)	Other productive assets		Personnel expenses	Non interest expenses			
Dietsch and Weill (1998)	DEA Malquist indices	European Union	Loans	Demand deposits	Time deposits	Other earning assets	Labour	Other non interest expenses	Other funding (long term borrowing)		
Casu and Molyneux (2000)	DEA	5 Largest EU countries	Total loans	Other earning assets			Total cost=(interest expenses, non-interest expenses, personnel expenses)	Total deposits=(total customers and short term funding)			Country dummy Equity/ Total assets ROE Commercial/ non commercial Quoted/ non quoted

4.4 Conclusion

This chapter has analysed the literature that examines the effects of capital adequacy regulation on banks' behaviour. Although the earlier literature found that in that financial regulation does not appear to be effective, later empirical studies tend to find that capital regulation in banking has been effective in increasing capital ratios without substantially shifting banks' portfolios and OBS exposure towards riskier assets. Yet some of these later studies express concerns as to whether these results would continue to hold in the future. In addition, two recent studies find that under certain conditions, simple capital to total assets ratios could be important indicators of lower probability of bankruptcy or higher profits under a macroeconomic situation that leaves most banks undercapitalised. Berger and De Young (1997) and Kwan and Eisenbeis (1997) also emphasise the importance of including operating efficiency in empirical models investigating capital and relationships as their results show that operating efficiency may be an important indicator of bank risk-taking and moral hazard incentives.

Given the importance of measuring capital, risk and efficiency appropriately, the second part of this chapter was devoted to how the applied banking literature has measured these variables. Section 4.3.1 considers whether banking capital has to be measured using accounting or market values. Section 4.3.2 shows how the empirical banking literature has measured banking risk, concluding that although none of the studies in our literature review use market values of banking risk, the use of this type of indicators seems to be more appropriate. Finally, Section 4.3.3 explains how the empirical banking literature calculates banking efficiency. The following chapter outlines the modelling approach to be adopted in this thesis to examine the relationship between capital, risk and efficiency in European banking during the 1990s.

CHAPTER 5

DATA AND METHODOLOGY

5.1 Introduction

This chapter begins by outlining the methodological and econometric aspects of the approach to be adopted in this study in order to analyse the empirical relationship between capital, risk and efficiency in European banking. The previous Chapters 3 and 4 illustrated that the existing theoretical literature on the determinants of bank risk-taking, and hence studies that examine relationships between a bank's capital and risk position often yields conflicting predictions. The main reason for this is that most of the hypotheses are non-exclusive. For instance, agency cost and information asymmetry problems[112] may have a significant impact on trade-offs between risk, leverage and efficiency (see Jensen, 1986, and Schultz, 1990) and this explains why some institutions may react to the increased cost of capital by taking on more risk, and reducing the level of efficiency, while others may increase the level of efficiency and reduce leverage.

Given that theory provides contradictory evidence the only way to determine the relationship between capital, risk and efficiency in European banking is to resort to empirical analysis. As indicated by Berger, Herring and Szego (1995), and more recently by Jackson et. al (1999), empirical research is scant on this topic, particularly in Europe. The aim of this chapter, therefore, is to outline an appropriate methodological approach so as to examine the relationship between bank leverage and risk-taking. The first part of the chapter outlines the methodological approach to be undertaken in our later empirical study. This is then followed by discussion of the data sample. The chapter ends with a descriptive analysis of the variables included in the model specification.

[112] See section 5.2.3 for a detailed account of the different factors that may affect these relationships in light of the different hypotheses included in our model.

5.3 Methodological approach

As with most of the work testing the relationship between risk and capital, we take into account the fact that both variables are dependent on one another, so a simultaneous equation framework will be needed (see Shrieves and Dahl, 1992, Jacques and Nigro, 1997, and Rime, 2001). In addition, as suggested by Hughes and Moon (1995) and Hughes and Mester (1998), capital and risk are also going to be simultaneously determined by the level of efficiency of the banking firm. Hence, building on earlier work by Kwan and Eisenbeis (1997)[113] and Berger and De Young (1997) our work includes a measure of bank efficiency in our simultaneous equation framework. Besides, given that we are more interested in the overall relationship between the levels of capital and risk, the methodological approach to be adopted in our study uses equations of levels rather than changes of studied variables[114,115]. The following two sections commence by briefly reminding the reader of the Kwan and Eisenbeis (1997) approach already considered in the previous chapter. We then show how our modelling approach extends and develops this methodology.

5.3.1 Kwan and Eisenbeis (1997)

Kwan and Eisenbeis (1997) aimed to test several hypotheses about the interrelationships between risk-taking, capitalization and bank operating efficiency. To do so, they employed a model that allows leverage, risk and efficiency to be simultaneously determined so that a simultaneous equation model in which risk, capital and efficiency are used as endogenous variables. As indicated in Chapter 3, due to moral hazard, charter value and agency problem considerations, these variables are likely to be

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113 As far as we are aware, the only works analysing the relationship between capital and risk that take into account the effect of (operative) efficiency would be the studies by Kwan and Eisenbeis (1997) and Berger and Young (1997).

114 As we have seen in Chapter 4, the literature examining the effectiveness of capital adequacy regulations normally uses a partial adjustment framework. Partial adjustment models use a stochastic process in which actual changes in capital are derived from differences between the target capital and the previous period capital position multiplied by a convergence coefficient.

115 See also Berger and Young (1997), mentioned in the previous chapter, for a similar approach using levels and Granger causality to evaluate the relationship between efficiency and risk.

determined contemporaneously (See Berger and De Young, 1997, and Hughes and Mester, 1998). Each of these endogenous variables are regressed against the two other endogenous variables and a set of exogenous variables likely to influence each dependent variable. The precise specification of the Kwan and Eisenbeis (1997) simultaneous modelling framework is as follows:

(1) $BADLOAN = f(GAP, CAPITAL, C\_INEFFICIENCY, RELOAN, CILOAN, GROWTH, GROWTHSQ, TIME\_EFFECT\_DUMMIES)$

(2) $GAP = g(BADLOAN, CAPITAL, C\_INEFFICIENCY, SLOPE, VOLATILITY)$

(3) $CAPITAL = h(BADLOAN, GAP, C\_INEFFICIENCY, ROA, SIZE, TIME\_EFFECT\_DUMMIES)$

(4) $C\_INEFFICIENCY = k(BADLOAN, GAP, CAPITAL, GROWTH, GROWTHSQ)$

Where the endogenous variables are:

BADLOAN	=	proxy for credit risk. (Past due and non-accrual loans to total loans);
GAP	=	proxy for interest rate risks. (Difference between assets and liabilities that with outstanding maturity below one year to total assets in absolute value);
CAPITAL	=	ratio of total equity to total assets;
C_INEFFICIENCY	=	estimate of firm-specific cost inefficiency from the stochastic cost frontier;

And the exogenous variables:

RELOAN	=	proxy for portfolio composition (ratio of real estate loans to total assets);
CILOAN	=	proxy for portfolio composition (ratio of commercial loans to total assets);

GROWTH	=	proxy intended to capture linear features in the amount of loan growth (one-year rate growth of total loans);
GROWTHDQ	=	proxy intended to capture exponential features in the amount of loan growth square of one rate growth of total loans;
SLOPE	=	slope of the yield curve derived from 30 year constant maturity and three month treasury securities;
VOLATILITY	=	standard deviation of the 30-year constant maturity treasury yield over the preceding three months;
ROA	=	earnings (Return on total assets);
SIZE	=	size (log of total assets);
TIME_DUMMIES	=	time dummies variables.

Overall, Kwan and Eisenbeis (1997) find a positive effect of inefficiency on risk-taking, supporting the moral hazard hypothesis under which poor performers are more vulnerable to risk-taking than high performing organisations. Cost inefficiency is found to have a positive effect on capital, possibly indicating that regulators prefer to discipline weaker performers by imposing higher capital requirements on them. The study also found a U-shaped relationship between inefficiency and loan growth, indicating that operating efficiency improves at a decreasing rate as loan growth increases. Hence, a sustainable loan growth probably improves efficiency whereas excessive loan growth reduces efficiency as suggested by the moral hazard hypothesis.

5.3.2 Description of our modeling approach

The methodological approach adopted in this study builds on the study of Kwan and Eisenbeis (1997), Berger and De Young (1997), and to a lesser extent on the models by Gropp and Vessala (2000) and Saunders, Strock and Travlos (1990). Regarding the former, and apart from the fact that we aim to use a different sample of European banks, our approach introduces several innovations in terms of model specification. These are outlined as follows.

First, given that profit efficiency appears to be quantitatively more important than cost efficiency (see for instance Berger and Mester, 2000), we estimate two model specifications, one including cost efficiency and a second replacing cost efficiency with profit efficiency. Moreover, the concept of profit efficiency gives us complementary information, so that it is expected that the inclusion of profit efficiency allows us to distinguish better between the different hypotheses included in our model. Hence we could specify our model as:

MODEL 1 Accounting model with cost efficiency

$$BADLOANS_{i,t} = \beta_0 + \beta_1 CAP_{i,t} + \beta_2 C\_INEFF_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 GROWTHSQ_{i,t} + \beta_5 SLOPE_{i,t} + \beta_6 ROA_{i,t} + \beta_7 SOTA + DUMMY\_VARIABLES$$

$$CAP_{i,t} = \alpha_0 + \alpha_1 C\_INEFF_{i,t} + \alpha_2 BADLOANS_{i,t} + \alpha_3 GAP_{i,t} + \alpha_4 OBSOTA + \alpha_5 SIZE_{i,t} + \alpha_6 ROA_{i,t} + DUMMY\_VARIABLES$$

$$C\_INEFF_{i,t} = \lambda_o + \lambda_1 CAP_{i,t} + \lambda_2 BADLOANS_{i,t} + \lambda_2 SOTA_{i,t} + \lambda_4 GROWTH_{i,t} + \lambda_5 GROWTHSQ_{i,t} + DUMMY\_VARIABLES$$

MODEL 2 Accounting model with profit efficiency

$$BADLOANS_{i,t} = \beta_0 + \beta_1 CAP_{i,t} + \beta_2 P\_INEFF_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 GROWTHSQ_{i,t} + \beta_5 SLOPE_{i,t} + \beta_6 ROA_{i,t} + \beta_7 SOTA + DUMMY\_VARIABLES$$

$$CAP_{i,t} = \alpha_0 + \alpha_1 P\_INEFF_{i,t} + \alpha_2 BADLOANS_{i,t} + \alpha_3 GAP_{i,t} + \alpha_4 OBSOTA + \alpha_5 SIZE_{i,t} + \alpha_6 ROA_{i,t} + DUMMY\_VARIABLES$$

$$P\_INEFF_{i,t} = \lambda_o + \lambda_1 CAP_{i,t} + \lambda_2 BADLOANS_{i,t} + \lambda_2 SOTA_{i,t} + \lambda_4 GROWTH_{i,t} + \lambda_5 GROWTHSQ_{i,t} + DUMMY\_VARIABLES$$

Where the endogenous variables are:

BADLOAN	=	proxy for credit risk. (loan loss provisions to total loans);
MKRISK	=	proxy for overall market risk
CAPITAL	=	ratio of total equity to total assets;
C_INEFFICIENCY	=	estimate of firm-specific cost inefficiency from the stochastic cost frontier;
P_INEFFICIENCY	=	estimate of firm-specific profit inefficiency from the stochastic cost frontier;

And the exogenous variables:

GROWTH	=	proxy intended to capture linear features in the amount of loan growth (one-year rate growth of total loans);
GROWTHDQ	=	proxy intended to capture exponential features in the amount of loan growth square of one rate growth of total loans;
SLOPE	=	Slope of the yield curve derived from 10 years government bonds and three-month money markets treasury bills for every European country in each year;
GAP	=	proxy for interest rate risks. (Difference between assets and liabilities that with outstanding maturity below one year to total assets in absolute value);
ROA	=	earnings (Return on total assets);
SIZE	=	size (log of total assets);

QCHV = proxy measuring the bank charter value *(Q_CHV)* derived from stock market information;

TIME_DUMMIES = time dummies variables.

Secondly, as recognised by Rime (2001), and Shrieves and Dahl (1992), the measurement of banks' risk is quite problematic especially for those institutions that do not have frequently traded securities. A limitation associated with using accounting variables is that even assuming that they accurately reflect portfolio quality, they would do so with a lag (see Chapter 5). Furthermore, managers are likely to have some timing discretion over these measures, and there is evidence that such discretion is exercised in a manner that minimises regulatory costs (Shrieves and Dahl, 1992). In order to minimise these inaccuracies, to the aforementioned, we also estimate two further model specifications (models 3 and 4) where we substitute the accounting measure of bank risk (loan loss provisions to total assets) with three alternative market measures of risk which try to assess the amount of systematic (BETA, beta of the regression of each bank stock prices against the overall market index calculated yearly from daily stock prices), intrinsic (INTRINSIC, residuals of the regression of each bank stock prices against the overall market index calculated yearly from daily stock prices) and overall risk (VOLATILITY, defined as the standard deviation of each bank stock prices calculated yearly from daily stock prices). The main advantage of these measures is that they incorporate not only credit, or interest risk but also can be regarded as more comprehensive risk concepts. In addition, unlike accounting measures, which are backward looking and reported with a lag, market measures of risk, tend to be forward looking. The main inconvenience is that these risk measures can only be obtained for banks that have their stock quoted.

MODEL 3 Market model with cost efficiency[116]

$$MKRISK_{i,t} = \beta_0 + \beta_1 CAP_{i,t} + \beta_2 C\_INEFF_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 GROWTHSQ_{i,t} + \beta_5 SLOPE_{i,t} + \beta_6 ROA_{i,t} + \beta_7 SOTA + Q\_CHV_{i,t} + DUMMY\_VARIABLES$$ (*Table* 6.3) (*Table* 6.5) *and* (*Table* 6.7),

$$CAP_{i,t} = \alpha_0 + \alpha_1 C\_INEFF_{i,t} + \alpha_2 MKRISK_{i,t} + \alpha_3 GAP_{i,t} + \alpha_4 OBSOTA + \alpha_5 SIZE_{i,t} + \alpha_6 ROA_{i,t} + DUMMY\_VARIABLES$$

$$C\_INEFF_{i,t} = \lambda_o + \lambda_1 CAP_{i,t} + \lambda_2 MKRISK_{i,t} + \lambda_2 SOTA_{i,t} + \lambda_4 GROWTH_{i,t} + \lambda_5 GROWTHSQ_{i,t} + + Q\_CV_{i,t} + DUMMY\_VARIABLES$$

MODEL 4 Market model with profit efficiency

$$MKRISK_{i,t} = \beta_0 + \beta_1 CAP_{i,t} + \beta_2 P\_INEFF_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 GROWTHSQ_{i,t} + \beta_5 SLOPE_{i,t} + \beta_6 ROA_{i,t} + \beta_7 SOTA + Q\_CHV_{i,t} + DUMMY\_VARIABLES$$ (*Table* 6.4) (*Table* 6.6) *and* (*Table* 6.8),

$$CAP_{i,t} = \alpha_0 + \alpha_1 P\_INEFF_{i,t} + \alpha_2 MKRISK_{i,t} + \alpha_3 GAP_{i,t} + \alpha_4 OBSOTA + \alpha_5 SIZE_{i,t} + \alpha_6 ROA_{i,t} + DUMMY\_VARIABLES$$

$$P\_INEFF_{i,t} = \lambda_o + \lambda_1 CAP_{i,t} + \lambda_2 MKRISK_{i,t} + \lambda_2 SOTA_{i,t} + \lambda_4 GROWTH_{i,t} + \lambda_5 GROWTHSQ_{i,t} + + Q\_CV_{i,t} + DUMMY\_VARIABLES$$

The variable notation is the same as in models 1 and 2 with the new market risk variables being defined as follows:

The Market risk variable MKRISK can be identified as:

BETA = beta of the regression of each bank stock prices against the overall market index calculated yearly from daily stock prices;

[116] Note that in the results from the first equation should be interpreted with care, as there could be identification problems.

INTRINSIC = residuals of the regression of each bank stock prices against the overall market index calculated yearly from daily stock prices;

VOLATILITY = defined as the standard deviation of each bank stock prices calculated yearly from daily stock prices.

Thirdly, following Keeley (1990) and Gropp and Vessala (2000), and considering that market measures of risk (*MKRISK*) are likely to be influenced by the charter value of the institution, we also use a proxy measuring the bank charter value (*Q_CHV*) derived from stock market information (see Section 3.4.4). As mentioned earlier, since charter values are valuable assets, a high charter value could prevent managers from taking additional risk. Hence, the inclusion of this variable could provide us with additional information of the studied hypotheses. Finally, we have also included the slope of the yield curve as a determinant of bank risk-taking[117]. On the one hand, this recognises the effect of the yield curve on interest rate risk-taking, on the other hand, from a portfolio perspective, developments of the yield curve are also likely to affect the amount of volatility of a portfolio (see Elton and Gruber, 1995).

Consequently, model 3 follows the structure of Model 1, the only two changes being the substitution of the accounting measure of banking risk for a market measure. Also, the first equation that examines the determinants of bank risk-taking includes a bank charter value variable. In Model 4, the cost efficiency variable is substituted with the profit efficiency measure to see whether profit efficiency adds additional information to that provided by cost efficiency as managers could be achieving high levels of operating efficiency at the expense of reduced profits. For example this could be the case in which managers devote fewer resources to screening, monitoring and underwriting loans.

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[117] As Kwan and Eisenbeis (1997) do this on the interest rate risk equation.

Models 3 and 4 are re-estimated using the three different market measures of risk $MKRISK_{i,t}$. As in Models 1 and 2 earlier equations, risk, efficiency and capital are still used as the endogenous variables. The use of Two Stage Least Squares allows us to calculate each equation independently as simultaneity is accounted for in the instrument used to estimate the empirical model. This is useful, as it allows us to present the results from the US models according to the main factors influencing the dependent variables.

The overall structure of our four models allows us to test for various hypotheses. Foremost among these hypotheses is the effect of moral hazard provided by flat-rate deposit insurance, the existence of a safety net, and agency problems between depositors, shareholders, managers and regulators as well as the effects of regulatory actions. The main hypotheses to be tested are outlined below.

The first hypothesis affecting the endogenous variables is the so-called 'regulatory hypothesis' that tests whether higher risk-taking is accompanied by higher capital positions. Hence, a factor contributing to this relationship would be the action of regulators and supervisors (see Aggarwal and Jacques, 1998, Jacques and Nigro, 1997, Shrieves and Dahl, 1992, Perraudin et al. 1998) that would force institutions to increase the amount of capital for each unit of risk taken. An increase in capital, when the amount of risk rises, could also be due to an efficient market monitoring[118] from the markets when the capital positions are deemed inadequate (see Calomiris, 1991 and Berger 1995). According to this hypothesis, the relation between capital and risk is expected to be positive.

If we identity the symbol ↑ as increases in the indicated variable and the symbol ↓ as declines, then according to this hypothesis increases in risk would be accompanied by increases in bank capital due to greater regulatory pressure.

$$\begin{cases} \uparrow \textit{increases in the indicated variable} \\ \downarrow \textit{declines in the indicated variable} \end{cases}$$

↑RISK→↑CAP

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[118] Which could take place from the subordinated debt holders, (see Calomiris, 1999).

An alternative hypothesis suggests a negative relation between risk and capital. This 'moral hazard hypothesis'[119], could be put down to the fact that managers may have incentives to exploit the deposit insurance scheme (see Demirguc-Kunt and Detragiache, 1999), or a particularly generous safety net in which TBTF problems occur (see Gardener and Molyneux, 1998) this may exist particularly when the leverage and risk position of the bank is already high. According to this hypothesis, a negative relationship between risk and capital is expected

↑RISK→↓CAP

The same relationship can be found in the cases where bad managers (see Berger and De Young, 1997) are more likely to be both less efficient in controlling operating costs and are also probably worse than their peers in screening and monitoring loans. This would indicate that an increase in risk (↑RISK) would be accompanied with a decline in operating efficiency (↓C_EFFIC) and more leverage (↓CAP).

↑RISK (and ↓C_EFFIC)→ ↓CAP

As we have seen in Chapter 4, the direction of causality that explains the moral hazard hypothesis could also flow from capital to risk. As indicated by Kahane (1977), Koehn and Santomero (1980) and Kim and Santomero (1988), banks could respond to regulatory actions forcing them to increase their capital by increasing asset risk[120]. Consequently,

↑ CAP →↑ RISK

These two hypotheses could be complicated further if we introduce the effects of 'charter value' and 'agency problems'. Since charter values are valuable assets, institutions that strongly value their charter values (see Keeley,1990, Gropp and Vessala, 2000) could be deterred from pursuing a high risk strategy limiting the effects

[119] For a theoretical discussion of the issue, see for instance Dewatripont and Tirole, (1993), Matutes and Vives, (1995).

[120] See Freixas and Rochet (1997), for a criticism.

of moral hazard. Finally, it could also be that agency problems can affect this relationship, so managers of stockholder-controlled banking firms are more likely to take more risks than managerially-controlled firms as managers cannot diversify their human capital (Saunders, Strock and Travlos, 1990). Although under certain circumstances this may not be the case. According to Gorton and Rosen (1995), in an unhealthy banking industry (more prone to moral hazard), entrenched managers will tend to take on more risk rather than less risk.

In the framework of these two hypotheses, the concept of efficiency can also be included, as risk-taking and the amount of leverage are simultaneously dependent on cost and profit efficiency. Other things being equal, regulators would allow an efficient firm with better management probably more room for manoeuvre.
↑C_EFFIC → ↑RISK.

On the other hand, from a moral hazard point of view, a less efficient firm may be tempted to take on higher risk.

↓C_EFFIC → ↑RISK

Simultaneously, risk affects efficiency (see Berger and De Young, 1997) so that managers who are not very efficient in assessing and monitoring loans, are not likely to be very efficient in achieving a high level of operating efficiency either. Also, it could be more expensive to manage a riskier portfolio in terms of monitoring and costs of recovery than a portfolio with a lower degree of bad loans[121]. This would suggest a negative relationship between risk and cost efficiency (C_EFFIC) and profit efficiency (P_EFFIC).

↑RISK →↓C_EFFIC
↑RISK →↓P_EFFIC

However, the bank may chose to maximise short-term profits by reducing the

[121] Note that a riskier portfolio is likely to be more profitable, so that under this hypothesis, there could be a positive relationship between risk and profit efficiency.

funds devoted to allocating and monitoring loans. In the short-term, this strategy would produce a positive relationship between risk and efficiency.

↑RISK →↓C_EFFIC

Also, the amount of leverage, agency problems and the charter value of the institution should be considered when evaluating the relationship between risk and efficiency. For instance, a firm with a large amount of leverage, low charter value and entrenched management (see Gorton and Rosen, 1995), is more likely to be subject to moral hazard incentives than an institution with a large charter value and higher capital position.

↓C_EFFIC (and ↓CAP + ↓ CHARTER VALUE+ AGENCY PROBLEMS DUE TO ENTRENCHED MANAGEMENT) → ↑RISK

The amount of credit risk in the form of bad loans *(BADLOANS)* is expected to be related to the composition of the institution's asset structure so that the variable of total securities to total assets is included to account for this. The amount of loan growth is incorporated by the inclusion of a one-year growth rate *(GROWTH)* and the square term of loan growth rate *(SQGROWTH)*. The inclusion of *SQGROWTH* allows for a U-shaped relationship between the rate of loan growth and credit risk. Excessive loan growth, which is normally achieved by loosening credit standards, is expected to be conducive to higher portfolio risk.

The amount of interest rate risk assumed by the bank *(GAP)* is expected to be affected by the situation of the bond market so that the slope of the yield curve as well as a measure of volatility of the bond market *(VOLATILITY)* are also included in all model specifications. Apart from inefficiency and risk, leverage is expected to be positively related to earnings *(ROA)* as retained earnings are the main source of augmenting banks' capital. The variable logarithm of total assets SIZE is also included to account for the effect of size in the bank capital position. On the one hand, larger banks may benefit from lower risk due to portfolio diversification and more diversified sources of income. On the other hand, some large banks could use their TBTF (Too Big To Fail) status to operate with a higher leverage. In the equation including inefficiency as a dependent variable, the rate of loan growth is also included (see for instance Salas and Saurina, 1999). The authors argue that whereas a moderate growth rate captures managerial quality, a high growth rate reflects managerial entrenchment, so that the relationship between growth and inefficiency is likely to be U-shaped.

Finally, it is clearer to analyse the abovementioned relationships if the results of the different models are presented according to each dependent variable rather than several sets of models and this is done in the following chapter. Table 5.1 shows the different hypotheses that are tested using the specifications outlined in models 1 to 4 above.

As we have already mentioned, overall, the empirical analysis conducted builds on earlier US work by Kwan and Eisenbeis (1997) and Berger and De Young (1997). The aforementioned shows how we refine this model by including market measures of bank risk similar to that of Saunders, Stock and Travlos (1990) as well as including proxies accounting for charter value (see Keeley, 1990 and Gropp and Vessala, 2000), and profit efficiency.

Table 5. 1 RISK as dependent variable

Dependent Variable	Variables Affecting the Dependent Variable.	Rationale.	
Risk	CAP: Equity to total assets	Changes in the capital are probably a major source of changes in the risk position, as capital constitutes among other things a buffer against potential losses and it is the most expensive form of financing. As charter values of banks are valuable, this could impose a cap on the amount of risk-taking by managers and shareholders. Besides, agency problems may also play a role so that banks controlled by shareholders would probably be willing to take on additional risks as they could diversify their investments. Yet, managers or government-controlled banks are less likely to take on more risk, as they cannot diversify their human or reputation capital.	• This would be the moral hazard hypothesis under which the increase in financial risk is contemporaneous to an increase in credit risk so that shareholders would be exploiting the deposit insurance. ↓CA/TA→↑RISK • A regulatory imposed increase on capital could be effective so that ↑CA/TA→↓RISK, or under certain circumstances could be counterproductive and lead to an increase in risk ↑ CA/TA →↑RISK • According to whether stockholders or managers control the bank. Banks controlled by shareholders would probably be willing to take on additional risks as they could diversify their investments. Yet, manager or government-controlled banks are less likely to take on more risk, as they cannot diversify their human or reputation capital. ↓ CA/TA →↓RISK, or ↑RISK
	EFF: Cost and profit efficiency Levels.	Inefficiency levels could affect risk several ways.	• Banks with better quality of management would have more flexibility in taking additional risk. The same direct relationship would be obtained if agency problems were introduced and managers control the entity rather than the shareholders, the entity could spend resources on monitoring. ↑EFFIC→↑RISK or ↓EFFIC→↓RISK • A decline in efficiency could also produce an increase in the amount of risk due to bad management. ↓EFFIC→↑RISK
	SLOPE: Slope of the yield curve derived from 10 years government bonds and three-month money markets treasury bills for every European country each year.	• It is important to control for the effect of the slope of the Yield curve might affect bank's interest rate decision. ↑SLOPE→↑RISK	

Table 1 (cont.) RISK as dependent variable

Dependent Variable	Variables Affecting the Dependent Variable.	Rationale.
Risk	GROWTH: One-year loan growth rate. GROWTHSQ:Square term of loan growth.	• Excessive loan growth can be achieved by compromising lending standards. To allow for the possibility of a U-shape relationship between loan growth and risk. ↑GROWTH SQ→↑RISK
	SOTA: Securities over total assets.	• Takes into account portfolio composition factors; loans are expected to be riskier than other securities. ↓SOTA→↑RISK
	CHARTER VALUE, market value to book value.	• It is expected to be negatively related to risk, as institutions with a strong charter value will not be willing to jeopardize it by taking additional risk.
	COUNTRY and TIMEDUMMIES.	They aim to control for country and economic specific conditions.

Table 5. 2 CAPITAL as dependent variable:

Dependent Variable	Variables Affecting the Dependent Variable.	Rationale.	
Capital	RISK: Risk Proxy derived from market values (Beta, volatility of returns, and intrinsic risk) or Risk Proxy derived from accounting values (loan loss provisions).	Capital levels would increase when the risk position increases, unless the value of the capital is so low that it is in interest of debt holders also to bet on taking on higher risk.	• An increase in risk will be normally accompanied by an increase in the bank's capital position because of risk related costs and managerial and regulatory aversion to higher asset and financial risk-taking. ↑RISK→↑CAP • However under the moral hazard hypothesis and particularly if the charter value and capital ratio are low then: ↑RISK→↓CAP
	EFFIC: cost and profit efficiencies.	Theoretically, efficiency should influence at least indirectly the capital of the financial institution so that institutions with a higher level of cost efficiency would be allowed to operate with a lower capital to total assets ratio.	• If the firm is efficient it could allow itself to increase its amount of leverage and maximise the incentives in terms of taxes and higher return on equity provided by higher leverage. ↑EFFIC →↓CAPITAL • On the other hand, under the moral hazard hypothesis, a less efficient bank would also increase leverage. ↓EFFIC →↓CAPITAL
	ROA: Return on assets.	• Banks might keep some of their earnings in the form of equity increases, as it would be cheaper than external sources of financing. • However if the cost of capital (ROA) becomes more expensive then: ↑Cost of capital ⇒↓Capital. That is as capital becomes more expensive banks would lower the amount. (see DeBondt and Prast, 2000)	• Retained earnings hypothesis ↑ROA →↑CAP • If there is a large increase in competition and emphasis on shareholder value then institutions could become more cautious about the increased costs of capital so: ↑ROA →↓CAP
	SIZE :Total assets.	Impact on capital due to its relationship to possible access to equity capital. Also, bigger banks might be allowed to operate with a smaller capital assets ratio.	• Larger banks may have a decline in the amount of risk taken due mainly to diversification ↑SIZE→↓RISK →↓CAP • However due to Too Big to Fail considerations larger banks will have an incentive to take on higher risk so that ↑SIZE →↑ RISK →(and be forced to reduce leverage)↑CAP
	GAP: Proxy for interest risk	Value of the difference between assets and liabilities that will mature within one year.	
	COUNTRY DUMMIES and TIMEDUMMIES	They aim to control for country and macroeconomic conditions and other external conditions.	

Table 5. 3 EFFICIENCY as dependent variable

Dependent Variable	Variables Affecting the Dependent Variable.	Rationale.	
Efficiency	CAPITAL	Better capitalised firms are likely to be more efficient	• Highly capitalised banks are likely to be more efficient, as capital is more expensive than debt (see Berger 1995, and Eisenbeis, 1995) ↑ CAP→↑ EFFIC
	RISK: Risk Proxies, both accounting (loan loss provisions) and market value proxies (beta, volatility of returns and intrinsic risk).	Efficiency values has been found to be significantly associated with differences in market and accounting measures of bank risk. (Eisenbeis, Ferrier and Kwan 1996).	• If managers are risk averse as they cannot diversify their human capital and want to keep the charter value of the bank, they would spend a substantial amount of resources in screening and monitoring and be cautious in the portfolio investments that the bank undertakes, this would drive the costs of the firm up and reducing the revenues bringing cost and profit efficiencies down[122]. ↓RISK→↑COST and ↓REVENUES → ↓ EFFICIENCY • It could be cheap to attain a certain high level of risk, but once it is obtained, a high level of risk could bring cost efficiencies up, as it would increase the costs of monitoring and other associated costs. That will probably be shown in lagged measures of risk such as accounting loan loss provisions. ↑RISK→↓ex post EFFICIENCY • Finally, and very plausibly, if you have bad management, you could have an increase in risk coupled with a decline in efficiency..Bad management will produce both ↑RISK and ↓ EFFICIENCY.
	GROWTH:One year loan growth rate. GROWTHSQ: Square term of loan growth rate.	A low moderate growth rate captures managerial quality, while a high growth rate reflects managerial entrenchment. The relationship between growth and efficiency might be U-shaped.	• A positive growth of loans is likely to influence efficiency positively, yet very fast growth would be normally associated with a declining in lending standards that is likely to impair cost efficiency.
	COUNTRY DUMMIES: set of country dummies. TIMEDUMMIES: set of time dummies for every year.	They aim to control for country and time derived economic conditions.	

122 Another possibility is that due to external factors, both efficiency and the amount of risk taken could be affected. If, say because of an economic downturn, there is an increase in bankruptcies in a given country, it will increase the amount of risk and cause a decline in its efficiency in relation to other countries. However the inclusion of dummy variables will hopefully take into account this eventuality.

5.3.3 Econometrics of the model

Concerning the econometric methodology to be used, two problems have to be kept in mind:

- First, as in all simultaneous equation models, there will be the issue of endogeneity/exogeneity of the dependent variables. This problem arises when some of the regressors are in turn determined by the dependent variable. Part of the literature has not dealt specifically with this problem (see Berger and De Young, 1997, or Berger, 1995), whereas other strands of the latest literature have typically adopted the use of instrumental variables estimation procedure to deal with this problem. This is the case for Kwan and Eisenbeis (1997) who use two stage least squares, or Jacques and Nigro (1997) and Rime (2001) who used the three stage least squares[123] procedure to deal with this problem. However, the use of instrumental variables also has problems of its own, such as the existence and selection of adequate instruments, and in the case of three stage least squares (in which all parameters are calculated simultaneously), the amplification of estimation problems derived from a possible misspecification of the model;

- Another problem related to model estimation concerns the most appropriate panel data estimation procedure. Apart from Barrios (1998) who considers dynamic panel data procedures (as he incorporates lagged values of the dependent variable) and Perraudin et al (1998) who incorporate random effects[124], no other studies, as far as the author is aware, consider the issue specifically. Again the use of panel data procedures could create problems of their own. (see Baltagi, 1995);

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[123] Alternatively De Bondt and Prast (2000), use lagged values of the variables considered endogenous. Given that we are working with annual data, we though this procedure would blur the underlying economic relationship.

[124] Although they do not report any formal testing.

In order to avoid the problem of endogeneity between capital, efficiency and risk, discussed by Shrieves and Dahl (1992), and Kwan and Eisenbeis (1997), we adopt a two stage least squares procedure. Given that we do not have an obvious choice of instrumental variables, this estimation procedure conveniently combines all the available information from predetermined variables into a linear combination that is used as the instrument to provide consistent estimations. Although a maximum likelihood procedure such as three stage least squares[125] could produce a more efficient estimator, it could also produce important biases if the model is not perfectly specified.

Regarding the possible problems that could arise from the use of panel data, it is important to consider that our sample (discussed in the following section) incorporates only the largest European banks, this would tend to reduce common estimation problems associated with changes in the individual heterocedasticity of errors. Overall, we have choose to use fixed effects estimation procedure by including country and time dummy variables, both when calculating the efficiency values and in the main equations. This, on the one hand, would avoid the reduction of degrees of freedom derived from the use of individual dummies as well as reducing the potential sources of errors derived from the pooling of data[126]. As advocated by Mundlak (1978), we use the fixed effects model that is more likely to provide consistent estimators. This would particularly be the case when the economic reality behind each observation is likely to be substantially different. In addition, hypothesis testing in Chapter 6 also shows that fixed effects should be preferred in this case to random effects (GLS) as shown by the rejection of the null hypothesis of the Haussman test (1978). Finally, the fixed effects model is preferred over the random effects model because the fixed effects approach is considered to be the more appropriate specification if we are focusing on a specific set of *N* firms. (See Baltagi, 1995).

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[125] Available in most econometric packages such as Limdep.

[126] Calculated with the econometric package Stata.

Once the main features of the empirical model have been introduced is useful to spell out more clearly how the proxies for efficiency, risk and charter value have been constructed.

5.3.4 Constructed variables

This section explains the methodology used to calculate certain variables used in the models outlined in the previous section. It considers the model and economic rationale used in the construction of the variables, but also serves as a reference point for the sample used to calculate these variables.

5.3.4.1 Risk variables

The problem of risk measurement is of extreme importance for bank managers, regulators, depositors and shareholders. However, due to the 'specialness' of the banking firm, and the predominant role played by the financial sector in the economy, it is extremely difficult to gauge the amount of risk taken by a financial institution (see Chapter 4). This section look at how we calculate the market and accounting measures of risk included in our model.

Market measures of risk

In practical terms, the methods employed to measure the amount of banking risk depends on the goals of the institution measuring it. Consequently, the main economic agents interested in evaluating this economic variable, namely: 1) external rating agencies, 2) qualitative credit risk internal modellers and consultants, 3) banking supervisors 3) financial stability regulators and 4) commercial banks, would all tend to come up with very different measures of banking risk. Our goal is more limited, for the purposes of our study we would only like to distinguish between two dimensions of risk: relative and absolute risk. This distinction is often also referred to by the terms idiosyncratic and systematic risk.

For the purposes of this study, we define relative risk as the amount of risk taken by a particular institution when compared to overall stock market volatility or the volatility of its peers, whereas changes in systematic risk relate to absolute changes in volatility. Due to the inherent problems of measuring risk from accounting data (see Borio and Furfine, 2001, and Fernadez de Lis et al, 2001), we have also resorted to market measures of risk. In our case, these are derived from bank stock market data. In order to measure these two dimensions of risk, three simple different measures of risk from market data are calculated. Before considering them in detail, it is important to briefly consider the data sources and methodology.

The different market measures of bank risk included is our estimation are as follows:

- A simple yearly standard deviation of weekly returns. This provides a proxy of overall volatility of the stock price for each banking institution for each given year. This is our proxy for the overall risk for each banking institution (VOLATILITY).

- Given that the volatility of banks stocks is likely to be severely influenced by developments in the overall stock market, we have also run a CAPM type of model in which weekly returns for each institution are regressed yearly against weekly returns of the overall national market so as to estimate beta for each individual bank for each year[127]. So that for each banking institution i with weekly returns $R_{i,w,t}$ we would calculate parameters for each year t. (BETA)

$$R_{i,w,t} = \alpha_t + \beta_t M_{j,w,t} + e_{i,w,t}$$

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[127] In order to have a consistent set of national stock market indicators, the national indices utilised are the total country indices provided by Datastream, a private data provider, under the codes TOTMKIT (Italy), TOTMKFR (France),TOTMKBD (Germany), TOTMKUK (United Kingdom), TOTMKSP (Spain). Besides as most of the empirical banking studies measuring banking risk, we have not deducted the value of the daily values of the risk free interest rate to the market values as the standard CAPM methodology would employ the main reason is that in the case of the individual/intrinsic bank risk we only want to have a proxy of individual risk clean of the influence of the overall stockmarket volatility.

Where $R_{i,w,t}$ indicates the individual bank weekly stock returns for bank i in year t. $M_{j,w,t}$ represents the overall market stock returns for each national country index j in year t.

- So that $\beta_t = \text{cov}(R_{t,i}, M_{t,i}) / \text{var}(M_{t,i})$ is a measure of systematic risk of each banking institution. Consequently, the larger the value of beta, the larger the reaction of the banks' stock to positive or negative changes in the stock market.

- The third measure of banking risk uses the yearly standard deviation of residuals $e_{,i,w,t}$ derived from the previous β regressions. This offers a reasonable proxy for unsystematic risk, in that it shows a measure of banking volatility after the volatility of the market. (UNSYSTEMATIC OR INTRINSIC RISK)

Accounting measure of risk

The accounting measure of risk used in the models is the ratio of loan loss provisions to total loans[128]. In most countries, the balance sheet value of a loan is equal to the bank's recorded investment minus a provision for bad and doubtful debts. The need to create provisions arises largely out of the absence of market value accounting. So in theory, and in the absence of market value accounting, the creation of provisions allows the value of the loans on a bank's balance sheet to approximate more closely to their fair economic value. In practice, provision policies tend to be backward looking, and do not increase substantially until the economy is well into recession (see Appendix VIII). This factor reflects the fact that accounting standards in most countries are created to reflect events that have already occurred rather than events that have not yet happened but for which there is a reasonable likelihood of occurrence (see Borio and Furfine 2001, and Saurina, 2001).

[128] See Beaver et al. (1989) pp. 161-163 for a discussion on different accounting measures. Although the amount of non-performing loans is preferable, this variable is not available for most of the institutions in Europe.

5.3.4.2 Efficiency variables

As shown in the previous chapter, the calculation of an accurate proxy for bank efficiency is of great importance for the purpose of our study. In this sense, it is suggested by most empirical studies that differences in efficiencies among institutions derived from X-efficiencies are substantially larger than scale or scope economies (see for instance Berger and Humphrey, 1998). Finally, and given that a major objective of the firm is to maximise profits, for our study, we have calculated both, cost and profit X-efficiencies for a sample of European banks.

There is not an optimal methodology that can be applied when we calculate the efficiencies of financial institutions, as each type of approach (parametric and non-parametric) has certain drawbacks that should be taken into account. As we note in the previous chapter, in this study we have opted for a parametric approach rather than a non-parametric method, mainly because non-parametric methods assume away noise in the data and 'bad luck' factors. These issues are likely to be relevant in our case, both due to potential inaccuracies that might be still present in the audited accounting data, and the potential luck derived from other factors that might give temporary advantages to efficiencies calculated for certain institutions. These two factors are also particularly relevant in our study as we have a sample of five countries over a period in which the regulatory and competitive scenario has drastically changed in European banking.

Another reason for choosing the parametric stochastic frontier methodology arises from the early literature on the relationship between efficiency measures and banking risk. In one of the few studies (see Eisenbeis, Ferrier and Kwan, 1990) that compare bank efficiency levels with measures of banking risk, two different methods for calculating efficiencies (parametric and non-parametric) are employed. The authors find that efficiency values obtained by the use of the stochastic frontier approach were significantly associated with differences in accounting and market measures of bank risk and seem to strongly affect bank stock returns. Alternatively, non-parametric DEA efficiency values were much less informative in this regard. Within the parametric methods, we reject the thick frontier (TFA) approach since we wanted to obtain firm-level efficiencies estimates as opposed to industry wide averages. Then, the stochastic frontier approach is chosen as opposed to the distribution free approach (DFA), as we wanted to obtain efficiencies measures for each year for every firm, as we could not assume (as required by the DFA) that the efficiency of each firm is stable over time. This reason appears particularly relevant as our period of study (see Chapter 2) has undergone considerable regulatory and competitive changes, which has probably altered both allocative and technical efficiencies in European banking. Yet, as suggested by Berger and Humphrey (1997), a solution to overcome the limitations of the parametric and non-parametric methods would lie in adding more flexibility to parametric and non-parametric approaches. In the case of the parametric approaches, recent methodological advances have focused on specifying a Fourier-flexible functional form which adds Fourier trigonometric terms to a standard translog functional form, increasing 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 is most needed (see Gallant,1981, 1982; Mitchell and Onvural, 1996; Berger and DeYoung, 1996; Berger, Leusner and Mingo, 1996; Beger and Mester, 1997; Altunbas, Gardener, Molyneux and Moore, 1998 and Altunbas 1997).

To estimate bank cost efficiency we estimate a translog (transcendental logarithmic functional form) with Fourier terms, including the first, second and third order trigonometric terms[129] as well as X-efficiency and random error terms. Additionally, in order to keep limited the number of Fourier terms, the study applies Fourier terms only for the outputs, leaving the input price effects to be defined entirely by the translog terms as in the studies undertaken by Mitchell and Onvural (1996), Berger et. Al (1994), and Berger and Mester (1997).

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[129] As suggested by Berger, Leusner and Mingo (1994), we have dropped the 'own' third order terms, that would allow us to keep a more parsimonious model in term of the number of parameters while maintaining symmetric treatment of all the outputs. When estimating the efficiency function, the use of the Fourier Flexible requires that the data be scaled so that the difference between the maximum and minimum values of each independent variable does not exceed 2Π. Hence, the z_i are adjusted values of the log output $ln(y_i)$ such that they span the interval $(0.1*2\Pi, 0.9*2\Pi)$. As Berger and Mester (1997), we cut 10% off of each end of the $(0,2\Pi)$ interval to reduce approximation problems to reduce approximations near the endpoints wherever it is most needed 129. The formula for z_i is $0.2*\Pi-\mu*a+\mu*$ variable, where (a,b) is the range of the variable being transformed and $\mu=(0.9*2\Pi-0.1*2\Pi)/(b-a)$. As Berger and Mester (1997) we also limit the Fourier Terms to a second order.

Cost efficiency function[130]

$$\ln TC = \alpha_0 + \sum_{i=1}^{3}\alpha_i \ln(y_i) + \sum_{j=2}^{2}\beta_j \ln(p_j) + 1/2\sum_{i=1}^{3}\sum_{k=1}^{3}\alpha_{ik}\ln(y_i)\ln(y_k) + 1/2\sum_{j=1}^{3}\sum_{h}^{3}\beta_{j,h}\ln(p_j)\ln(p_h)$$
$$+\sum_{i=1}^{2}\sum_{j=1}^{3}\delta_{i,j}\ln(y_i)\ln(p_j) + \sum_{i=1}^{3}[a_i\cos(z_i) + b_i\sin(z_i)] + \sum_{i=1}^{3}\sum_{j=1}^{3}\lfloor a_{ij}\cos(z_i+z_j) + b_{ij}\sin(z_i+z_j)\rfloor +$$
$$+\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1\,k\geq j,k\neq i,j\geq i}^{3}[a_{ijk}\cos(z_i+z_j+z_k) + b_{ijk}\sin(z_i+z_j+z_k)] + c_t T + \varepsilon$$

Where

LnTC	=	the natural logarithm of total costs (Operating and Financial cost);
lnQ_i	=	the natural logarithm of bank outputs;
lnP_l	=	the natural logarithm of *i*th input prices;
T	=	linear time trend;
Z_i	=	the adjusted values of the log output lnY_i such that they span the interval [0, 2π] (see Chapter 6);
$\varepsilon = u + v$	=	where ε is the error term where u and v are independently distributed; u is assumed to be distributed as half-normal, $u \sim N(0,\sigma_u^2)$, or truncated normal that is, a positive disturbance capturing the effects of inefficiency, and v is assumed to be distributed as two-sided normal with zero mean and variance, σ^2_v, capturing the effects of the statistical noise.

As in Berger (1994), we exclude consideration of factor share equations embodying Shephard's Lemma or Hotelling's Lemma restrictions because this would impose the undesirable assumption of no allocative inefficiencies. Besides, although these systems approaches could provide more efficient estimators of the parameters than the single equation estimation, it suffers from other problems (see Coelli, Rao and Battese, 1998). Foremost is the problem of selecting an appropriate way to represent the link between the allocative efficiency in the error terms of the input demand equations, and the allocative inefficiency error which appears in the cost frontier. As Coelli et al (1997) indicates this problem has not been solved to the satisfaction of the majority of

[130] Following Cebenoyan, Cooperman, Register and Hudgins, (1993), symmetry and homogeneity conditions were imposed so that we normalised total cost, the price of labour, and the price of capital by the price of borrowed funds.

researchers, and debate continues as to how best address this issue (see also Bauer, 1993, and Green 1993).

To calculate the profit inefficiencies we use the alternative profit function formulation as specified in Berger and Mester (1997). Inefficiencies are calculated in the same way as in the above cost frontier case although because we are maximizing profits (as opposed to minimizing costs) the inefficiency term, u, is subtracted from the estimated residuals.

Profit efficiency function

$$\ln(\Pi) = \alpha_0 + \sum_{i=1}^{3}\alpha_i \ln(y_i) + \sum_{j=2}^{2}\beta_j \ln(p_j) + 1/2\sum_{i=1}^{3}\sum_{k=1}^{3}\alpha_{ik}\ln(y_i)\ln(y_k) + 1/2\sum_{j=1}^{3}\sum_{h}^{3}\beta_{j,h}\ln(p_j)\ln(p_h)$$
$$+\sum_{i=1}^{2}\sum_{j=1}^{3}\delta_{i,j}\ln(y_i)\ln(p_j) + \sum_{i=1}^{3}[a_i\cos(z_i) + b_i\sin(z_i)] + \sum_{i=1}^{3}\sum_{j=1}^{3}\lfloor a_{ij}\cos(z_i + z_j) + b_{ij}\sin(z_i + z_j)\rfloor +$$
$$+\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1\,k\geq j,k\neq i,j\geq i}^{3}[a_{ijk}\cos(z_i + z_j + z_k) + b_{ijk}\sin(z_i + z_j + z_k)] + c_t T + \varepsilon$$

Where

ln (Π)	=	where Π are profits[131].
lnQ_i	=	the natural logarithm of bank outputs;
lnP_i	=	the natural logarithm of ith input prices;
T	=	linear time trend;
Z_i	=	the adjusted values of the log output lnY_i such that they span the interval $[0, 2\pi]$;

[131] We have standardised profits by calculating *ln (Π+(Πmin+1))* where *Πmin* is the absolute value of the minimum value of profits *Π*. In practice, the constant term *Πmin+1* is summed to bank's profit so that the logarithm can take a positive value. This adjustment was necessary as some of the banks have negative results over the period study, particularly in the early 1990's.

$\varepsilon = v - u$ = where ε is the error term where u and v are independently distributed; u is assumed to be distributed as half-normal, $u \sim N(0, \sigma_u^2)$, or truncated normal that is, a negative disturbance capturing the effects of inefficiency, and v is assumed to be distributed as two-sided normal with zero mean and variance, σ^2_v, capturing the effects of the statistical noise.

For our definition of inputs and outputs we choose the intermediation approach as suggested by Sealey and Lindley (1977), where the inputs, labour, physical capital and deposits are used to produce three outputs. That is we consider deposits as an input, which seems to be predominant in the empirical literature. Apart from the two main outputs, which are common in the literature: loans and securities, the model includes a third output, other operating income, which is quite uncommon in the literature. The main reason for the inclusion of other operating income as an output is to recognise the changing nature of the banking business in which the so called 'brokerage function' is gaining increasing importance in Europe (see Bhattacharya and Thakor, 1993). In the banks' balance sheet, this is normally reflected in an increase in fees and commissions particularly in the case of the largest banks (see Favero, 1999).

Table 5. 4 Output and inputs used in our efficiency model estimations

	Cost efficiency estimator	Profit efficiency estimator
TC	Total cost operating and interest cost (operating and financial cost) (ECU mil)	Log pre-tax total profit (ECU mil)
Y_1	The value of total aggregate loans (all types of loans) (ECU mil)	The value of total aggregate loans (all types of loans) (ECU mil)
Y_2	The value of total aggregate securities (short term investment, equity and other investments and public sector securities) (ECU mil)	The value of total aggregate securities (short term investment, equity and other investments and public sector securities) (ECU mil)
Y_3	Other Operating Income (ECU mil)	
P_1	price of labour (ECU mil) (total personnel expenses/total asset)	price of labour (ECU mil) (total personnel expenses/total asset)
P_2	price of physical capital (%) (total depreciation and other capital expenses/total fixed assets)	price of physical capital (%) (total depreciation and other capital expenses/total fixed assets)
P_3	price of physical capital (%) (total depreciation and other capital	price of physical capital (%) (total depreciation and other capital

Note: See cost and profit efficient estimates of the production function in appendix VII

Regarding the distribution of the error term, we choose the truncated normal for our final reported results.[132] The model chosen is the Battese and Coelli (1992, 1995)[133] specification as it allows us to calculate time-varying firm level inefficiencies for an unbalanced panel of firms. The Battese and Coelli (1995) specification (see Appendix VIIa) permits the inclusion of other explanatory variables, which in our model allow us to incorporate individual country variables, as well as easily account for technical change in a single estimation procedure. Consequently, a country dummy has also been included in order to account for individual country factors. This is probably necessary as individual country factors seem to account for a large portion of the variability in efficiency scores (see Casu and Molyneux, 1999)[134].

5.3.4.3 Market value to book value

As in the case of accounting measures of risk, accounting measures of performance offer a partial measure of bank performance. In Europe, there is a growing emphasis towards the creation of market value. In this process, performance is increasingly measured by the ability of managers to create value added as recognised by the stock market[135]. Given that banks' charter value is to be included in our empirical study we need first to show how the market to book value variable is constructed.

The market value of banks' equity will be given by the expectation conditional on information at time 1, where:

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[132] The main reason is that the half normal and exponential functions are arbitrary selections. Other specifications of the error term were also tried, yielding a very similar ranking of efficiencies (significant Spearman correlation test) for both models.

[133] We are grateful to T. Coelli for answering questions on the calculations of firm efficiency level and for providing the FRONTIER programme.

[134] According to Bikker (1999), this approach of a common frontier including country specific dummies, is robust when compared with the X-efficiencies rankings obtained while calculating several individual country frontiers.

[135] This ratio as evaluator of performance is receiving increasing attention also from the academic literature interested in measuring banks' performance (see Hughes, 1998). See also Kane and Unal (1990), method to estimate hidden capital by the use of a regression of market against book value.

$$MVE = \sum_{t=1}^{\infty} E[\frac{CFE_t}{\underset{t=1}{\overset{t}{H}}(1+w_{k,t})}]$$

Where:

$MVE = market \quad value \quad of \quad equity$

$CFE = cash \quad flow$

$\Sigma, H = sumation \quad terms$

$w_{k,t} = discount \quad factor$

That is, the market value for a bank is determined by its expected net cash flows, conditional on information at that time discounted by the required return on equity. In practical terms, we have derived the market value of banks equity by multiplying the amount of shares outstanding by their price and dividing this quantity by the accounting value of their equity.

Interestingly, banks can have large increases in profits but declines in their market to book value ratios, for example, due to the fact that the amount of required return on equity by the market has largely increased due to a substantial increase in the risk-taking position of the institution. Hence, and unlike other measures of performance, this ratio provides a more comprehensive measure of performance encompassing risk and other factors that could affect the economic value of the institution. Consequently it provides a complementary measure to standard accounting indicators of performance such as ROA and ROE.

5.3.4.4 Bank Charter value

The definition of charter value could be referred to as the value of the institution minus the replacement value of the bank. As in Gropp and Vessala (2000), Demsetz (1996) and Keeley (1990), we can calculate a bank's charter value[136] as follows:

$$\frac{CV}{A} = \frac{E + L - A}{A}$$

Where:

- CV= charter value
- A = accounting value of total assets
- L= accounting value of total liabilities
- E= market value of equity

5.4 Data: sample and sources of the data

As we will use models incorporating only accounting data and models incorporating both accounting and market data, we will have a larger sample which incorporates only accounting information and a second more restricted sample that also includes variables constructed from market prices.

5.4.1 Data issues relating to bank accounting information

Since we are making an international comparison, only the largest institutions that are more likely to be susceptible to international competitive pressures have been included in our sample. Competition for small banks is largely reduced to the local and regional level, in a cross-country study it is necessary to concentrate on the largest institutions,

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[136] The degree of regulation discussed in preceding chapters which decreases the amount of competition in the banking sector would imply that this figure would be normally larger than one (that is, charter value is positive)

as they are more likely to operate in a market more competitive and contestable market compared with smaller institutions. The sample has been drawn from the largest EU banks initially ranked according to equity size. The sample comprises the largest 440 banks in the biggest five EU economies[137]. The number of banks selected from each country is proportional to each country's amount of outstanding deposits[138].

This study includes bank observations from 1990 to 1997 drawn from the main five EU countries, namely France, Germany, Italy, Spain and the UK. By including only observations from the larger countries, there are fewer possibilities of including outliers derived from including observations representing major banks operating in small countries. In addition, an unbalanced panel has been formed; this is undertaken in order to avoid *'attrition problems'*, that is the fact that if we take out banks for which we do not have data for the whole period of study (say because they have merged or disappeared), this omission could affect the results obtained, as those results are restricted to a limited sample (balance panel) that might be not representative of the population as it does not take into account institutions that have disappeared or merged (See for instance Green 1997).

Table 5. 5 Sample distribution by country 1990-1997

Country	Number of banks accounting sample	In %	Number of banks market sample	In %
France	93	21.1	19	19.4
Germany	149	33.9	23	23.5
Italy	80	18.2	28	28.6
Spain	46	10.5	19	19.4
UK	72	16.4	9	9.2
Total	440	100	98	100

137 They represent around 60 % of total deposits and around 55% of total assets of the combined loans and total assets figures of the five countries included (calculated from the IMF, IFS (1999) statistics).

138 As measured by the International Financial Statistics of the IMF in 1997.

Although the sample includes several kinds of banking institution, (commercial, savings and mutual banks), the majority are commercial banks. The reason for combining different types of banking institutions is that due to the process of conduct deregulation[139] mentioned earlier, there has been a dramatic breakdown of traditional barriers between different types of financial institutions. This trend is accentuated in the case of the top savings and mutual banks that have long broken with their origins, to compete head-on with the established commercial banks both at home and (in an increasing number of cases) internationally (see Williams, 2000). Consequently, the sample has not been restricted to commercial banks only.

As in most studies, data has been obtained wherever possible[140] on an unconsolidated basis (see Van der Vennet, 1997, for an exception). Given that we are focusing on the largest institutions, unconsolidated data will probably provide a more homogeneous data set.

Cost and profit efficiency measures are calculated by using this sample of 440 banks to construct a common efficient frontier across the five countries. Financial deregulation and particularly the Single Market for Financial Services have probably made competitive conditions more similar across European countries particularly for the largest institutions. Consequently, as in other previous studies, we have calculated a single cross-country production function. Furthermore, a country dummy has also been included in order to account for individual country factors. This is probably necessary as individual country factors seem to account for a large portion of the variability in efficiency scores (see Casu and Molyneux, 1999)[141].

[139] Unlike in the US, in the EU the Second Banking Directive implemented by all member states allows universal banking.

[140] Consolidated data had to be taken for UK clearings banks, as this was the only format reported by FITCH IBCA.

[141] According to Bikker (1999), this approach of a common frontier including country specific dummies is robust when compared with the X-efficiencies rankings obtained while calculating several individual country frontiers.

As mentioned earlier, when selecting specific banks, instead of including all those available for a given country we have selected only the largest banks institutions operating within each financial system, the reasons are as follows:

- Firstly, it allows us to control for the inclusion of every single institution so that we can have a better understanding of the possible outliers included in the sample[142]. Although in Europe, banks are universal and therefore subject to the same rights and obligations regardless of their legal status, specialist institutions due to their different functions or legal status were excluded from the sample. Consequently, a detailed case-by-case analysis has been undertaken, in order to improve the homogeneity of the data sample. Foreign banks have been excluded from the sample due to the likely cross-country subsidies that might take place from their mother entity (see Barrios 1997). Besides, special purpose institutions such as Deutsche Apotheker-und Artenbank, or Westdeutsche Genossenschafts-Zentralbank eG-WGZ Bank in Germany or Renault Credit International SA Banque are not included under the assumption that they are niche operators and have different operational behaviour to mainstream commercial and savings banks. Likewise, institutions such as CECA (clearing entity) in Spain, or Mediobanca (investment bank with very specific features[143]) in Italy have also been dropped from the sample. Finally, as Berger (1995), and Berger and De Young (1997) point out, banks with extremely high values of the equity to total assets ratio, have been taken out from the sample as their economic behaviour may be different from those of their peers due to special status or other factors[144].

[142] We are grateful to Claudia Girardone, Franco Fiordilisi, R. Desmonts and Gaby Ebers for looking and correcting at our initial data list for each of their respective countries, as well as to J. Williams for his advice on savings banks characteristics on a country basis as well as on the convenience of included specific institutions in the list or not. Besides, significant background reading has also been undertaking for understanding and improving our data selection.

[143] Cazanove would be the closest equivalent in the UK.

[144] This happened for four institutions: Credit du Nord, Credit mutual du Nord, Immobienbank and Banque Hervet.

- Secondly, the conventional econometric literature in banking microeconomics does not take into account the relative size of each individual observation on the sample. Having a sample as homogenous as possible will reduce possible distortions in the estimation derived from the influence of smaller observations.

In other words, in the trade-off between having a larger number of observations and improved econometric properties, and a better understanding of the observations that results in a lower number of outliers, and a more standardised sample, we have chosen the latter.

Finally, apart from the aforementioned criteria, when selecting our sample, all banks quoted in the five countries stock exchanges were included in our sample, as their stock price information is needed to obtain market proxies of banking risk.

5.4.2 Issues related to market data

In order to obtain variables constructed from bank stock market data we obtained daily stock returns for a final sample of 98 banks over 9 years obtained for all quoted banks from France, Germany, Italy, Spain and the UK between 1990 and 1997. This totalled 290,000 observations[145]. For the purpose of analysis, we converted the daily stock returns into weekly series, so that we can avoid problems associated with non-synchronous trading (see Scholes and Williams, 1977). Consequently, the different risk measures were manually obtained so that we could dispose of several observations for which there was a clear lack of liquidity. In this sense, those stocks with very low levels of liquidity were not included in the sample.

[145] Banks where quoted but did not have trading liquidity, were not included. This was the case of small French banks quoted on regional stock exchanges. A one by one examination of yearly risk values was undertaken; also we created a macro according to which companies that did not change price over a period of three days were dropped from the sample.

5.4.3 Data sources

Bank accounting data was obtained from Bankscope a commercially available database that contains comprehensive microeconomic accounting information of bank account figures on an annual basis. The database is maintained by Fitch-IBCA and Bureau van Dijk, a major European rating agency and a publisher of financial databases on CD-ROM respectively146. In addition, and in order to avoid spurious relationships due to inflationary pressures, data has been deflated to 1990 figures on a country basis utilising the 1990 GDP deflator obtained from the IMF[147] (See Table 5.6, See Altunbas and Molyneux, 1998). Finally, national currency values have been transformed into 1990 millions of Euros/ECU's.

Table 5. 6 GDP deflator 1990 values

	US dollar equivalent	1990	1991	1992	1993	1994	1995	1996	1997
France	6.9501	100	103.3	105.5	108.1	109.7	111.5	112.8	113.9
Germany	2.0420	100	103.7	109.4	113.5	116.2	118.7	119.9	121.1
Italy	1.5403	100	107.7	112.7	117.7	121.1	127.9	134.2	137.8
Spain	132.12	100	107	114	119	124	130	134	137
UK	1.4126	100	106.5	111.4	115.0	116.9	119.8	123.5	126.6

Source: IMF International Financial Statistics, 1998 yearbook end of period.

Daily market data utilised to construct market measures of risk was obtained from Datastream. The initial data that included banks over the whole period of study was completed with data for merged or non-existing banks previously quoted with historical data obtained from Datastream[148]. Although more time-consuming, it is

[146] Within this database, the data has been selected mainly from the global form, and when necessary been from the spreadsheet format after comparing that the detailed items configuring specific variables were comparable across-countries.

[147] Gross domestic product deflator, International Financial Statistics, Yearbook International Monetary Statistics, 1998, IMF Publication Services, Washington, DC.

[148] Datastream has a facility that allows the retrieval of 'dead' (no longer quoted) institutions.

important to include data from those banks that were quoted at least over a period of our sample as the inclusion of those institutions may affect the results of the relationships that we aim to evaluate.

Data on market value used to calculate charter value were manually obtained from Bloomberg for each bank and individual bank as end of year market capitalisation divided by the accounting value of equity, as obtained from Bankscope.

5.5 Descriptive analysis of the data

Tables 5.8 to 5.10 show the descriptive statistics of the main variables incorporated in our model. Table 5.8 provides the mean, median and standard deviation of performance and risk variables. Regarding the risk variables, it is clear that provisions increased substantially when the European economy was in recession (see Appendix VIII), so that the amount of loan loss provisions has been declining from its peak in the early 1990s which was a period in which there was a short but intense economic downturn (see Borio et al 2000, for a comprehensive description of the relationship between economic cycles and banking risks) in which several banking institutions experienced substantial difficulties[149].

Given the above-mentioned deficiencies in terms of timeliness and reliability of accounting measures of risk, market measures of risk could provide (despite the remaining asymmetries of information between the institution and the market over the quality of the banks' portfolio) a more accurate picture of the risk profile of the banking institution. Regarding market-based measures of risk, we should also bear in mind that the number of institutions included in the sample is limited to quoted banks, and consequently the sample is substantially smaller than the broader sample used in the case of accounting measures of risk.

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[149] Well known examples include Banesto (Spain), Credit Lyonaise (France), Banco di Napoli (Italy), and the almost systemic crises in the Scandinavian countries. For a detailed account see IMF (1998).

The descriptive statistics of market measures of risk also show that the effect of the economic downturn of the early 1990's, which was felt in the form of earlier increases of market measures of risk as compared to loans loss provisions to total assets. This is reflected in a large intrinsic risk, and volatility of returns, particularly for the years 1992 and 1993. Then, these measures show lower values suggesting that the improvement in macroeconomic conditions could have improved the quality of the banks portfolio and lowered their amounts of risk as perceived by the market. Interestingly, from 1997 onwards[150], and despite the good macroeconomic conditions, market measures of risk have not declined substantially in the second half of the 1990's.

[150] For consistency purposes with the rest of the variables, only figures until 1997 are shown, yet the trend towards a larger Beta, intrinsic risk and volatility of returns, appears also to be confirmed by the implied volatility derived from options on the EUROSTOXX banking sectors which have also increased since their introduction in 1999.

Table 5. 7 Descriptive statistics concerning performance and risk variables.

Mean

	ROA	ROE	Net Interest Margin	Market to Book value	Beta	Intrinsic Risk	Deviation	Provisions Total Loans
1990	0.573	9.644	3.536	*	0.780	2.802	2.842	0.869
1991	0.611	9.842	3.590	*	0.798	2.400	2.184	1.068
1992	0.455	7.346	3.360	92.110	0.726	3.481	2.649	1.433
1993	0.474	7.671	3.233	95.580	0.679	3.341	2.336	1.325
1994	0.384	6.538	3.109	101.000	0.565	3.326	2.383	1.117
1995	0.472	7.371	2.979	96.600	0.570	3.281	2.173	0.927
1996	0.486	7.731	2.828	91.690	0.626	2.955	2.021	0.701
1997	0.493	8.111	2.581	109.250	0.774	2.945	2.461	0.643

Median

	ROA	ROE	Net Interest Margin	Market to Book value	Beta	Intrinsic Risk	Deviation	Provisions Total Loans
1990	0.500	9.120	3.270	*	0.653	2.919	2.884	0.626
1991	0.510	9.160	3.375	*	0.715	2.187	2.134	0.759
1992	0.365	7.590	3.160	85.710	0.599	2.362	2.290	0.840
1993	0.415	8.115	3.060	87.270	0.659	2.486	2.153	1.021
1994	0.370	7.060	3.120	94.510	0.530	2.319	2.114	0.833
1995	0.395	7.455	2.915	94.690	0.511	2.227	1.913	0.674
1996	0.410	7.450	2.775	83.620	0.524	2.043	1.761	0.586
1997	0.400	7.440	2.580	99.850	0.723	2.842	2.554	0.523

Standard Deviation

	ROA	ROE	Net Interest Margin	Market to Book value	Beta	Intrinsic Risk	Deviation	Provisions Total Loans
1990	0.447	5.838	1.619	*	0.062	0.124	0.122	1.704
1991	0.774	10.422	1.693	*	0.072	0.154	0.106	2.028
1992	0.523	8.518	1.563	7.200	0.056	0.781	0.258	6.150
1993	0.672	14.877	1.381	7.740	0.041	0.735	0.229	1.517
1994	0.758	17.635	1.314	7.740	0.040	0.716	0.230	1.428
1995	0.511	11.611	1.458	6.680	0.046	0.759	0.241	2.613
1996	0.453	12.679	1.392	6.680	0.052	0.518	0.179	0.634
1997	0.547	8.668	1.262	8.920	0.056	0.143	0.122	0.613

Source: Author's own calculations.

Market to book value figures also reflect this factor, as we observe a clear increase over the last years of our period of study coupled with an increase in the variability of these figure. There appears to have been a creation in value added by the banking firms that could have been accompanied by an increase in risk. That would typically not show up in accounting measures of risk because of the favourable situation of the economic cycle.

Variables indicating performance from an accounting point of view also reflect the two factors mentioned concerning the effect of the economic cycle in the early 1990's and the slow recovery of accounting figures after 1993. On the one hand, the effect of the economic cycle that lowered return-on-equity (ROE) and return-on-assets

(ROA), in 1992 and 1993. On the other hand, return-on-assets has not experienced a substantial increase over recent years and remained below 0.5% in 1997, possibly reflecting again the effect of more competitive markets.

Concerning the descriptive statistics of banking capital, Table 5.9 shows the mean, median and standard deviation of the total capital and Tier 1 capital to total assets ratios for our sample of European banks. The main observation that can be derived from these figures is their diverging trends. While the ratio of total capital has shown an overall increase over the last few years, the ratio TIER 1 capital to total assets has actually experienced a slight decline.

The total capital to assets ratio has increased from 11.3% to 15.7% of total assets, although the level of growth is slightly lower when median values are considered. The standard deviation is normally expected to be higher during periods of macro economic problems in which banks may be faced with exogenous shocks which reduce their levels of regulatory capital. However, we do not observe a decline in volatility, and the highest values for this latter ratio are those for 1995 and 1997. A factor presumably explaining the increase in the total capital ratio is the impact of the Basle 1988 capital adequacy regulations which were fully enforced in 1993, in the European Union.

The ratio of the more expensive TIER 1 capital to total assets ratio shows a substantial increase in the early 1990s particularly in 1993, but then it declines over the last two years, so that annual changes of the median of the equity to total assets ratio show negative figures during 1996 and 1997. Probably a main factor explaining this development could be the fact that, as in the case of other industries, banks' shareholders have favoured an increased amount of financial leverage over recent years, as it was expected in general to be conducive to increased shareholder wealth (greater returns on capital employed).

This diverging trend between the total capital and core capital ratio could also indicate that in a financial system in which the creation of shareholder value is increasingly important, banks may find the high cost of keeping core capital more expensive due to competitive pressures and enhanced shareholder demands.

Table 5. 8 Descriptive statistics concerning capital and capital changes variables

Mean

	Total Capital to TA	Equity to TA	Total Capital to TA (annual % changes)	Equity to TA (annual % changes)
1990	11.347	6.094	*	*
1991	12.104	6.132	1.600	7.890
1992	12.078	5.777	2.180	1.407
1993	13.238	5.891	5.190	1.740
1994	13.732	5.972	6.010	3.740
1995	14.672	6.242	1.830	2.060
1996	14.490	5.935	3.960	0.625
1997	15.730	5.880	11.800	-0.140

Median

	Total Capital to TA	Equity to TA	Total Capital to TA (annual % changes)	Equity to TA (annual % changes)
1990	10.700	5.130	*	*
1991	11.375	5.405	0.440	1.280
1992	11.300	5.175	1.030	0.768
1993	12.085	5.165	7.180	1.392
1994	12.800	5.265	5.440	1.060
1995	13.185	5.280	2.080	1.010
1996	13.360	5.310	0.600	-0.421
1997	13.220	5.300	-1.800	-0.336

Standard Deviation

	Total Capital to TA	Equity to TA	Total Capital to TA (annual % changes)	Equity to TA (annual % changes)
1990	0.478	0.213	*	*
1991	0.500	0.198	1.970	1.450
1992	0.468	0.145	1.710	0.905
1993	0.470	0.152	1.760	0.724
1994	0.419	0.152	1.730	1.570
1995	0.553	0.281	1.260	1.190
1996	0.432	0.139	1.790	0.755
1997	1.160	0.138	4.100	0.749

Source: Author's own calculations.

Concerning the results of our efficiency estimates[151], Table 5.10 shows that for our sample of European banks, profit efficiency is systematically larger than cost efficiency, and this is a finding shown in a few recent efficiency studies (see Berger, De Young, Genay and Udell 2000, for a recent review of the efficiency literature). We found that when country and time dummies are included cost and profit efficiencies appear to be above 90 % in all models. Probably, the main reason for this factor, apart from the use of dummies, would be the more homogeneous nature of our sample. In our sample, unlike most studies that include a larger number of institutions, only the largest institutions are incorporated. Furthermore, this is also likely to be a more competitive and contestable market (see Davis and Brandt, 1999) in which differences in efficiency among institutions are likely to be smaller (See Maudos et. al. 1999).

Even when the linear effect of technology is taken into account, we can also observe an increase in cost efficiencies over the 1990s (see Table 10), which is probably a response to the more competitive conditions faced by European banks. In addition, the standard deviation of cost efficiencies also shows a decline indicating that competition has probably become more acute in the late 1990s, so that the market is forcing the less efficient institutions to operate more efficiently or they will be more likely to be driven out of the market as implied by the classic theory of the firm literature.

- Regarding the level of profit inefficiencies, our results appear slightly lower than those found in other few European studies which model cross-country comparisons. The main reason for this result is probably that our sample incorporates a smaller number of banks. Nevertheless, the results are comparable to those by Maudos, Perez and Quesada (1999) for European banking when in a larger sample they truncate the sample to dispose of 5% of the least efficient institutions. Unlike cost inefficiencies, profit inefficiency has been increasing over the 1990's. This result is in line with other studies (see for instance Dietsch, Ferrier and Weill, 1999), although the findings need to be interpreted with caution given that profit inefficiencies are difficult to interpret as profit inefficiency scores would reflect to a larger extent (compared with cost

[151] Table 10 shows only those results included in Model 1 (that is the model also incorporating commissions as an output).

efficiencies) the risk position of the institution as well as the position of the economic cycle (see Appendix IX).

Table 5. 9 Descriptive statistics concerning efficiency, loans and charter value

MEAN

	Profit Inefficiency	Cost Inefficiency	Loan Growth	Loan Growth sq.	Securities Total Assets	Charter Value
1990	7.780	1.274	*	*	34.600	*
1991	8.363	1.745	7.096	148.300	32.664	*
1992	7.958	1.869	3.029	108.000	34.121	99.268
1993	5.813	1.393	1.612	97.500	37.560	99.908
1994	9.866	1.351	4.114	116.800	37.158	100.130
1995	9.438	1.284	4.775	101.800	37.034	99.956
1996	10.302	0.953	5.399	119.700	36.621	99.911
1997	11.429	1.061	8.135	168.600	36.828	100.630

MEDIAN

	Profit Inefficiency	Cost Inefficiency	Loan Growth	Loan Growth sq.	Securities Total Assets	Charter Value
1990	5.587	1.714	*	*	34.030	*
1991	6.269	2.497	6.620	55.200	33.183	*
1992	6.251	2.240	3.197	29.900	32.777	99.200
1993	5.076	1.655	1.136	21.900	36.761	99.900
1994	7.057	1.624	3.705	29.500	36.352	100.400
1995	6.789	1.250	4.017	26.600	36.023	100.100
1996	7.455	1.134	4.503	34.700	36.334	99.800
1997	8.420	1.061	7.487	64.000	36.160	100.700

STANDARD DEVIATION

	Profit Inefficiency	Cost Inefficiency	Loan Growth	Loan Growth sq.	Securities Total Assets	Charter Value
1990	0.507	0.081	*	*	1.080	*
1991	0.575	0.092	0.681	15.900	0.985	*
1992	0.382	0.063	0.653	12.800	0.835	0.398
1993	0.247	0.046	0.545	11.200	0.868	0.433
1994	0.484	0.044	0.531	11.800	0.867	0.430
1995	0.414	0.034	0.462	10.400	0.855	0.412
1996	0.468	0.027	0.475	10.500	0.843	0.469
1997	0.478	0.020	0.505	12.900	0.861	0.560

Source: Author's own calculations.

5.6 Conclusion

Chapter 5 has presented the methodology to be used in the empirical analysis. The modelling approach builds on earlier work by Kwan and Eisenbeis (1997), and Berger and De Young (1997) it also incorporates adjustments to better capture the relationships between capital, risk and efficiency to be analysed. Foremost among these improvements is the inclusion of market measures of risk in the analysis. This chapter has also outlined how various risk, efficiency and bank charter values have been calculated in order that they are included in various model specifications. In particular, these are then used to advance previous US work to testing the relationship between capital, risk, cost and profit efficiency in European banking during the 1990s. The final part of the chapter discusses how the sample has been constructed and also provides information on the data sources utilised to construct the sample. The chapter ends with a descriptive analysis of the data and variables used in the various model specifications.

CHAPTER 6

EMPIRICAL RESULTS

6.1 Introduction

This chapter reports the results of this thesis that examines the relationship between capital, risk and efficiency in European banking during the 1990s. The empirical analysis conducted builds on earlier US work and use a simultaneous equation model (estimated through two stage least squares with fixed effect) in which capital, risk and cost efficiency are the endogenous variables that are regressed against each of the other endogenous variables and a set of explanatory exogenous variables. Previous US models are refined by including market measures of bank risk, as well as by incorporating proxies accounting for charter value, and profit efficiency.

The majority of the results agree with earlier US work. A positive effect of inefficiency on bank risk-taking, and of inefficiency on higher leverage was found. This supports the moral hazard hypothesis that inefficient organisations are more likely to have more incentives towards bank risk-taking.

Excessive rates of loan growth are found to have a negative effect on banking risk. This concords with the hypothesis that due to agency problems, entrenched managers may engage in a growth objective, which may be counter productive both for the risk and efficiency position of the institution. The empirical model also shows a positive effect of risk on the level of capital, probably indicating regulators' preference for capital, as a mean of restricting risk-taking activities. Finally, as in most studies analysing the determinants of bank efficiency (See Berger and Humprey, 1997), banking capital is found to affect positively the efficiency of the financial institutions indicating that better capitalised banks tend also to operate more efficiently.

6.2 Determinants of bank risk. The relationship between capital, inefficiency and risk

Tables 6.1 to 6. 8 show the results of the models that offer a vision of the determinants of bank risk-taking for European banks over period under of study. For ease of exposition the results are presented to each equation specification that look at the determinants of bank risk, capital and efficiency individually (One of course needs to remember that all the estimates reported come from a system of equations estimation).

Table 6.1 shows the results of the regression in which accounting risk is utilized as the dependent variable. As expected, the results show that the amount of loans, generally considered riskier than other assets, influences positively the amount of bad loans, as indicated by the negative sign of the securities to total assets (SOTA) ratio. Regarding changes in the rate of growth of the loan portfolio, the negative coefficient on the GROWTH term, and the positive coefficient of SQGROWTH suggest that the relationship between loan growth and portfolio risk is U shaped, that is, while a low rate of loan growth does not appear to have a negative effect on the amount of bad loans, a large credit expansion would rapidly (exponentially) deteriorate the quality of the portfolio.

These results are similar to those found by Kwan and Eisenbeis (1997), and would tend to support the regulators' view in which a fast credit expansion followed by a decline in loan quality is often associated with moral hazard and agency problems. The sign of the cost inefficiency variable also supports this view as it shows a positive and significant coefficient indicating that more inefficient banks are also more prone to risk-taking. This moral hazard hypothesis would fall within what Berger and De Young (1997) called the 'bad management' hypothesis, according to which bank managers have problems both in controlling operating expenses and in screening and monitoring loans.

However, and contrary to the moral hazard hypothesis, the ratio of equity to total assets (CAP) is significantly and positively related to risk. This can be argued to probably be the effect of regulatory and market pressure that would force banks with a large and recognized proportion of bad loans to hold a larger amount of capital. This is consistent with the Kwan and Eisenbeis (1992) results and with regulators preference for using capital requirements rather than portfolio restrictions to discipline inefficient banks.

The fact that only accounting measures of risk which reflect bank risk with a lag and not market measures of risk are related to capital would support the regulatory hypothesis rather than the Kim and Santomero (1988) hypothesis according to which banks could respond to regulatory actions forcing them to increase their capital by increasing asset risk.

Finally, the negative relation between earnings and bad loans would also tend to support this 'bad management' version of the moral hazard hypothesis in which less efficient managers who are able to generate only a low amount of profit per unit of capital invested would also be responsible for a deterioration in credit quality.

Table 6.1 BAD LOANS as dependent variable (Two Stage Least Squares estimation with Fixed Effects[152])

Variable	Coefficient	Standard Error	t-values	p-values
Constant	0.858	0.464	1.852	0.064
CAP	0.135	0.017	8.134	0.000
C_INEFF	0.823	0.053	15.592	0.000
GROWTH	-0.249	0.050	-4.954	0.000
GROWTHSQ	0.213	0.041	5.259	0.000
SLOPE	0.562	0.057	9.775	0.000
ROA	-0.101	0.070	-1.434	0.152
SOTA	-0.130	0.016	-7.988	0.000
D_90	-2.237	0.295	-7.596	0.000
D_91	-1.963	0.250	-7.848	0.000
D_92	-1.088	0.250	-4.344	0.000
D_93	0.497	0.236	2.108	0.035
D_94	-0.170	0.237	-0.719	0.472
D_95	-0.517	0.245	-2.107	0.035
D_96	-0.048	0.232	-0.209	0.834

Source: Author's own estimations
Note 1: CAP indicates capital to total assets ratio, C_INEFF indicates cost inefficiency, GROWTH is the one year loan growth, GROWTHSQ is the square of the GROWTH variable trying to into account excessive loan growth, SLOPE is the slope of the yield curve, ROA is the return on assets, SOTA is the securities to total assets ratio. $R^2_{adj.}$= 0.43, n= 3453

Table 6.2 shows that using profit efficiency as an endogenous explanatory variable, the results follow a similar pattern to the previous model. In the case of the inefficiency variable, it can be seen that less efficient institutions are more prone to risk-taking than their more profit efficient counterparts. Consequently, these results would probably go against the hypothesis that efficient banks with good management have more flexibility in taking on additional risk and concords with the moral hazard hypothesis which states that less efficient banks are likely to take on more risks.

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152 Results from the Haussman (1978) test show that we have to reject the use of random effects, so this factor coupled with the specification of our model suggest that the use of fixed effects seems to improve the estimation of our model. The F and LR tests indicate the convenience of using fixed effects as opposed to the classical model in almost all the regressions. (See Baltagi, 1995, Chapter 4, for an explanation of the different tests and De Bondt 2000, pg.79, for a practical application to European banking data). As we do not use OLS, R-squares adjusted are not restricted to be bound between (0,1).

The positive correlation between an increase in reported portfolio risk and the accompanying increase in the equity to total assets ratio could be attributed to the action of regulators and the markets which force riskier banks to hold a larger amount of capital, as the marginal cost of capital would be clearly more expensive for these institutions (see Hughes and Mester, 1998).

Table 6.2 BAD LOANS as dependent variable (Two Stage Least Squares estimation with Fixed Effects) including profit efficiency as efficiency proxy.

Variable	Coefficient	Standard Error	t-values	p-values
Constant	0.803	0.463	1.733	0.083
CAP	0.136	0.017	8.150	0.000
P_INEFF	0.819	0.053	15.549	0.000
GROWTH	-0.248	0.050	-4.923	0.000
GROWTHSQ	0.213	0.041	5.238	0.000
SLOPE	0.560	0.058	9.721	0.000
ROA	-0.103	0.070	-1.456	0.145
SOTA	-0.131	0.016	-8.004	0.000
D_90	-2.200	0.296	-7.443	0.000
D_91	-1.931	0.251	-7.691	0.000
D_92	-1.050	0.251	-4.179	0.000
D_93	0.545	0.237	2.303	0.021
D_94	-0.149	0.237	-0.626	0.531
D_95	-0.495	0.246	-2.013	0.044
D_96	-0.037	0.232	-0.161	0.872

Source: Author's own estimation.
Note: P_INEFF indicates profit inefficiency. $R^2_{adj.}$= 0.37, n= 3552

Table 6.3 incorporates the values of the betas of individual banking firms as the measure of risk (see, for instance, Dewenter and Hess 1997, and Weltmore and Brick, 1998) and an indicator for charter value is included among the independent variables. The equation is calculated using the same system of simultaneous equations using the same set of instrumental variables, and an indicator for charter value is included among the independent variables.

It is important to emphasize that when one interprets the results of the models incorporating market values of risk, only those firms listed actively on the respective country stock exchanges are included in the sample so that the sample size is much smaller than the size of the sample used to obtain results in Tables 6.1 and 6.2 where accounting measures of bank risk are used.

The results from table 6.3 show that as was the case with accounting measures of risk, there is a direct and positive relationship between the growth of loans and banking risk so that banks that have experienced a period of loan expansion are recognised as riskier by the market. Regarding the cost inefficiency (CINEFF) variable, we also observe a positive relationship between cost inefficiency and risk that would tentatively provide support for the moral hazard hypothesis.

Finally, it is surprising that the banks' charter value is positively related to beta. We speculate that this result could possibly be due to the fact that the proxy we use to account for charter value is (to a large extent) picking up the effect of market value creation over book value. Or, in other words, because of the way it is constructed, the value representing charter value is mainly capturing the effect of performance as measured by the market. So the fact that a higher performance is accompanied by higher risk, measured by beta, could be a plausible result from a portfolio risk-return trade-off point of view.

To illustrate this argument further, it may be convenient to consider how bank charter value (See Chapter 5 Section 3.4.3) and market to book value have been constructed in the empirical literature (See Chapter 5, Section 3.4.4). As we indicated in Chapter 5, charter value is defined as the Tobin q of each banking institution, that is the ratio of the market value of equity plus the accounting value of liabilities divided by the accounting value of total assets, but this variable (also used by Keeley (1990) and Demsetz, Saidenberg, and Strahan (1996)), can be subject to substantial criticism (see Gropp and Vessala, 2000), as it may reflect not only market power derived from oligopoly rents, but it may also merely be a reflection of performance and value creation.

$$CV = \frac{E + L}{A}$$

Where:

- CV= charter value
- A = accounting value of total assets
- L= accounting value of total liabilities
- E= market value of equity

Given the increased emphasis on the creation of shareholder value in European banking over the period of study, which tends to increase the differences between accounting and market values compared with past years (see Danthine, et al. 1999), this variable (we believe) could probably largely be interpreted as a measure of performance. Consequently, as indicated, the positive sign of the coefficient of this variable explaining market risk could also be seen within a risk-return framework so that better stock market performers are also subject to a larger degree of volatility.

Table 6.3 BETA as dependent variable (Two Stage Least Squares estimation with Fixed Effects).

Variable	Coefficient	Standard Error	t-values	p-values
Constant	0.763	0.869	0.877	0.380
CAP	0.095	0.065	1.455	0.146
CINEFF	0.137	0.027	5.515	0.001
GROWTH	-0.501	0.266	-1.884	0.060
GROWTHSQ	0.314	0.159	1.973	0.048
Q_CHV	0.017	0.008	2.066	0.039
SLOPE	-0.027	0.140	-0.195	0.845
SOTA	-0.092	0.064	-1.444	0.149
D_90	0.633	0.691	0.915	0.360
D_91	1.411	0.871	1.620	0.105
D_92	-0.820	0.521	-1.575	0.115
D_93	-0.227	0.386	-0.588	0.556
D_94	-0.051	0.386	-0.131	0.896
D_95	-0.254	0.428	-0.594	0.553
D_96	-0.154	0.387	-0.397	0.692

Source: Author's own estimation.
Note: BETA indicates the value of the coefficient obtained from running the regression of the weekly returns of each bank against the overall market returns. Q_CHV indicates charter value. $R^2_{adj.}$= 0.08, n= 452

In Table 6.4, again we incorporate the profit efficiency variable instead of the cost efficiency variable used earlier, yet the results remain mainly unaltered. The only exception is that profit inefficiency appears to be insignificant. The reason for this could be that differences in profit efficiency are not so pronounced among the largest banks (see Humphrey, 1987, and Maudos et al., 2000) in contrast to differences in profit efficiency among medium and small-sized banks. It could be that heightened competition between the largest banks forces them to operate closer to the profit frontier.

Table 6.4 BETA as dependent variable (Two Stage Least Squares estimation with Fixed Effects) including profit efficiency as efficiency proxy.

Variable	Coefficient	Standard Error	t-values	p-values
Constant	0.763	0.868	0.879	0.380
CAP	0.095	0.065	1.456	0.146
P_INEFF	0.856	0.288	0.097	0.923
GROWTH	-0.501	0.266	-1.886	0.059
GROWTHSQ	0.314	0.159	1.975	0.048
Q_CHV	0.017	0.008	2.067	0.039
SLOPE	-0.027	0.140	-0.195	0.845
SOTA	-0.092	0.064	-1.444	0.149
D_90	0.633	0.693	0.914	0.361
D_91	1.411	0.872	1.618	0.106
D_92	-0.821	0.520	-1.578	0.115
D_93	-0.227	0.386	-0.589	0.556
D_94	-0.051	0.387	-0.131	0.896
D_95	-0.254	0.428	-0.594	0.553
D_96	-0.154	0.387	-0.397	0.691

Source: Author's own estimation. $R^2_{adj.}$= 0.09, n= 461

Tables 6.5 to 6.6 follow in the same way as the previous tables, but here we use a different dependent variable accounting for market risk[153]. These two tables use annual standard deviations of each bank stock returns (DEVIATION) instead of betas as the dependent variable. That is, we incorporate the simple standard deviation of weekly returns for each institution during each year. Unlike the previous measure of banking risk (BETA), this measure of banking risk, recently used by Gropp and Vesala (2000) and Galloway, Lee and Roden (1997) provides an absolute measure of banking risk and tend to be affected by changes in the volatility of the overall stock market. The results of these additional sets of equations are quite similar to those found in the tables using beta as the dependent variable and thus confirm the results reported relating to banking risk, bank capital and efficiency.

Table 6.5 DEVIATION of stock returns as dependent variable (Two Stage Least Squares estimation with Fixed Effects)

Variable	Coefficient	Standard Error	t-values	p-values
Constant	0.998	0.931	1.073	0.283
CAP	0.095	0.070	1.351	0.177
CINEFF	0.977	0.295	0.103	0.918
GROWTH	-0.502	0.285	-1.764	0.078
GROWTHSQ	0.306	0.170	1.797	0.072
Q_CHV	0.019	0.009	2.185	0.029
SLOPE	-0.076	0.150	-0.511	0.609
SOTA	-0.092	0.069	-1.340	0.180
D_90	0.603	0.740	0.814	0.415
D_91	1.383	0.932	1.484	0.138
D_92	-1.016	0.558	-1.822	0.069
D_93	-0.375	0.413	-0.908	0.364
D_94	-0.186	0.414	-0.451	0.652
D_95	-0.123	0.458	-0.268	0.789
D_96	-0.107	0.414	-0.260	0.795

Source: Author's own estimation.
Note: DEVIATION is calculated as the standard deviation of returns of each banking institutions for every given year. $R^2_{adj.}$= 0.12, n= 452

153 As in previous equations, when running the simultaneous equations the instrumental variables and the other two endogenous variables considered remain unchanged.

Table 6.6 DEVIATION of stock returns as dependent variable (Two Stage Least Squares estimation with Fixed Effects) including profit efficiency as the efficiency proxy.

Variable	Coefficient	Standard Error	t-values	p-values
Constant	0.999	0.930	1.074	0.283
CAP	0.095	0.070	1.351	0.177
P_INEFF	0.965	0.295	0.102	0.919
GROWTH	-0.503	0.285	-1.766	0.077
GROWTHSQ	0.306	0.170	1.799	0.072
Q_CHV	0.019	0.009	2.186	0.029
SLOPE	-0.077	0.150	-0.511	0.609
SOTA	-0.092	0.069	-1.341	0.180
D_90	0.603	0.742	0.813	0.416
D_91	1.383	0.933	1.482	0.138
D_92	-1.016	0.557	-1.825	0.068
D_93	-0.376	0.414	-0.909	0.363
D_94	-0.187	0.414	-0.451	0.652
D_95	-0.123	0.459	-0.268	0.789
D_96	-0.108	0.414	-0.260	0.795

Source: Author's own estimation. $R^2_{adj.}$= 0.14, n= 461

As in Saunders, Strock and Travlos (1990) Tables 6.7 and 6.8 also the standard deviation of residuals of the regression of the weekly returns of each individual bank (for each year) against the overall stock market index (INTRINSIC RISK). Unlike BETA which can be considered as a measure of market risk for each individual bank, the intrinsic risk variable would be a relative proxy of banking risk accounting for non systematic risk.

Table 6.7 Intrinsic Risk of stock returns as dependent variable (TSLS estimation with Fixed Effects).

Variable	Coefficient	Standard Error	t_values	p-values
Constant	1.021	0.922	1.107	0.278
CAP	0.093	0.069	1.348	0.187
C_INEFF	0.890	1.944	0.458	0.611
GROWTH	-0.488	0.275	-1.775	0.084
GROWTHSQ	0.291	0.169	1.722	0.075
Q_CHV	0.017	0.009	1.933	0.062
SLOPE	-0.068	0.150	-0.453	0.651
SOTA	-0.091	0.060	-1.517	0.175
D_90	0.577	0.740	0.780	0.436
D_91	1.372	0.936	1.466	0.144
D_92	-1.021	0.543	-1.880	0.066
D_93	-0.382	0.410	-0.932	0.340
D_94	-0.191	0.421	-0.454	0.643
D_95	-0.120	0.454	-0.264	0.784
D_96	-0.100	0.411	-0.243	0.793

Source: Author's own estimation.

Note: Intrinsic risk is calculated as the standard deviation of the residuals obtained from the regression of the individual bank returns on the market returns. $R^2_{adj.}$= 0.11, n= 452

Table 6.8 Intrinsic risk of stock returns as dependent variable (TSLS estimation with Fixed Effects), including profit efficiency as efficiency proxy.

Variable	Coefficient	Standard Error	t-values	p-values
Constant	1.021	0.936	1.084	0.278
CAP	0.094	0.071	1.325	0.185
P_INEFF	0.103	1.961	0.107	0.915
GROWTH	-0.503	0.289	-1.740	0.082
GROWTHSQ	0.303	0.173	1.750	0.080
Q_CHV	0.019	0.009	2.186	0.029
SLOPE	-0.075	0.152	-0.496	0.620
SOTA	-0.092	0.070	-1.314	0.189
D_90	0.588	0.753	0.780	0.435
D_91	1.393	0.948	1.469	0.142
D_92	-1.033	0.566	-1.827	0.068
D_93	-0.385	0.420	-0.916	0.360
D_94	-0.193	0.420	-0.459	0.647
D_95	-0.130	0.466	-0.278	0.781
D_96	-0.110	0.421	-0.260	0.795

Source: Author's own estimation. $R^2_{adj.}$= 0.12, n= 461

The results from tables using the variable intrinsic risk as the dependent variable confirm the results presented in the tables using the market betas (BETA) and the standard deviation of returns (VOLATILITY) as the bank risk dependent variable.

All in all, the aforementioned results looking at the determinants of bank risk-taking are very similar to those obtained by Kwan and Eisenbeis (1997) in their study of large US banks. In addition, the main findings suggest the predominance of a moral hazard effect, which works in two ways: inefficient banks and banks experiencing an exponential rate of loan growth are also more likely to take on more risks.

However, unlike Kwan and Eisenbeis (1992) who found a negative relationship between capital and risk, and Shrieves and Dahl (1992) who found a positive relationship between changes in capital and risk, we do not find significant relationship in our estimates that include market measures of risk. It may be that the positive statistically significant relationship we find when using accounting measures of risk (BADLOANS) is possibly due to the action of regulators forcing riskier banks to reduce ('ex post') leverage. Analysing a UK bank sample from 1989 to 1995, Editz, Michael and Perraudin (1998) concluded that regulators affected bank behaviour by influencing the banks' capital targets. It could be that this is the case also in other European countries in our sample.

6.3 Capital as the dependent variable: Relationship between capital, inefficiency and risk

Tables 6.9 and 6.10 show the results for the model where capital is used as the dependent variable against a set of explanatory variables. The results for the risk variable BADLOAN indicates, as in the previous equations, that regulators are probably forcing riskier banks to hold a larger amount of capital. A similar motivation could also be argued for the positive and significant coefficient of the off-balance sheet to total assets item and the GAP coefficient, so that banks which are more active in OBS activities or have a larger interest rate GAP are forced to operate with larger amounts of capital.

However, as was the case in the earlier risk equations, there is also evidence of the moral hazard hypothesis as more inefficient banks are shown to operate with larger amounts of leverage so the effect of inefficiency and higher leverage reinforce each other. The negative sign of the coefficient on the return on assets variable also probably points in this direction, so that banks with low earnings also have a higher leverage. Once the rest of the variables have been taken into account, we find a positive relationship between size and the capital ratio. Normally, descriptive statistics show that the largest banks typically operate with lower capital ratios, the rationale is that they can better diversify their portfolio and have better access to equity capital. On the other hand, because of their larger bank status, they may have moral hazard incentives to take on more risk because of their TBTF status (see Demsetz and Strahan, 1997). Once other factors have been taken into account, if these institutions are operating with a larger level of portfolio risk they are likely to be forced to hold more capital. These results also hold in Table 6.10, where the results report estimates for the model that incorporates a variable accounting for profit inefficiency.

In general we find evidence that riskier banks hold a larger amount of capital suggesting the impact of regulatory action. There is also evidence of moral hazard, as shown by the fact that less cost and profit efficient banks or banks with lower earnings are more likely to increase their amount of leverage. This may suggest that supervisors should consider measures of bank efficiency along with other traditional predictors of troubled banks, as less efficient banks may have incentives to take on additional amounts of risk in order to compensate for their increased costs potentially derived from larger capital requirements.

These results are different from those obtained by Kwan and Eisenbeis (1997) for very large banks (not for medium sized banks) and very small banks but similar to the results obtained by Berger and De Young (1997) in their capital equation.

Table 6.9 Capital as dependent variable (Two Stage Least Squares estimation with Fixed Effects)

Variable	Coefficient	Standard Error	t-values	p-values
Constant	-1.973	0.309	-6.393	0.000
CINEFF	-0.149	1.175	-8.484	0.000
BADLOAN	0.162	1.231	6.983	0.000
GAP	0.235	2.149	1.577	0.115
OBSOTA	0.125	2.467	2.685	0.007
SIZE	0.999	0.002	563.549	0.000
ROA	-0.392	2.118	-3.302	0.001
D_90	2.356	0.605	3.897	0.000
D_91	2.842	0.626	4.542	0.000
D_92	0.827	0.441	1.876	0.061
D_93	-0.247	0.386	-0.640	0.522
D_94	-0.166	0.384	-0.432	0.666
D_95	0.141	0.384	0.366	0.714
D_96	-0.169	0.383	-0.441	0.659

Source: Author's own estimation. $R^2_{adj.}$= 0.31, n= 3453

Table 6.10 Capital as Dependent variable (Two Stage Least Squares Estimation with Fixed Effects), including profit efficiency as the efficiency proxy.

Variable	Coefficient	Standard Error	t-values	p-values
Constant	-1.804	0.318	-5.674	0.000
P_INEFF	-0.149	1.176	-8.455	0.000
BADLOAN	0.163	1.233	6.981	0.000
GAP	0.234	2.149	1.566	0.117
OBSOTA	0.130	2.472	2.744	0.006
SIZE	0.999	0.002	560.000	0.000
ROA	-0.388	2.119	-3.249	0.001
D_90	2.332	0.606	3.852	0.000
D_91	2.819	0.627	4.500	0.000
D_92	0.778	0.441	1.764	0.078
D_93	-0.335	0.389	-0.862	0.389
D_94	-0.203	0.386	-0.528	0.598
D_95	0.102	0.386	0.264	0.792
D_96	-0.191	0.385	-0.497	0.619

Source: Author's own estimation. $R^2_{adj.}$= 0.38, n= 3552

6.4 Inefficiency as the dependent variable: Relationship between capital, inefficiency and risk

Table 6.11 shows that bank capital (CAP) has a significant and negative coefficient indicating that better capitalised firms are more efficient than more leveraged firms, this confirms the results of the capital equations and, given that capital is more expensive than debt at the margin, better capitalised institutions probably have a greater incentive to operate more efficiently. This result is also found by Kwan and Eisenbeis (1997) and, in general, in most of the literature analysing the determinants of bank efficiency (See Berger and De Young, 1997).

There appears to be a U-type relationship between inefficiency and loan growth so efficiency improves with loan growth, yet as loan growth exceeds a certain threshold, excessive loan growth damages operating efficiency. This may indicate, as in the set of risk equations, that entrenched managers who pursue a purely growth objective tend to operate inefficiently. With regard to the effects of risk on efficiency, the results are consistent with those in the risk equation (Tables 6.1 to 6.8). The coefficient accounting for credit risk (BADLOANS) is positive and significant, so it appears that operating inefficiently stems, among other things, from having to manage a larger amount of bad loans and correlates with the results found in the BADLOANS equation indicating that the relation goes in both directions. The results do not change when, in the following table (see Table 6.13), we substitute profit inefficiency for cost inefficiency.

All in all, the main finding is that banking capital is positively related to efficiency and that excessive credit risk is an important determinant of the inefficiency variable. These results agree with the results obtained by earlier studies by Kwan and Eisenbeis' (1997) results for a sample of the largest US banks and those of Berger and De Young (1997).

Table 6.11 Cost Inefficiency as dependent variable (Two Stage Least Squares estimation with Fixed Effects).

Variable	Coefficient	Standard Error	t-values	p-values
Constant	-2.415	0.390	-6.197	0.000
BADLOAN	0.836	0.049	16.955	0.000
CAP	-0.098	0.013	-7.658	0.000
SOTA	0.098	0.012	7.817	0.000
GROWTH	-0.208	0.043	-4.818	0.000
GROWTHSQ	0.177	0.035	5.083	0.000
D_90	0.816	0.274	2.983	0.003
D_91	1.106	0.252	4.391	0.000
D_92	0.156	0.225	0.693	0.488
D_93	-0.538	0.213	-2.530	0.011
D_94	-0.399	0.210	-1.899	0.058
D_95	-0.275	0.211	-1.306	0.192
D_96	-0.202	0.210	-0.963	0.336

Source: Author's own estimation. $R^2_{adj.}$= 0.08, n= 3453

Table 6.12 Profit Inefficiency as dependent variable (Two Stage Least Squares estimation with Fixed Effects)

Variable	Coefficient	Standard Error	t-values	p-values
Constant	-2.355	39.315	-5.991	0.000
BADLOANS	0.841	0.050	16.903	0.000
CAP	-0.100	0.013	-7.715	0.000
SOTA	0.099	0.013	7.875	0.000
GROWTH	-0.208	0.043	-4.781	0.000
GROWTHSQ	0.178	0.035	5.059	0.000
D_90	0.779	0.276	2.820	0.005
D_91	1.075	0.254	4.230	0.000
D_92	0.114	0.227	0.502	0.616
D_93	-0.600	0.214	-2.796	0.005
D_94	-0.425	0.212	-2.006	0.045
D_95	-0.300	0.213	-1.411	0.158
D_96	-0.215	0.211	-1.017	0.309

Source: Author's own estimation. $R^2_{adj.}$= 0.09, n= 3552

6.5 Conclusions

This chapter reports the results of models analysing the relationship between bank risk, capital and efficiency (profit and cost) for a sample of large European banks between 1990 and 1997. The empirical analysis conducted builds on earlier US work and use a simultaneous equation model (estimated through two stage least squares with fixed effects) in which capital, risk and cost efficiency are the endogenous variables that are regressed against each of the other endogenous variables and a set of explanatory exogenous variables. Kwan and and Eisenbeis' (1997) and Berger and De Young (1997) models are refined by including market measures of bank risk, as well as including proxies accounting for bank charter value, and profit efficiency.

The majority of the results concord with the US findings of Kwan and Eisenbeis (1997) and Berger and De Young (1997). A positive effect of inefficiency on bank risk-taking, and of inefficiency on higher leverage was found, therefore, supporting the moral hazard hypothesis that inefficient organisations are more likely to have more incentives towards bank risk-taking.

In addition, excessive rates of loan growth are found to have a negative effect on banking risk and efficiency. This supports the hypothesis that due to agency problems, entrenched managers may pursue growth objectives that damage both the risk and efficiency position of the institution. The empirical model also shows a positive effect of risk on the level of capital, probably indicating regulators' preference for capital, as a mean of restricting risk-taking activities. Finally, as in most studies analysing the determinants of bank efficiency, banking capital is found to affect positively the efficiency of the financial institutions indicating that better capitalised banks tend also to operate more efficiently.

CHAPTER 7

CONCLUSIONS

7.1 Introduction

Market forces, technological advances and other factors have induced regulators to relax many of the barriers that restricted competition in banking. EU banking markets have become increasingly integrated and liberalized on the road to greater product and service deregulation. These forces are progressively increasing concentration and emphasizing the concept of efficiency of financial institutions. On the other hand, this could be making the banking sector riskier. In this environment, bank capital has become a focal point of bank regulation as the primary means for limiting risk-taking by banks. Yet, while most theoretical and empirical models tend to agree on the fact that deregulation could increase the incentives for excessive risk-taking, the relationship between capital and risk is unclear at both the theoretical and empirical level.

While there is almost a consensus view that prudential regulation should be set up in conjunction with other prudential regulatory instruments, it is shown that among the different tools used by regulators for prudential regulatory purposes, capital adequacy regulations have played an increasingly prominent role, mainly due to concerns about financial stability.

This thesis presents various models to provide evidence concerning the relationship between capital and risk in European banking between 1990 and 1997. In particular, the thesis advances the previous US literature by examining EU bank behavior and also by including market information on the risk of listed banks, as well as proxies for bank charter value and profit efficiency, in the simultaneous modeling specification.

7.2 Main conclusion of the empirical model

The relationship between bank risk-taking, leverage and efficiency are analysed in a simultaneous equation framework. Inefficiency is found to have a positive effect on credit and market risk. This positive relationship between inefficiency and bank risk-taking supports the moral hazard hypothesis that poor performers are more prone to risk-taking than more efficient organisations. However, the positive effect of capital on certain measures of credit risk is tentatively attributed to the regulators preference to impose more stringent capital requirements on riskier banks, probably because capital requirements can be more easily applied than portfolio restrictions.

As in previous studies, we also find that better-capitalised firms tend to operate more efficiently, indicating that the level of capital could be an ex-ante incentive for improving performance and reducing agency problems as suggested by the latest theoretical literature[154].

At the same time, we also find evidence of a U-type exponential relationship between loan growth and risk and inefficiency. According to our results, up to a certain limit as loan growth increases, efficiency improves. Yet when loan growth rate becomes excessive, the outcome is an increase in risk-taking and a significant decline in efficiency.

7.3 Limitations

The main limitation of this study may be related to the sample size under investigation. Firstly, only large and medium size banks are included in the sample. Secondly, only quoted banks can be included when stock market information is used. Thirdly, our sample is restricted to the largest five EU countries, so it could be that results for smaller institutions or in countries not included in our model may be different.

[154] Dewatripont and Tirole (1993) and Santos (2000).

Regarding the variables included in our model, the variables accounting for charter value derived from the previous literature, could probably be subject to criticism as it may also reflect the creation of market value due to performance rather than charter value. Limitations associated with simultaneous modeling approaches also apply to our results (see Green, 1997). Finally, there are also limitations derived from the time period selected as it covers only the period ranging from1990 to 1997.

7.4 Possible policy conclusions

The results offer support to the findings already outlined in the established US literature, namely, that both regulatory action and moral hazard play a role when banking institutions decide on capital, risk and efficiency trade - offs. In terms of specific policy conclusions, our results would tentatively suggest that supervisors should consider bank efficiency measures along with traditional predictors of bank failure to help identify troubled banks. This is because less efficient banks appear to take on additional amounts of risk in order to compensate for the increased costs derived from larger capital requirements. Besides, the fact that the European banking markets are becoming increasingly more integrated together with the existence of a flat-rate deposit insurance scheme in most European countries would suggest that regulators should be concerned with the actual determinants of bank risk-taking.

Finally, as intuitively expected, according to our results, supervisors should also be concerned with the effect of rapid loan expansion in terms of bank risk-taking. This maybe of importance in Europe as some countries have been experiencing loan growth rates above 20% over the last 4 years, prompted by a positive phase of the economic cycle coupled with an increase in competition in banking and the effect of a single monetary policy.

7.5 Suggestions for future research

The topic of the determinants of bank risk-taking and its relation to bank capital has developed rapidly in the theoretical literature but has hardly been addressed in the empirical literature, particularly in Europe. There are four main areas for potential future research:

1. To analyse the consistency of the results using other panel data methods. For instance, and particularly for the purpose of this study, the use of latent variables methods using LISREL, could be particularly fruitful. The main reason is that this kind of structural equation modelling could provide a further insight into the relationships among variables in formally less constrained framework.

2. Concerning the relationship between capital changes and risk, a partial adjustment model to see the effects of changes in capital and changes in banking risk could also be used. This could be a topic of interest that has not been undertaken in Europe. Besides, the inclusion of target efficiency (which is as in the case of capital and risk often determined by several factors) together with target capital and risk, could probably improve the empirical model.

3. Finally, after analysing the empirical results and the discussion of Chapters 2 and 3, as well as the comments from several academics (see for instance, Benston and Bennink, 2001), we wonder whether the banking sector is becoming riskier. Empirically, however, it is difficult to model this problem. A time series model of volatility could probably address this issue (see Perez-Quiros, 2001) and provide further insight into this question.

4. Finally, it would be interesting to investigate further the issue of agency problems. In this case, it would be fruitful to look at whether banks which are stock controlled tend to take more risk than managerially controlled firms as suggested by Saunders, Strock and Travlos (1990) in the US.

7.6 Concluding remarks

This final chapter has briefly summarised the main conclusions of the introductory and empirical chapters. The results derived from our model are broadly similar to those found in the US literature suggesting that both regulatory action and moral hazard incentives affect the relationship between capital and risk for the largest banks. The model has some limitations principally derived from the data sample and the time period in which the study was undertaken. Finally, we think that there are substantial avenues for further research in connection with the issue of the determinants of bank risk-taking, which could be of interest to academics and policymakers alike, particularly given the current trends occurring in Western Europe.

APPENDIX I European Union major financial directives contributing to the creation of the Single Financial Market

1960 EEC Council: First Directive for the implementation of Article 67 of the Treaty, 11 May 1960

73/183 Council Directive of 28 June 1973 on the abolition of restrictions on freedom of establishment and freedom to provide services in respect of self- employed activities of banks and other financial institutions (repealed by Directive 2000/12/EC)

77/780 First Council Directive of 12 December 1977 on the coordination of the laws, regulations and administrative provisions relating to the taking up and pursuit of the business of credit institutions (repealed by Directive 2000/12/EC)

80/390 Council Directive of 17 March 1980 coordinating the requirements for the drawing up, scrutiny and distribution of the listing particulars to be published for the admission of securities to official stock exchange listing

82/121 Council Directive of 15 February 1982 on information to be published on a regular basis by companies the shares of which have been admitted to official stock-exchange listing

83/350 Council Directive of 13 June 1983 on the supervision of credit institutions on a consolidated basis

85/611 Council Directive of 20 December 1985 on the coordination of laws, regulations and administrative provisions relating to undertakings for collective investment in transferable securities (UCITS)

86/635 Council Directive of 8 December 1986 on the annual accounts and consolidated accounts of banks and other financial institutions

87/102 Council Directive of 22 December 1986 for the approximation of the laws, regulations and administrative provisions of the Member States concerning consumer credit

88/361 Council Directive of 24 June 1988 for the implementation of Article 67 of the Treaty

89/117 Council Directive 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

89/298 Council Directive of 17 April 1989 coordinating the requirements for the drawing-up, scrutiny and distribution of the prospectus to be published when transferable securities are offered to the public

89/299 Council Directive of 17 April 1989 on the own funds of credit institutions

89/646 Second Council Directive of 15 December 1989 on the coordination of laws, regulations and administrative provisions relating to the taking up and pursuit of the business of credit institutions and amending Directive 77/780/EEC (repealed by Directive

2000/12/EC)

89/647	Council Directive of 18 December 1989 on a solvency ratio for credit institutions (repealed by Directive 2000/12/EC)
91/308	Council Directive of 10 June 1991 on prevention of the use of the financial system for the purpose of money laundering
92/30	Council Directive of 6 April 1992 on the supervision of credit institutions on a consolidated basis (repealed by Directive 2000/12/EC)
93/22	Council Directive of 10 May 1993 on investment services in the securities field
93/6	Council Directive of 15 March 1993 on the capital adequacy of investments firms and credit institutions
94/19	Directive of the European Parliament and of the Council of 25 April 1994 on deposit-guarantee schemes
95/46	Directive of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data
97/5	Directive of the European Parliament and of the Council of 27 January 1997 on cross-border credit transfers
97/9	Directive of the European Parliament and of the Council of 3 March 1997 on investor-compensation schemes
98/26	Directive of the European Parliament and of the Council of 19 May 1998 on settlement finality in payment and securities settlement systems
2000/12	Directive of the European Parliament and of the Council of 20 March 2000 relating to the taking up and pursuit of the business of credit institutions

APPENDIX II Average capital to total assets ratio of commercial banks in Europe

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Source: Benink and Benston (1998).

APPENDIX III (From chapter 3, proof result 1)

Note: under this framework all banks will chose collinear portfolios.

If we define:

K	Banks' real capital, outstanding amount
$x_1^*(K)$	Actual portfolio chosen by a bank having net worth K
$\mu(K)$	Expectation of $\tilde{K}_1$
$\sigma(K)$	Standard deviation of the return of $x_1^*(K)$
V	Invertible variance covariance matrix.
ρ	Vector of Expected excess returns.
x_M	Portfolio collinear to $V^{-1}\rho$, so that is product is = *I*, and that its return has a unitary variance.

If we remember:

$$\tilde{K}_1 = K + \sum_{i=1}^{n} x_i(\tilde{r}_i - \tilde{r}_o)$$

$$x_1^*(K) = \sigma(K)x_M$$

and

$$\mu(K) = K + \langle x_1^*(K), \rho\rangle = K + \sigma(K)\langle x_M, \rho\rangle$$

So the probability of failure:

$$\Pr obability(\tilde{k}_1 \langle 0) = N\left(-\frac{\mu(K)}{\sigma(K)}\right) = (- < x_M, \rho > - \frac{K}{\sigma(k)})$$

$< x_M, \rho >$ is positive as both os the vectors are positive

and $CR(K) = \dfrac{K}{< x_M, \alpha > \sigma(K)}$

Consequently,

$$P(\tilde{K}_1 < 0) = N(- < x_M, \rho > - < x_M, \alpha > CR(K))$$

As $< x_M, \rho >$ and $\langle x_M, \alpha\rangle$ are positive, the probability of bankruptcy is a decreasing function of the $CR(K)$.

APPENDIX IVa Explanatory variables used on the literature dealing with the determinants of banking capital

The variables determining the target capital could be divided into two main groups according to whether the data used is macro or microeconomic in nature, it could be divided into two main blocks. The first one incorporates variables from individual institutions:

- Variables representing the size of the institution (normally using total assets or loans).
- Representing the profitability of financial institutions (normally by using Return on assets (ROA), return on equity (ROE), net interest income or fee income to total assets or equity.
- Variables representing risk (see table 4.1 and section 4.2 for a comprehensive analysis of this issue).
- Variable representing operational efficiency (that could be either accounting ratios or a more sophisticated measures, see 4.4.1 for details).
- The amount of asset growth or the amount of loans in the portfolio.
- Institutional variables, normally dummies to take into account institutional features of the institutional and distinguish among savings and commercial banks, or quoted and non-quoted.
- The amount of OBS activities normally divided by total assets.
- The cost of capital, which could be represented by the ratio net interest income to total equity.
- A proxy accounting for the charter value of the institution.
- A variable taking into account the deposit insurance premium as it could be banking contributions to the deposit insurance fund divided by insured deposits.
- A proxy for the amount of liquidity as could be the ratio of liquid assets to total deposits or loans, and finally
- A dummy variable to take into account the effect of regulation or variables incorporating regulatory pressure normally increasing for the lower capitalised banks.

The second one would incorporate industry wide variables including 1) Macroeconomic variables such as GDP, and long or short interest rates and the slope of the yield curve 2) An index taking into account the banking sentiments, 3) A proxy that takes into account market concentration such a Herfindahl index.

APPENDIX IVb Main means of augmenting regulatory capital ratios

When looking at the effectiveness of banking capital regulation researchers also have tried to find out how this has been achieved. Clearly, a change in the capital ratio could be due to a change in the denominator TIER 1 or TIER 2, or the numerator of the ratio Risk weighted assets or total assets, more specifically an increase in the capital ratio can be attained by:

1. Capital (the denominator) could be increased by:

   ⇒ I) Retaining earnings

   ⇒ II) Issuing equity

   ⇒ III) Issuing subordinated debt (or similar TIER 2 instruments)

2. The numerator (RWA) could be reduced by:

   ⇒ I) Cutting back loans (if too strong *'credit crunch'* hypothesis could apply)

   ⇒ II) Shifting assets and OBS towards those with lower credit weights

APPENDIX V Fixed effects in panel data

The use of a panel data procedure would avoid biases derived from correlation within each individual bank observations and the error term. In the case of Fixed Effect each regression incorporates dummy variables for every bank in the sample. The individual bank dummies control for bank location, regulatory environment, and other idiosyncrasies that are not already captured by the other variables, so that allowing for a purer test of the relationship between the studied variables. Analytically,

$$y_{it} = x_{it}^{'}\beta + \varepsilon_{it} \qquad \begin{cases} i = 1,\_,N \\ t = 1,\_,T_i \end{cases}$$

As $T_i \neq T$ for every i, the panel data set is unbalanced. The convention is to stack observations in groups of all time observations for each individual:

$$y = (y_{11}, y_{12}, \_, y_{1T_1}, y_{21}, y_{22}, \_, y_{2T_2}, y_{N1}, y_{N2}, \_, y_{NT_N})^{'}$$

The fixed effects (or within) estimates can be obtained by either a regression of y_{it} on x_{it} and a set of N dummy variables for each individual or, equivalently (using partitioned regression theory) expressing all the regression variables as deviations from individual bank means.

$$y_{it} = x_{it}^{'}\beta + \varepsilon_{it} \qquad \begin{cases} i = 1,\_,N \\ t = 1,\_,T_i \end{cases}$$

As $T_i \neq T$ for every *i*, the panel data set is unbalanced. The convention is to stack observations in groups of all time observations for each individual:

$$y = (y_{11}, y_{12}, \_, y_{1T_1}, y_{21}, y_{22}, \_, y_{2T_2}, y_{N1}, y_{N2}, \_, y_{NT_N})^{'}$$

APPENDIX VI List of quoted banks included in the sample in order to calculate the restricted market risk measures

FRANCE

Banque Nationale de Paris BNP
Crédit Agricole de la Brie
Crédit Agricole d'Ile-de-France
Crédit Agricole de Toulouse et du Midi Toulousain
Crédit Commercial de France
Crédit Lyonnais
Crédit Agricole du Nord
Crédit Agricole du Morbihan
Société Générale
Via Banque
Natexis S.A.
Crédit Agricole Loire-Atlantique
Crédit Agricole de la Gironde
Crédit Agricole de l'Ille-et-Vilaine
Crédit Agricole Loire Haute-Loire
Crédit Agricole du Morbihan
Crédit Agricole du Pas-de-Calais
Crédit Agricole du Midi
CLF / Dexia France

GERMANY

Rheinische Hypothekenbank AG - RHEINHYP
Bayerische Handelsbank AG
BHF-BANK AG
Commerzbank AG
Deutsche Bank AG
Deutsche Pfandbrief-und Hypothekenbank AG DePfa-

Bank

Dresdner Bank AG

Deutsche VerkehrsBank AG

Deutsche Hypothekenbank (Actien-Gesellschaft)

IKB Deutsche Industriebank AG

Deutsche Hypothekenbank Frankfurt-Hamburg AG

Allgemeine Privatkundenbank AG Allbank

Nürnberger Hypothekenbank

Oldenburgische Landesbank - OLB

Rheinboden Hypothekenbank AG

Süddeutsche Bodencreditbank AG

Trinkaus & Burkhardt KGaA

Vereins- und Westbank AG

Baden-Wuerttembergische Bank AG

Württembergische Hypothekenbank AG

Bankgesellschaft Berlin AG

Deutsche Siedlungs- und Landesrentenbank - DSL Bank

Rheinische Hypothekenbank AG - RHEINHYP

ITALY

Banca Agricola Mantovana SpA

Banco di Chiavari e della Riviera Ligure SpA

Banca di Roma

Credito Bergamasco

Banca Fideuram Spa

Banca Nazionale del Lavoro SpA - BNL

Banca Popolare Commercio e Industria

Banca Popolare di Bergamo - Credito Varesino

Banca popolare dell'Emilia Romagna

Banca popolare di Lodi

Banca popolare di Milano SCaRL

Banca Toscana SpA

Banca Commerciale Italiana SpA, COMIT

Banca Popolare di Cremona SCaRL

Credito Valtellinese SCarl

Banca Popolare di Novara SCarl

Rolo Banca 1473 S.P.A.

Istituto Bancario San Paolo di Torino SpA

Credito Italiano

Banco Desio - Banco di Desio e della Brianza SpA

Banca Intesa (Proforma)

Credito Lombardo

Banco di Napoli SpA

Banca Popolare di Sondrio SCarl

Credito Emiliano SpA

Credito Emiliano SpA

Credito Emiliano SpA

Credito Fondiario

Banca Popolare di Verona - -Banco S. Geminiano ES Prospero Scrl

Banca Popolare di Spoleto SpA

SPAIN

Banco Atlántico SA

Banco Bilbao Vizcaya, BBV

Banco de Andalucia SA

Banco de Castilla SA

Banco de Crédito Balear SA

Banco de Galicia SA

Banco de Vasconia SA

Banco Español de Crédito SA, BANESTO

Banco Herrero SA

Bankinter SA

Banco Pastor SA
Banco Popular Español SA
Banco Zaragozano
Banco Guipuzcoano SA
Caja Postal SA
Banca Catalana SA
Banco Central Hispanoamericano - BCH
Banco de Valencia SA

UNITED KINGDOM

Royal Bank of Scotland plc (The)
Standard Chartered Plc
Alliance & Leicester PLC
Barclays Bank Plc
Halifax PLC
Leopold Joseph Holdings Plc
Lloyds TSB Group plc
Northern Rock PLC
Woolwich Plc

APPENDIX VIIa Alternative profit efficiency

To calculate the profit inefficiencies we use the alternative profit function formulation as specified in Berger and Mester (1997). Inefficiencies are calculated in the same way as in the above cost frontier case because we are maximizing profits (as opposed to minimizing costs) so that the inefficiency term, *u*, is subtracted from the estimated residuals. In general, profit maximisation is more aligned with final goal of most firms, that is, maximise profits. The alternative profit function has essentially the same specification as the cost function with the exception of the dependent variable and the random error. Yet, in the case of alternative profit efficiency, we measure how close a bank comes to the upper bound of the profit performers, given inputs prices and outputs. We use this specification because as Berger and Mester (1997) point out it might be particularly useful when one or more of the following conditions hold:

Output prices cannot be determined exactly.

1. There might be non-quantifiable differences in the quality of banking services.
2. Output markets are not perfectly competitive, so that banks have some market power over prices.
3. Outputs are not completely variable, so that a bank cannot achieve every output scale and product mix.

Condition 3 cannot be ruled out, particularly in Europe over our period of study (see, Molyneux and Thornton, 1992, Vander Vennet, 1994, and Davis and De Brandt, 1998). Condition 2 probably also holds, due to among other factors, important institutional differences (an example could be the heterogeneous number of branches per 1000 capita in different European countries, see ECB, 1999). Finally, estimations of output prices, particularly, when a cross-country analysis based on accounting measures is undertaken, cannot be completely accurate.

APPENDIX VIIb Battese and Coelli' specification used in our empirical analysis to calculate individual bank efficiencies

In our empirical model we have used the Battese and Coelli (1995) specification, which is particularly useful for our purposes. Firstly, it will allow us to calculate inefficiencies for a panel of data so that there would be a larger number of degrees of freedom for estimating the equation parameters, and it permits the simultaneous investigation of both technical change and technical efficiency change over time. From our Chapter 3 we indicated that:

Following Aigner et. Al (1977) we could assume that the error of the production/ cost function is distributed as follows:

$$\varepsilon_i = u_i + v_i$$

Where v_i represents a random uncontrollable factor and u_i is the controllable component of the error term. The underlying idea is that deviations from the production "frontier" might not be entirely under the control of the agent being studied. As in Aigner et al. (1977), v_i are assumed to be independent and identically distributed (i.i.d.) normal random variables with zero mean and constant variance σ_v^2 independent of the u_i's which were assumed to be i.i.d. exponential or half normal random variables. The imposition of a particular statistical distribution (such as the exponential or half normal are important limitations of the model). Several researchers have attempted to overcome this limitation by specifying more general distributional forms, such as the truncated-normal (Stevenson, 1980) and the two parameter gamma (Greene, 1990), which allow for a wider range of distributional shapes.

Following the parameterisation of Battese and Corra (1977), who replace σ_v^2 and σ_u^2 with $\sigma = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$. The parameter γ must lie between 0 and 1, thus this range can be searched to provide a good starting value for use in a iterative maximisation process (see Coelli, Rao and Battese, 1998). Battese and Corra (1977) show that the log-likelihood function in terms of this parameterisation40 is equal to:

$$\ln(L) = -\frac{N}{2}\ln(\Pi/2) - \frac{N}{2}\log(\sigma_s^2) + \sum_{i=1}^{n}\ln[1-\Phi(z_1)] - \frac{1}{2\sigma_s^2}\sum_{i=1}^{n}(\ln Y_i - X_i\beta)^2$$

Where: $Z = \frac{(\ln Y_i - X_i\beta)}{\sigma_s}\sqrt{\frac{\gamma}{1+\gamma}}$ and $\Phi()$ is the distribution function of the standard normal random variable.

The parameter γ can be employed to test whether a stochastic frontier function is essential at all. Acceptance of the null hypothesis γ=0 would indicate that $\sigma_u = 0$ and hence that the term u_i should be removed from the model, and the model would not be an improvement on the more simple translog funcion.

The maximum likelihood estimates of β, σ_s^2 and γ are obtained by finding the maximum of the log-likelihood function. The maximum likelihood estimators are consistent and asymptotically efficient (Aigner et. al., 1977).

Following Coelli, Rao and Battesse (1998), we know that the efficiency of the i-th firm is defined by:

$$TE_i = exp(-u_i)$$

[40] For the half normal distribution of the Aigner, Lovell and Schmidt (1977) model, according to the Battese and Corra (1977) suggested parameters.

The best predictor of exp($-u_i$) is obtained by using:

$$E[exp(-u_i)/e_i]=\frac{1-\Phi(\sigma_A+\sigma_{ei}/\sigma_A)}{1-\Phi(\gamma e_i/\sigma_A)}exp(\gamma e_i+\sigma_A^2/2)$$

Where:

$$\begin{cases} \sigma_a = \sqrt{\gamma(1-\gamma)\sigma_s^2} \\ e_i = \ln(Y_i) - X_i\beta \end{cases}$$

And $\Phi()$ is the density function of a standard random normal variable.

An operational predictor of exp($-u_i$)involves replacing the known parameters with the maximum likelihood or corrected ordinary least squares estimators.

The one-side generalised likelihood-ratio test could be used to test the null hypothesis that there are no technical inefficiency effects. That is H_0:σ^2=0 (≡ H_0:γ^2=0 under the Battese and Corra (1977) parameterisation), against H_1:σ^2>0 (≡ γ^2>1). In other words, as σ^2 is the variance of the normal distribution which is truncated at zero, if this variance is not statistically different from zero, them all the μ_i's are zero implying that all firms are fully efficient. The test estimator will be:

$$LR=-2\{ln[L(H_0)/L(H_1)]\}=-2\{ln[(H_0)]-ln[L(H_1)]\}$$

Where $L(H_0)$ and $L(H_1)$ would be the values of the likelihood function under H_0 and H_1. Under H_0 , LR has an asymptotic distribution $\rightarrow$ $1/2\chi_0^2+1/2\chi_1^2$, (see Coelli 1995a). In practical terms, the critical value of a test for α=0.05 is 2.71.

APPENDIX VIIc Main results of our efficiency models

MODEL 1. COST FUNCTION (unbalanced panel, truncated normal) (with country and time dummies)

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.21511081E+01	0.99996242E+00	0.21511889E+01
beta 1	0.61213133E+00	0.99732437E+00	0.61377356E+00
beta 2	0.39550840E+00	0.99781880E+00	0.39637297E+00
beta 3	-0.79731796E-01	0.99876093E+00	-0.79830712E-01
beta 4	0.46878152E+00	0.99981275E+00	0.46886932E+00
beta 5	0.23917441E+00	0.99981833E+00	0.23921787E+00
beta 6	0.16261517E+00	0.94828179E+00	0.17148402E+00
beta 7	0.16890314E+00	0.96436226E+00	0.17514491E+00
beta 8	0.15752616E-01	0.98947002E+00	0.15920256E-01
beta 9	-0.16435234E+00	0.81820091E+00	-0.20087039E+00
beta10	-0.90878898E-02	0.90474749E+00	-0.10044670E-01
beta11	0.39561553E-02	0.92230417E+00	0.42894259E-02
beta12	0.95077712E-01	0.99970848E+00	0.95105437E-01
beta13	-0.35393377E-02	0.99886000E+00	-0.35433771E-02
beta14	0.73749528E-01	0.99970037E+00	0.73771632E-01
beta15	0.20732397E-01	0.98663949E+00	0.21013143E-01
beta16	-0.15285015E-01	0.98920003E+00	-0.15451895E-01
beta17	-0.34667078E-01	0.99392083E+00	-0.34879114E-01
beta18	-0.16140357E-01	0.98697929E+00	-0.16353288E-01
beta19	0.86980715E-02	0.98927888E+00	0.87923352E-02
beta20	0.20490893E-01	0.99409876E+00	0.20612532E-01
delta 1	0.84123868E-02	0.99999673E+00	0.84124143E-02
delta 2	0.95468629E-02	0.99998876E+00	0.95469702E-02
delta 3	-0.25784005E-01	0.99995256E+00	-0.25785228E-01
delta 4	0.52908672E-02	0.99999872E+00	0.52908740E-02
delta 5	-0.46571401E-02	0.99999800E+00	-0.46571494E-02
delta 6	-0.29255772E-02	0.99999855E+00	-0.29255814E-02
delta 7	-0.10816608E-02	0.99999884E+00	-0.10816620E-02
delta 8	0.82861119E-03	0.99999918E+00	0.82861187E-03
delta 9	0.82459463E-03	0.99999940E+00	0.82459512E-03
delta10	0.43511486E-02	0.99997605E+00	0.43512528E-02
delta11	0.14146255E-02	0.99999992E+00	0.14146257E-02
sigma-squared	0.27415447E-02	0.99486282E+00	0.27557012E-02
gamma	0.23844524E-02	0.99949487E+00	0.23856574E-02

log likelihood function = 0.41721387E+04

LR test of the one-sided error = 0.25292974E+03
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations = 2

(maximum number of iterations set at : 100)

number of cross-sections = 431

number of time periods = 8

MODEL 1. COST FUNCTION (unbalanced panel, truncated normal)

(with country dummies and fourier terms)

	coefficient	standard-error	t-ratio
beta 0	0.86318018E+01	0.94980323E+00	0.90879895E+01
beta 1	0.13517155E+01	0.19217878E+00	0.70336353E+01
beta 2	0.75168091E+00	0.24065891E+00	0.31234285E+01
beta 3	-0.37535002E+01	0.44164020E+00	-0.84990002E+01
beta 4	0.40890439E+00	0.58514821E-01	0.69880482E+01
beta 5	0.32273593E+00	0.48588365E-01	0.66422473E+01
beta 6	0.89854763E-01	0.34206498E-01	0.26268332E+01
beta 7	0.10073807E+00	0.35562482E-01	0.28327063E+01
beta 8	0.70070869E+00	0.97312055E-01	0.72006361E+01
beta 9	-0.15966812E+00	0.43438164E-02	-0.36757566E+02
beta10	-0.64313595E-01	0.24633773E-01	-0.26107895E+01
beta11	0.25241049E-01	0.18432523E-01	0.13693757E+01
beta12	0.87323744E-01	0.87484614E-02	0.99816116E+01
beta13	0.69631178E-02	0.69135926E-02	0.10071635E+01
beta14	0.61285522E-01	0.65672556E-02	0.93319838E+01
beta15	0.10140618E-01	0.36214215E-02	0.28001761E+01
beta16	-0.40178564E-02	0.38049524E-02	-0.10559544E+01
beta17	-0.20231192E-01	0.12293649E-01	-0.16456621E+01
beta18	-0.13066658E-01	0.32815637E-02	-0.39818389E+01
beta19	0.32863500E-02	0.34209464E-02	0.96065521E+00
beta20	0.63292440E-02	0.10033383E-01	0.63081857E+00
beta21	0.78802881E+00	0.24439436E+00	0.32244149E+01
beta22	0.47340328E+00	0.20618924E+00	0.22959651E+01
beta23	-0.14770006E+01	0.19911225E+00	-0.74179291E+01
beta24	-0.28585251E+00	0.14078137E+00	-0.20304712E+01
beta25	0.26614073E+00	0.88601987E-01	0.30037784E+01
beta26	0.42335842E-01	0.11158863E+00	0.37939209E+00
beta27	0.22502302E+00	0.51844486E-01	0.43403463E+01
beta28	-0.10991956E+00	0.42091538E-01	-0.26114408E+01
beta29	0.37854326E-01	0.59814373E-01	0.63286337E+00
beta30	-0.27509983E-01	0.40251048E-01	-0.68346004E+00
beta31	0.19639997E+00	0.49410722E-01	0.39748451E+01
beta32	-0.29928453E+00	0.39785607E-01	-0.75224321E+01
beta33	0.34773992E-01	0.38403539E-01	0.90548926E+00
beta34	0.26342604E+00	0.44920276E-01	0.58643014E+01
beta35	-0.47258267E+00	0.10288436E+00	-0.45933384E+01
beta36	-0.43421004E-01	0.30517816E-01	-0.14228084E+01
beta37	0.10906671E+00	0.64346806E-01	0.16949824E+01
beta38	0.52870626E-01	0.41067383E-01	0.12874116E+01
beta39	-0.42891932E-01	0.12572298E-01	-0.34116223E+01
beta40	0.16973146E+00	0.37510686E-01	0.45248829E+01
beta41	0.45820153E-01	0.12364675E-01	0.37057305E+01
beta42	-0.62295558E-01	0.38777927E-01	-0.16064695E+01
beta43	-0.51741169E-02	0.42853011E-01	-0.12074103E+00
beta44	-0.25655490E-01	0.28385617E-01	-0.90382007E+00
beta45	-0.84031009E-01	0.28953166E-01	-0.29023081E+01
beta46	0.51702388E-01	0.13199880E-01	0.39168832E+01
beta47	-0.11454443E+00	0.36004505E-01	-0.31813917E+01
beta48	-0.51075570E-01	0.11641330E-01	-0.43874344E+01
beta49	0.21351071E+00	0.43552788E-01	0.49023430E+01
beta50	-0.10058695E-01	0.38698456E-01	-0.25992497E+00
beta51	0.92572704E-01	0.25541890E-01	0.36243482E+01
beta52	-0.13815288E+00	0.36043411E-01	-0.38329580E+01
delta 1	-0.76006681E-04	0.32061203E-02	-0.23706746E-01
delta 2	0.36897114E-02	0.31420973E-02	0.11742830E+01
delta 3	-0.50570646E-01	0.31792807E-02	-0.15906317E+02
sigma-squared	0.18926213E-02	0.54270900E-04	0.34873593E+02
gamma	0.10000000E-07	0.18690547E-05	0.53502983E-02

log likelihood function = 0.44666664E+04
LR test of the one-sided error = 0.35228245E+03
with number of restrictions = 4
[note that this statistic has a mixed chi-square distribution]
number of iterations = 64
(maximum number of iterations set at : 100)
number of cross-sections = 431
number of time periods = 8

MODEL 1. PROFIT FUNCTION (unbalanced panel, truncated normal)
(with country and time dummies and fourier terms)

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	-0.48054798E+01	0.98306123E+00	-0.48882813E+01
beta 1	-0.38405016E+00	0.51369990E+00	-0.74761581E+00
beta 2	0.15088397E+01	0.61037900E+00	0.24719718E+01
beta 3	0.36481589E+01	0.75770986E+00	0.48147175E+01
beta 4	0.13593343E+00	0.14572491E+00	0.93280845E+00
beta 5	0.10790470E-01	0.12599944E+00	0.85639025E-01
beta 6	-0.44632992E-01	0.86682172E-01	-0.51490394E+00
beta 7	-0.26869601E+00	0.90916081E-01	-0.29554289E+01
beta 8	-0.87563128E+00	0.21802580E+00	-0.40161819E+01
beta 9	0.26271139E-01	0.90636559E-02	0.28985147E+01
beta10	0.12028011E+00	0.69140210E-01	0.17396550E+01
beta11	0.38895709E-01	0.48609141E-01	0.80017273E+00
beta12	0.17390286E-01	0.15929048E-01	0.10917342E+01
beta13	0.20469427E-01	0.11917112E-01	0.17176500E+01
beta14	-0.63996300E-01	0.11856185E-01	-0.53977146E+01
beta15	-0.12395077E-01	0.82216664E-02	-0.15076112E+01
beta16	-0.39381106E-01	0.83726960E-02	-0.47035156E+01
beta17	0.54518754E-01	0.30204536E-01	0.18049856E+01
beta18	0.19796579E-01	0.71427354E-02	0.27715683E+01
beta19	0.29879606E-01	0.74936775E-02	0.39873088E+01
beta20	-0.81769587E-01	0.26105377E-01	-0.31322891E+01
beta21	0.65112084E+00	0.62239028E+00	0.10461616E+01
beta22	0.14089726E+01	0.52841949E+00	0.26663902E+01
beta23	0.18422291E+01	0.45941726E+00	0.40099257E+01
beta24	0.68604762E+00	0.38016428E+00	0.18046083E+01
beta25	0.27656750E+00	0.24094963E+00	0.11478229E+01
beta26	-0.97874011E+00	0.31770603E+00	-0.30806470E+01
beta27	-0.10955568E+00	0.11917048E+00	-0.91931894E+00
beta28	0.28379734E+00	0.10140920E+00	0.27985365E+01
beta29	0.49849020E+00	0.16395661E+00	0.30403787E+01
beta30	0.41920702E-01	0.11206238E+00	0.37408364E+00
beta31	0.10398771E+00	0.13303283E+00	0.78166954E+00
beta32	0.13911347E+00	0.75385231E-01	0.18453677E+01
beta33	0.12864629E+00	0.10099752E+00	0.12737569E+01
beta34	-0.13489471E+00	0.10019127E+00	-0.13463718E+01
beta35	0.36086056E+00	0.27263427E+00	0.13236067E+01
beta36	0.90138508E-01	0.73634922E-01	0.12241272E+01
beta37	0.58479433E+00	0.18058309E+00	0.32383671E+01
beta38	-0.43187774E+00	0.10865650E+00	-0.39747070E+01
beta39	0.45083176E-01	0.25923398E-01	0.17390921E+01
beta40	-0.86415942E-01	0.78360186E-01	-0.11028042E+01
beta41	0.14490894E+00	0.27780365E-01	0.52162361E+01
beta42	-0.19134611E+00	0.96820902E-01	-0.19762892E+01
beta43	0.25121491E+00	0.11488385E+00	0.21866860E+01
beta44	-0.13374062E+00	0.72422698E-01	-0.18466672E+01
beta45	0.14177658E+00	0.68988991E-01	0.20550610E+01
beta46	0.18385453E-01	0.28374254E-01	0.64796251E+00
beta47	0.16976969E+00	0.96426755E-01	0.17606077E+01
beta48	0.34971894E-01	0.25842470E-01	0.13532721E+01
beta49	-0.11821884E+00	0.95070534E-01	-0.12434856E+01
beta50	-0.15603694E+00	0.98935727E-01	-0.15771546E+01
beta51	0.16372517E+00	0.65017749E-01	0.25181612E+01
beta52	0.57453654E-01	0.90524610E-01	0.63467441E+00
delta 1	0.80844534E-01	0.31949353E-01	0.25303966E+01
delta 2	-0.11971417E+01	0.48921439E-01	-0.24470696E+02
delta 3	-0.60282508E+00	0.43437164E-01	-0.13878095E+02
delta 4	-0.10088276E+00	0.40783282E-01	-0.24736303E+01
delta 5	-0.90918277E+00	0.45756670E-01	-0.19869950E+02
delta 6	-0.12519974E+01	0.53105370E-01	-0.23575721E+02
delta 7	-0.14605753E+01	0.62184872E-01	-0.23487630E+02
delta 8	-0.13420790E+01	0.59186846E-01	-0.22675291E+02
delta 9	-0.25005819E+01	0.45524751E-01	-0.54927966E+02
delta10	-0.18539798E+01	0.83333848E-01	-0.22247620E+02
delta11	-0.17037317E+01	0.90118755E-01	-0.18905406E+02
sigma-squared	0.20537913E+00	0.62537438E-02	0.32840988E+02
gamma	0.98480211E+00	0.92512992E-03	0.10645014E+04

```
log likelihood function =   0.21032662E+04

LR test of the one-sided error =    0.21789907E+04
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations =     83

(maximum number of iterations set at :   100)

number of cross-sections =    431

number of time periods =      8

total number of observations =   2607
```

MODEL 2. COST FUNCTION (unbalanced panel, truncated normal)

(with country and time dummies and Fourier terms)

```
the final mle estimates are :

                  coefficient     standard-error    t-ratio

  beta 0         0.19314337E+01  0.38170337E-01  0.50600384E+02
  beta 1         0.56571486E+00  0.17250251E-02  0.32794587E+03
  beta 2         0.42737686E+00  0.62502748E-02  0.68377291E+02
  beta 3         0.30501403E+00  0.17786479E-01  0.17148646E+02
  beta 4         0.35240256E+00  0.17813937E-01  0.19782407E+02
  beta 5         0.16112431E+00  0.15005756E-02  0.10737500E+03
  beta 6         0.16920358E+00  0.17643292E-02  0.95902500E+02
  beta 7        -0.16534259E+00  0.12401006E-02 -0.13332998E+03
  beta 8         0.91235470E-01  0.89742224E-02  0.10166393E+02
  beta 9        -0.42383662E-02  0.69734802E-02 -0.60778350E+00
  beta10         0.74657466E-01  0.65774509E-02  0.11350517E+02
  beta11         0.18026140E-01  0.33223657E-02  0.54256941E+01
  beta12        -0.16858563E-01  0.32974926E-02 -0.51125400E+01
  beta13        -0.18356197E-01  0.31912036E-02 -0.57521232E+01
  beta14         0.10884765E-01  0.30063435E-02  0.36205990E+01
  delta 1        0.24160548E-01  0.45898230E-02  0.52639389E+01
  delta 2        0.20652807E-01  0.35982931E-02  0.57396123E+01
  delta 3       -0.42718300E-01  0.35042699E-02 -0.12190357E+02
  delta 4        0.28122751E-01  0.53926980E-02  0.52149685E+01
  delta 5       -0.18162765E-01  0.44237915E-02 -0.41057010E+01
  delta 6       -0.13091980E-01  0.44127729E-02 -0.29668374E+01
  delta 7       -0.83477772E-02  0.44326277E-02 -0.18832570E+01
  delta 8       -0.50276449E-02  0.45119480E-02 -0.11142958E+01
  delta 9       -0.49664390E-02  0.44682633E-02 -0.11114920E+01
  delta10        0.55772673E-02  0.32934945E-02  0.16934193E+01
  delta11        0.63686796E-02  0.31552358E-02  0.20184480E+01
  sigma-squared  0.25516450E-02  0.82126082E-04  0.31069849E+02
  gamma          0.76589885E-02  0.65883349E-03  0.11625075E+02

log likelihood function =    0.42690635E+04

LR test of the one-sided error =    0.45949264E+03
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations =      46

(maximum number of iterations set at :    100)

number of cross-sections =    431

number of time periods =      8

total number of observations =   2607
```

MODEL 2. COST FUNCTION (unbalanced panel, truncated normal)
(with country and time dummies)

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.15479655E+01	0.98185638E+00	0.15765702E+01
beta 1	0.83852660E+00	0.66484997E+00	0.12612268E+01
beta 2	0.15668412E+00	0.66164836E+00	0.23680875E+00
beta 3	0.34732033E+00	0.26550512E+00	0.13081493E+01
beta 4	0.30334775E+00	0.21557690E+00	0.14071440E+01
beta 5	0.14560181E+00	0.11396288E+00	0.12776249E+01
beta 6	0.20824084E+00	0.12404829E+00	0.16787079E+01
beta 7	-0.17015515E+00	0.56992005E-01	-0.29855968E+01
beta 8	0.78145243E-01	0.42053671E+00	0.18582264E+00
beta 9	0.90787377E-02	0.34457426E+00	0.26347696E-01
beta10	0.64338337E-01	0.28387873E+00	0.22664022E+00
beta11	0.89271888E-02	0.11508187E+00	0.77572500E-01
beta12	-0.11487189E-01	0.11047059E+00	-0.10398414E+00
beta13	-0.73380031E-02	0.80793047E-01	-0.90824686E-01
beta14	0.57084688E-02	0.86997453E-01	0.65616504E-01
beta15	0.89526946E-01	0.83320711E+00	0.10744861E+00
beta16	-0.20203231E+00	0.80994156E+00	-0.24944060E+00
beta17	0.51730799E+00	0.81065192E+00	0.63813824E+00
beta18	-0.33885095E-01	0.89502399E+00	-0.37859427E-01
beta19	-0.32864288E-01	0.57027897E+00	-0.57628441E-01
beta20	-0.46858400E-01	0.68030923E+00	-0.68878089E-01
beta21	-0.65368394E-01	0.46650862E+00	-0.14012258E+00
beta22	0.13372545E+00	0.27760323E+00	0.48171434E+00
beta23	0.14308551E+00	0.51701559E+00	0.27675280E+00
beta24	-0.91871036E-01	0.34465194E+00	-0.26656178E+00
beta25	-0.60124794E-01	0.30743838E+00	-0.19556698E+00
beta26	-0.78819711E-02	0.31083860E+00	-0.25357118E-01
beta27	0.87161292E-01	0.34941826E+00	0.24944687E+00
beta28	-0.69365670E-01	0.35044023E+00	-0.19793866E+00
delta 0	0.67454824E-02	0.47391028E+00	0.14233670E-01
delta 1	0.13223256E-01	0.35581871E+00	0.37162903E-01
delta 2	0.17380735E-01	0.35854552E+00	0.48475673E-01
delta 3	-0.42565235E-01	0.33648361E+00	-0.12650017E+00
delta 4	0.19988911E-01	0.42930582E+00	0.46561005E-01
delta 5	-0.15299386E-01	0.12637015E+00	-0.12106803E+00
delta 6	-0.11573355E-01	0.12345910E+00	-0.93742421E-01
delta 7	-0.82279067E-02	0.12148745E+00	-0.67726394E-01
delta 8	-0.42097255E-02	0.10253037E+00	-0.41058326E-01
delta 9	-0.38102656E-02	0.14058302E+00	-0.27103312E-01
delta10	0.24347243E-02	0.11642684E+00	0.20912053E-01
delta11	0.55832961E-02	0.13455599E+00	0.41494221E-01
sigma-squared	0.23074150E-02	0.28783835E-03	0.80163571E+01
gamma	0.58610098E-02	0.15096428E-01	0.38823817E+00

log likelihood function = 0.43983658E+04

LR test of the one-sided error = 0.34121633E+03
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations = 36

(maximum number of iterations set at : 100)

number of cross-sections = 431

number of time periods = 8

total number of observations = 2607

MODEL 2. PROFIT FUNCTION (unbalanced panel, truncated normal)
(with country and time dummies)

	coefficient	standard-error	t-ratio
beta 0	0.81774861E+01	0.80817488E-01	0.10118461E+03
beta 1	-0.47477715E+00	0.22306840E-01	-0.21283927E+02
beta 2	-0.23716405E+00	0.20359986E-01	-0.11648537E+02
beta 3	0.32232706E+00	0.40484505E-01	0.79617389E+01
beta 4	-0.53366016E+00	0.38011354E-01	-0.14039493E+02
beta 5	0.68001834E-01	0.47550589E-02	0.14300945E+02
beta 6	0.25107370E-01	0.45775507E-02	0.54848918E+01
beta 7	0.16135187E-01	0.37424606E-02	0.43113846E+01
beta 8	-0.17329560E-01	0.18237801E-01	-0.95020008E+00
beta 9	0.66021884E-01	0.14215447E-01	0.46443761E+01
beta10	-0.98462408E-01	0.13914183E-01	-0.70764059E+01
beta11	-0.11254266E-01	0.89614281E-02	-0.12558563E+01
beta12	-0.16203844E-01	0.78918328E-02	-0.20532421E+01
beta13	0.31074094E-01	0.76126712E-02	0.40818911E+01
beta14	0.36171706E-01	0.70226926E-02	0.51506891E+01
delta 0	-0.30359626E+01	0.18353028E+00	-0.16542026E+02
delta 1	0.14451034E+01	0.95162117E-01	0.15185700E+02
delta 2	0.78474835E+00	0.66112463E-01	0.11869900E+02
delta 3	0.72689441E+00	0.67745468E-01	0.10729786E+02
delta 4	0.11692081E+01	0.93346641E-01	0.12525443E+02
delta 5	0.91772475E+00	0.84611498E-01	0.10846336E+02
delta 6	0.64722658E+00	0.81823766E-01	0.79100073E+01
delta 7	0.41030785E+00	0.77299141E-01	0.53080519E+01
delta 8	0.62318731E+00	0.79960392E-01	0.77937000E+01
delta 9	-0.84369602E+00	0.10135477E+00	-0.83241866E+01
delta10	-0.11331468E-01	0.82564587E-01	-0.13724369E+00
delta11	0.33254446E+00	0.86473533E-01	0.38456213E+01
sigma-squared	0.22753174E+00	0.10179636E-01	0.22351657E+02
gamma	0.97870802E+00	0.13972265E-02	0.70046483E+03

log likelihood function = 0.16875658E+04

LR test of the one-sided error = 0.21205113E+04
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations = 40

(maximum number of iterations set at : 100)

number of cross-sections = 431

number of time periods = 8

total number of observations = 2607

thus there are: 841 obsns not in the panel

MODEL 2. PROFIT FUNCTION (unbalanced panel, truncated normal)
(with country and time dummies, and Fourier terms)

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.50367912E+01	0.93873199E+00	0.53655264E+01
beta 1	-0.22563954E+01	0.44349058E+00	-0.50878090E+01
beta 2	0.21279855E+01	0.40735657E+00	0.52238889E+01
beta 3	0.19403283E+00	0.40828269E-01	0.47524138E+01
beta 4	-0.42118521E+00	0.39013388E-01	-0.10795915E+02
beta 5	0.35883806E+00	0.69254157E-01	0.51814660E+01
beta 6	-0.30482097E+00	0.55200932E-01	-0.55220257E+01
beta 7	0.12281714E-01	0.77907293E-02	0.15764524E+01
beta 8	-0.42729627E-02	0.17261380E-01	-0.24754467E+00
beta 9	0.51005315E-01	0.13662205E-01	0.37333150E+01
beta10	-0.88948219E-01	0.13515316E-01	-0.65812904E+01
beta11	0.88122461E-02	0.77749366E-02	0.11334171E+01
beta12	-0.20061100E-01	0.75377440E-02	-0.26614197E+01
beta13	0.25067323E-01	0.69969349E-02	0.35826148E+01
beta14	0.23156799E-01	0.65869482E-02	0.35155581E+01
beta15	-0.19362078E+01	0.47943442E+00	-0.40385248E+01
beta16	0.18154475E+01	0.30980777E+00	0.58599159E+01
beta17	0.62716218E+00	0.11239995E+00	0.55797370E+01
beta18	-0.18146154E+00	0.10169540E+00	-0.17843634E+01
beta19	-0.27985037E+00	0.63942101E-01	-0.43766215E+01
beta20	0.15605827E+00	0.63798244E-01	0.24461217E+01
beta21	0.21664289E+00	0.52664812E-01	0.41136174E+01
beta22	0.88621836E-01	0.34953347E-01	0.25354321E+01
beta23	0.10036241E+00	0.28243828E-01	0.35534281E+01
beta24	-0.39411246E-01	0.28031419E-01	-0.14059668E+01
beta25	-0.34606769E-01	0.24700476E-01	-0.14010568E+01
beta26	0.80737991E-01	0.21066215E-01	0.38325818E+01
beta27	0.82090419E-01	0.22138239E-01	0.37080827E+01
beta28	-0.36247852E-02	0.19224858E-01	-0.18854679E+00
delta 0	-0.29057245E+01	0.18323593E+00	-0.15857831E+02
delta 1	0.14105946E+01	0.97924747E-01	0.14404884E+02
delta 2	0.10427292E+01	0.79080033E-01	0.13185745E+02
delta 3	0.85189527E+00	0.75690012E-01	0.11255055E+02
delta 4	0.10413367E+01	0.92482227E-01	0.11259858E+02
delta 5	0.85698206E+00	0.79739001E-01	0.10747339E+02
delta 6	0.63158283E+00	0.76299977E-01	0.82776280E+01
delta 7	0.43094358E+00	0.74211769E-01	0.58069439E+01
delta 8	0.59916404E+00	0.76145371E-01	0.78686864E+01
delta 9	-0.64253373E+00	0.91750389E-01	-0.70030627E+01
delta10	0.94390427E-01	0.76561967E-01	0.12328631E+01
delta11	0.36576110E+00	0.83017682E-01	0.44058216E+01
sigma-squared	0.19080605E+00	0.86214398E-02	0.22131576E+02
gamma	0.97605944E+00	0.17049972E-02	0.57246982E+03

log likelihood function = 0.18598063E+04

LR test of the one-sided error = 0.22176019E+04
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations = 55

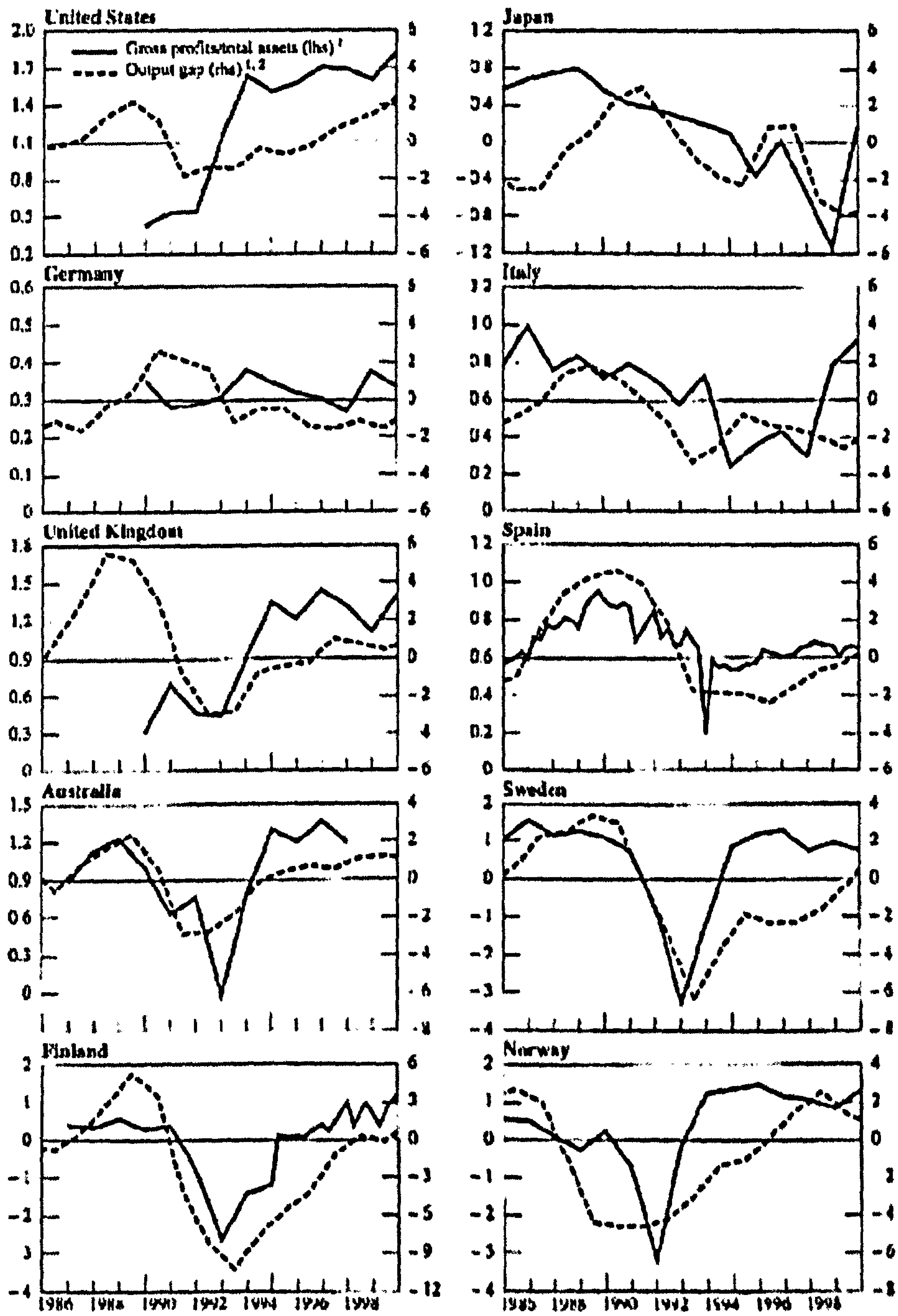
(maximum number of iterations set at : 100)

number of cross-sections = 431

number of time periods = 8

total number of observations = 2607

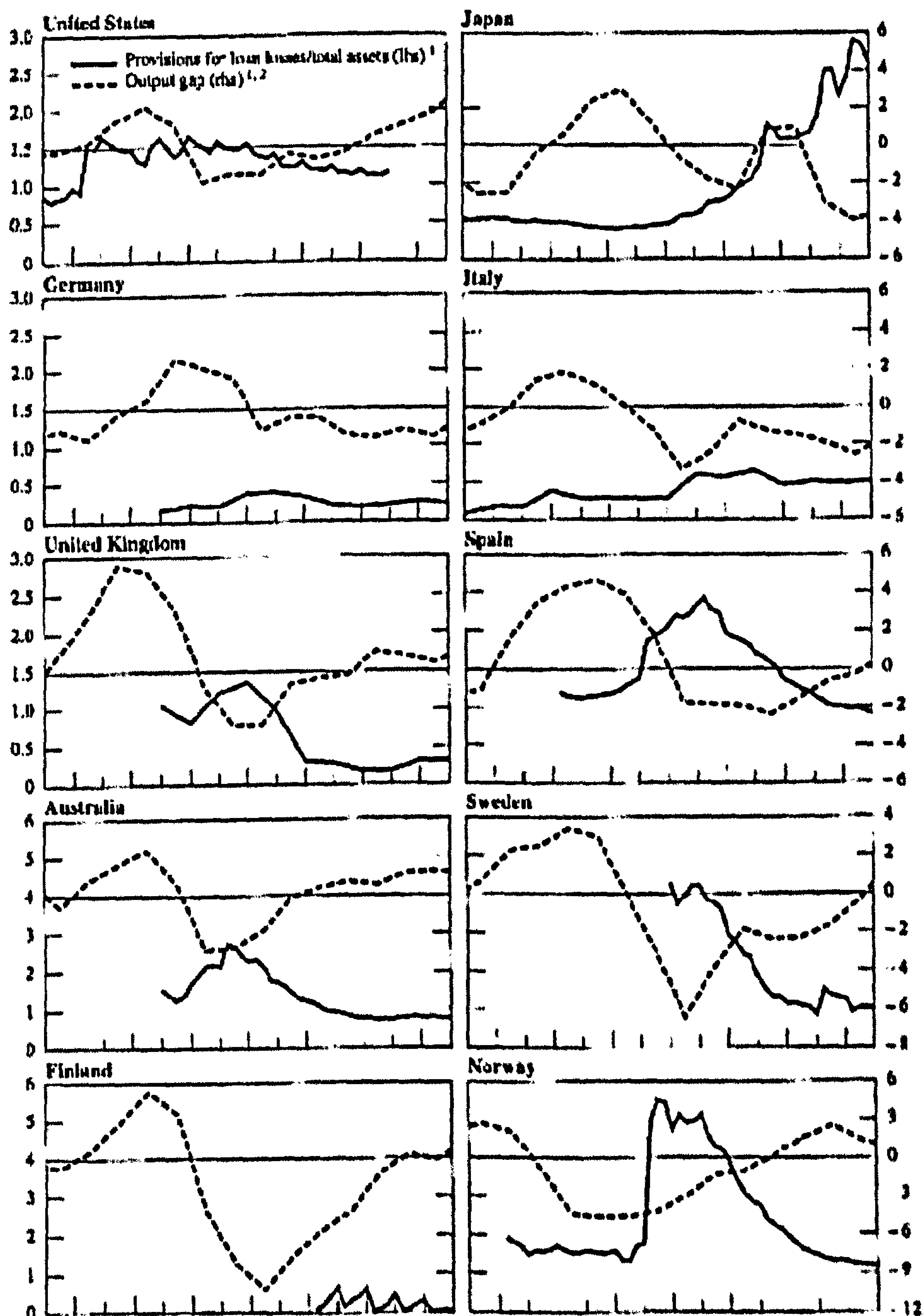
APPENDIX VIII Banking profitability



[1] In percentages. [2] As calculated by the OECD.

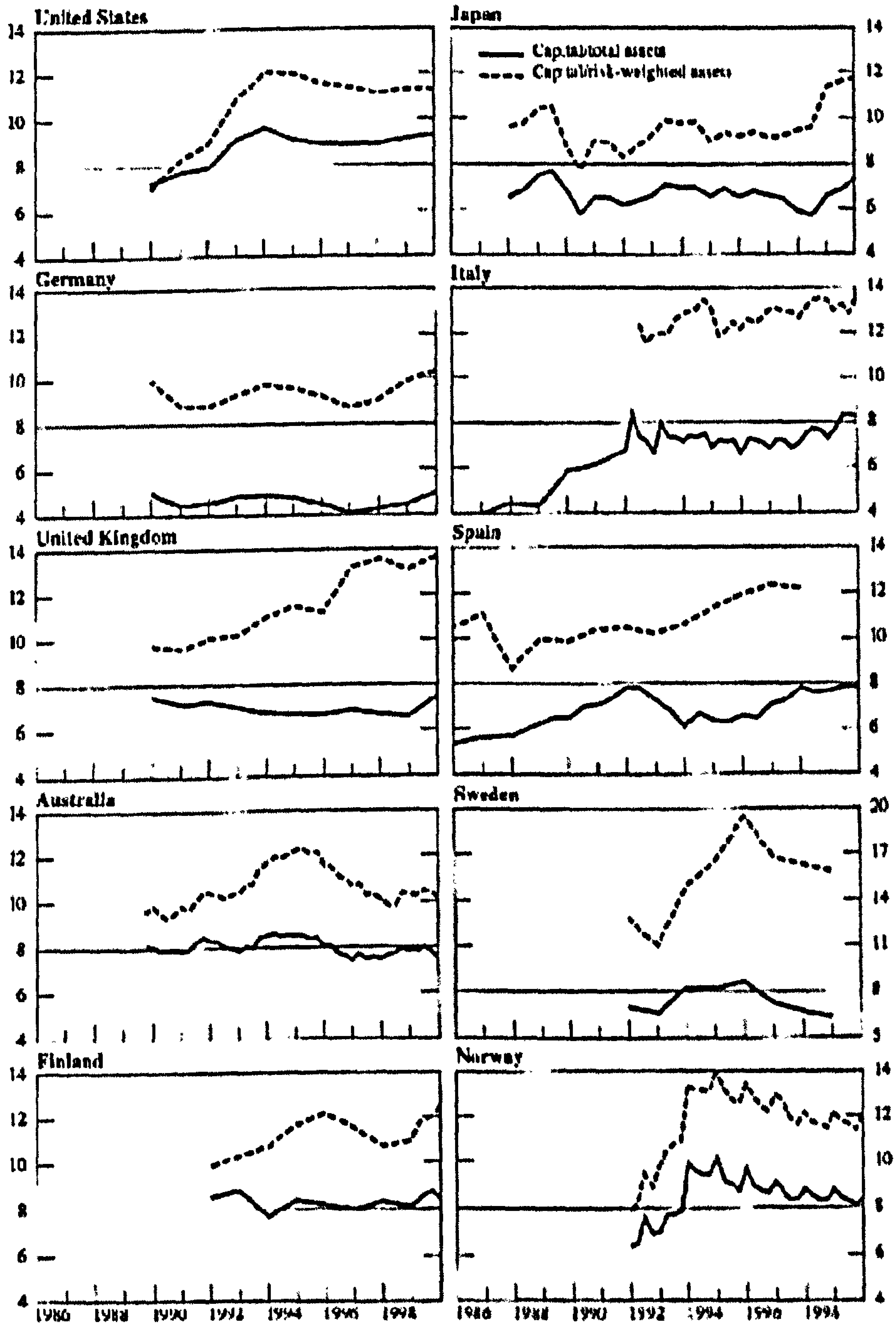
Sources: BIS Survey; BIS Capital and Profitability Report; OECD Economic Outlook; OECD Bank Profitability.

APPENDIX VIII (ctd) Bank provisioning and Output GAP



[1] In percentages. [2] As calculated by the OECD.
Sources: BIS Survey; BIS Capital and Profitability Report, OECD Economic Outlook.

APPENDIX VIII (ctd) Capital to total assets and Capital to risk weighted assets ratios.



[1] In percentages.

APPENDIX VIII (ctd)

Contribution of the change in the capital base and risk-weighted assets to the overall change in the capital ratio

	1989			1990			1991			1992			1993			1994			1995			1996		
	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR
Belgium	+	–	1.6	+	–	0.6	+	–	0.1	+	–	0.7	+	–	0.7	+	–	1.0	+	–	–0.4	+	–	0.0
Canada	+	–	0.7	+	–	–0.3	+	–	1.3	+	–	0.2	+	–	0.9	+	–	0.0	+	–	–0.1	+	–	–0.6
France	+	–	0.1	+	–	–0.1	+	–	0.6	+	–	–0.4	+	+	0.4	–	+	0.4	–	–	–0.1	+	–	0.2
Germany	+	–	0.3	+	–	–1.2	+	–	0.0	+	–	0.5	+	–	0.3	+	–	0.3	+	–	–0.2	+	–	–0.5
Italy	+	–	0.0	+	–	–0.2	+	–	1.0	+	–	–0.1	+	+	0.7	+	+	0.3	+	–	–0.3	+	–	0.3
Japan	+	–	–1.5	+	–	–0.4	–	–	–1.1	+	+	1.2	+	+	0.4	–	+	–0.9	+	–	0.4	–	–	–0.2
Luxembourg	+	–	0.2	+	–	0.7	+	–	0.4	+	–	0.4	+	–	0.3	+	–	2.1	+	–	–0.1	+	–	0.3
Netherlands	+	–	0.6	+	–	–0.8	+	–	–0.2	+	–	0.0	+	+	0.7	+	+	0.0	+	–	–0.2	+	–	0.3
Sweden	+	–	–0.2	+	–	0.1	+	–	0.1	–	+	–0.3	+	+	2.4	+	+	2.1	+	+	1.1	–	+	–1.3
Switzerland	+	–	–0.1	+	–	–0.6	+	–	0.3	+	–	–0.2	+	–	0.1	+	+	0.1	+	+	1.2	+	+	0.5
United Kingdom	+	–	0.1	–	–	–0.1	+	–	0.7	+	–	–0.4	+	–	0.8	+	+	0.8	+	–	–0.1	+	–	0.8
United States	+	+	0.2	+	+	1.3	+	+	0.6	+	–	2.0	+	–	1.2	+	–	0.0	+	–	–0.5	+	–	–0.2

Notes: C, A and CR stand for the capital base, risk-weighted assets and the capital ratio, respectively. The symbols + and – denote the sign of the contribution of C and A to the change in the CR. For instance, a minus sign (–) in the column for the risk-weighted assets means that the development of the denominator has caused a drop in the capital ratio i.e. the risk-weighted assets have increased (ceteris paribus the level of the capital). The column labelled CR contains the actual change in the capital ratio during the year.

Source: Calculations by De Nederlandsche Bank based on data obtained from the Basle Committee, FitchIBCA and national supervisory authorities.

APPENDIX IX Limitations interpreting profit efficiency scores

These problems in interpreting profit efficiency scores could arise from several reasons, among them:

Risk position of the institution is likely to have a predominant role in determining the efficiency scores as a higher amount of profit efficiency could be attained at the expense of increasing the risk position of the institution[41]. This could be done, either actively by financing projects which may offer a larger returns[42], or more passively, by devoting less resources to screening and monitoring borrowers.

Also, cyclical results from non- interest earnings activities are likely to play an important role for banks with a higher exposure to these kinds of activities[43]. Given that only a few large banks earn significant investment banking related earnings, this is probably going to be a main contributor to the creation of differences in terms of profit efficiencies in European banks. A related question is that this factor could make profit efficiencies more dependent on the economic cycle than cost efficiencies.

Finally, previous advantages held by a number of banks in term of cheaper cost of funds, or customer loyalty are fading away due to increased competition. This is probably affecting the profit efficiency scores of these banking institutions leading to a deterioration in their profit efficiency scores.

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41 The mentioned paper by Maudos et al (1999) shows that while profit efficiency to be positively related to risk, cost efficiency is not significantly related to this variable.

42 Lending to telecommunication companies could be a well-known example of this practise in recent years.

43 Favero at al (1999) suggest, for instance that the profit and losses accounts of the largest European players have changed dramatically, so now non interest earnings account for more than 40-50% of their profits, up from 10-20% in 1990.

APPENDIX X List of institutions included in our empirical model

FRANCE

Société générale
Crédit Mutuel (AGGR)
Banque Nationale de Paris BNP
Crédit Lyonnais
CLF / Dexia France
Banque Paribas
Crédit Commercial de France
Crédit Agricole Indosuez
Cetelem
Natexis S.A.
Compagnie Financière de CIC et de l'Union Européenne
Compagnie Bancaire
Crédit Agricole d'Ile-de-France
Crédit du Nord
Caisse d'épargne Ile-de-France Paris
Caisse d'épargne Provence - Alpes - Corse
Credit Agricole du Nord Est
Sovac
Crédit Agricole Centre France
CIC Paris
Credit Agricole Centre Loire
Union Industrielle de Crédit UIC
Caisse d'épargne Rhône-Alpes Lyon
Crédit Agricole de la Gironde
Banque CPR
Banque Bruxelles Lambert France
Crédit Agricole du Nord
Caisse d'épargne du Languedoc Roussillon
Banque Sudameris S.A.
Crédit Agricole du Midi
Crédit Agricole de l'Ille-et-Vilaine
Crédit Agricole Anjou-Mayenne
Credit Agricole Sud Rhone Alpes
Credit Agricole de la Touraine et du Poitou
Caisse d'épargne de Midi-Pyrénées
Crédit Mutuel du Nord
Banque Sofinco
Crédit Mutuel de Loire-Atlantique et du Centre-Ouest
Crédit Agricole du Pas-de-Calais
Credit Agricole Pyrenees Gascogne
Compagnie générale de crédits aux particuliers CREDIPAR
Caisse d'épargne de Bourgogne
Crédit Agricole du Finistère

Crédit Mutuel Océan
Crédit Agricole Loire-Atlantique
Caisse d'Epargne de Flandre
Crédit Agricole de Charente-Maritime Deux-Sevres
Crédit Agricole du Morbihan
Crédit Agricole de la Brie
Caisse d'épargne de Haute-Normandie
Credit Agricole Val de France
Lyonnaise de Banque
Crédit Agricole de Toulouse et du Midi Toulousain
Crédit Mutuel de Maine-Anjou et Basse-Normandie
Credit Agricole Alpes Provence
Caisse d'Epargne des Alpes
Credit Agricole Quercy Rouergue
Banque Commerciale pour l'Europe du Nord, BCEN - EUROBANK
Banque Worms
Crédit Mutuel du Centre (AGGR)
Via Banque
Banque AIG
Crédit Agricole Loire Haute-Loire
Crédit Agricole des Savoie
Caisse d'épargne des Pays de la Loire
Caisse d'épargne Aquitaine-Nord
Banque Populaire de la Région Ouest de Paris - B.P. ROP
Caisse d'épargne et de prévoyance de Champagne-Ardenne
Banque CIAL
Crédit Agricole des Côtes-d'Armor
Banque de Neuflize, Schlumberger, Mallet
Banque Hervet S.A.
Banque Parisienne de Crédit
Banque La Hénin
Banque CIO
Banque SNVB
Banque Française de l'Orient BFO
Banque de l'Economie-Crédit Mutuel
Banque Scalbert Dupont BSD
Crédit Universel
Banque de Bretagne
Banque d'Orsay
Banque régionale de l'Ouest
Banque CIN
Axa Banque
Banque de l'Ile de France - BDEI
Banque régionale de l'Ain
Banque Colbert

GERMANY

Deutsche Bank AG
Dresdner Bank AG
Commerzbank AG
Bayerische Vereinsbank AG
Bayerische Hypo-und Vereinsbank (Proforma)
Bayerische Hypotheken- und Wechsel-Bank AG
Bankgesellschaft Berlin AG
Deutsche Genossenschaftsbank DG BANK
BHW Holdings AG
BHF-BANK AG
BFG Bank AG
Hamburger Sparkasse
Bausparkasse Gemeinschaft der Freunde Wüstenrot gemeinnützige GmbH
Frankfurter Hypothekenbank Centralboden AG
Bausparkasse Schwäbisch Hall AG, Bausparkasse der Volksbanken und Raiffeisenbanken
Berliner Bank AG
Deutsche Pfandbrief-und Hypothekenbank AG DePfa-Bank
Landesgirokasse öffentliche Bank und Landessparkasse
BHW Bausparkasse
Westdeutsche Genossenschafts-Zentralbank eG - WGZ Bank
Deutsche Hypothekenbank Frankfurt AG
Rheinische Hypothekenbank AG - RHEINHYP
Deutsche Genossenschafts-Hypothekenbank DG- Hypothekenbank AG
Vereins- und Westbank AG
LBS Westdeutsche Landesbausparkasse
Deutsche Kreditbank AG DKB
Stadtsparkasse Köln
Baden-Wuerttembergische Bank AG
Deutsche Siedlungs- und Landesrentenbank - DSL Bank
Frankfurter Sparkasse
Kreissparkasse Köln
Deutsche Bau- und Bodenbank AG
Stadtsparkasse München
Bayerische Landesbausparkasse LBS
Süddeutsche Bodencreditbank AG
Nassauische Sparkasse
Trinkaus & Burkhardt KGaA
Westdeutsche Immobilienbank
Bayerische Handelsbank AG
Berliner Volksbank eG
Stadtsparkasse Nürnberg
Nürnberger Hypothekenbank
Sparkasse in Bremen
Allgemeine Hypothekenbank AG - AHB
Oldenburgische Landesbank - OLB
Hypothekenbank in Essen AG

Sparkasse Aachen
Landesbausparkasse Württemberg
Badische Beamtenbank eG
Stadtsparkasse Dortmund
Hypothekenbank in Hamburg
Stadt-Sparkasse Düsseldorf
Westfälische Hypothekenbank AG - Die WestHyp
Saechsische Aufbaubank GmbH
Württembergische Hypothekenbank AG
Kreissparkasse Esslingen Nuertingen
Stadtsparkasse Hannover
Kreissparkasse Ludwigsburg
Sparkasse Essen
SchmidtBank KGaA
Luebecker Hypothekenbank AG
Kreissparkasse Hannover
Kreissparkasse Waiblingen
Sparkasse Bochum
Landessparkasse zu Oldenburg
Grundkreditbank eG Kopenicker Bank
Münchener Hypothekenbank eG
Kreissparkasse Heilbronn
Sparkasse Bielefeld
Sparkasse Pforzheim
Stadtsparkasse Duisburg
M.M. Warburg Bank - M.M. Warburg & Co.
Deutsche Hypothekenbank (Actien-Gesellschaft)
Leonberger Bausparkasse AG
Sparkasse Krefeld
Sparkasse Neuss
Kreissparkasse Boeblingen
Sparkasse Herford
Sparkasse Osnabrück
Stadtsparkasse Wuppertal
Weberbank Berliner Industriebank KGaA
Deutsche Bank Lübeck AG, vormals Handelsbank
Kasseler Sparkasse
Sparkasse Münster
Kreissparkasse Göppingen
Rheinboden Hypothekenbank AG
DEUTSCHE VERKEHSBANK AG
Sparkasse Darmstadt
Sparkasse Bonn
Stadtsparkasse Augsburg, Kreditanstalt des öffentlichen Rechts
Mittlebrandenburgische Sparkasse in Potsdam
Sparkasse Karlsruhe
Deutsche Schiffsbank AG
Stadt- und Kreissparkasse Leipzig
Allgemeine Privatkundenbank AG Allbank
Sparkasse Ulm

Städtische Sparkasse Würzburg
Stadt -Sparkasse Gelsenkirchen
Kreissparkasse Muenchen
Sparkasse Saarbrücken
Bankhaus Löbbecke & Co.
Kreissparkasse in Siegburg
Sparkasse Koblenz
Stadt- und Kreissparkasse Erlangen
Norddeutsche Hypotheken-und Wechselbank AG - NORDHYPO-BANK
Kreissparkasse Ostalb
Bankhaus Reuschel & Co.
Kreissparkasse Hildesheim
BADENIA Bausparkasse AG
Stadtsparkasse Mönchengladbach
Kreis- und Stadtsparkasse Rosenheim
Taunus - Sparkasse
LBS Badische Landesbausparkasse
Kreissparkasse Reutlingen
Kreissparkasse Ravensburg
Sparkasse Rhein-Nahe
Bankhaus Hermann Lampe KG
Sparkasse Marburg-Biedenkopf
Kreissparkasse Tübingen
BFG-Hypothekenbank AG
Stadtsparkasse Dresden
Sparkasse Ingolstadt
Westfälische Landschaft - Bodenkreditbank-AG
Kreissparkasse Recklinghausen
Sparkasse Gifhorn-Wolfsburg
Sparda-Bank Mainz eG
Kreissparkasse Nürnberg
Sparkasse Kiel
Sparkasse Langen-Seligenstadt
Sparkasse Detmold
Debeka Bausparkasse AG, Sitz Koblenz am Rhein
Sparkasse Fürstenfeldbruck
Sparkasse Goettingen
Sparkasse Leverkusen
Kreissparkasse Osnabrück
Frankfurter Hypothekenbank AG
Kreissparkasse Kaiserslautern
Bausparkasse der Sparkassen und der Nord/LB
Deutsche Aussenhandelsbank
Kreissparkasse Herford
Landes-Bausparkasse Rheinland-Pfalz
Landesbausparkasse Hessen-Tueringen
Berliner Hypotheken-und Pfandbriefbank AG
Sparkasse Freiburg
Braunschweig-Hannoversche Hypothekenbank AG
IKB Deutsche Industriebank AG

Berlin-Hannoversche Hypothekenbank AG
Kreissparkasse Balingen
Sparkasse Mannheim

ITALY

Cassa di Risparmio delle Provincie Lombarde SpA - CARIPLO
Banca di Roma
Istituto Bancario San Paolo di Torino SpA
Unicredito SpA
Banca Commerciale Italiana SpA, COMIT
Banca Intesa (Proforma)
Credito Italiano
Banca Monte dei Paschi di Siena SpA
Banca Nazionale del Lavoro SpA - BNL
Istituto Mobiliare Italiano SpA - IMI
Mediobanca SpA
Rolo Banca 1473 S.P.A.
Cassa di Risparmio di Verona Vicenza Belluno e Ancona Banca SpA - CARIVERONA
Banca popolare di Milano SCaRL
Banca CRT SpA - Banca Cassa di Risparmio di Torino
Banco di Sicilia SpA - BDS
Banco Ambrosiano Veneto SpA
Banca Antoniana-Popolare Veneta SCaRL
Banca Popolare di Bergamo - Credito Varesino
Banco di Napoli SpA
Banca Popolare di Novara SCarl
Cassa di Risparmio di Padova e Rovigo SpA
Banca Carige SpA
Cassa di Risparmio di Parma e Piacenza SpA
Banca Toscana SpA
Banca popolare dell'Emilia Romagna
Cassa di Risparmio di Firenze SpA
Banco di Sardegna SpA
Banca Agricola Mantovana SCaRL
Banca popolare Vicentina SCarl
Banca popolare di Brescia SCarl
Banca delle Marche SpA
Credito Bergamasco
Banca Nazionale dell'Agricoltura SpA
Credito Agrario Bresciano SpA - CAB
Credito Emiliano SpA
Cassa di risparmio di Bolzano SpA-Suedtiroler Sparkasse
Cassa di risparmio di Venezia SpA
Banca Popolare Commercio e Industria
Banca Fideuram Spa
Banca San Paolo di Brescia SpA
Banca popolare di Lodi
Banca Popolare di Sondrio SCarl

Credito Valtellinese SCarl
Cassa di Risparmio di Lucca SpA
Banca Popolare FriulAdria
Banca popolare dell'Etruria e del Lazio Spa
Cassa di risparmio di Trento e Rovereto SpA CARITRO
Banca di Legnano SpA
Cassa di risparmio di Reggio Emilia SpA
Banca Popolare dell'Adriatico S.p.A.
Cassamarca, Cassa di Risparmio della Marca Trivigiana SpA
Banca Agricola Popolare di Ragusa
Cassa di risparmio di Trieste - Banca SpA
Banca Popolare di Asolo e Montebelluna
Cassa di risparmio di Perugia SpA
Banca di Credito Cooperativo di Roma
Cassa di Risparmio di Udine e Pordenone SpA
Cassa di risparmio di Ferrara SpA
Banca del Salento SpA
Cassa di risparmio di Prato SpA - CARIPRATO
Banca Sella SpA
Cassa di risparmio della provincia di Teramo SpA - TERCAS
Banca Popolare di Cremona SCaRL
Banco di Chiavari e della Riviera Ligure SpA
Cassa di risparmio di Asti SpA
Cassa di risparmio di Ravenna SpA
Cassa di Risparmio di Biella e Vercelli - BIVERBANCA
Cassa di risparmio di Rimini SpA CARIM
Banco Desio - Banco di Desio e della Brianza SpA
Banca di Piacenza
Cassa di risparmio di Pistoia e Pescia SpA
Banca popolare dell' Irpinia
Credito Fondiario Trentino Alto Adige-Hypotthekenbank Trentino - Suedtirol
Banca Popolare di Spoleto SpA
Banca Mercantile Italiana
Banca Briantea SpA
Banca Agricola Milanese SpA
Banca Popolare di Verona - Banco S. Geminiano e S. Prospero SCaRL
Credito Lombardo

SPAIN

Banco Bilbao Vizcaya, BBV
Banco Santander SA
Caja de Ahorros y Pensiones de Barcelona, LA CAIXA
Caja Madrid
Banco Central Hispanoamericano - BCH
Banco Español de Crédito SA, BANESTO
Banco Popular Español SA
Banco Exterior de España SA
Bilbao Bizkaia Kutxa, BBK.
Caja Postal SA

Banco de Sabadell SA
Caja de Ahorros y Monte de Piedad de Gipuzkoa y San Sebastian - Kutxa
Bankinter SA
Caja de Ahorros de Galicia - Caixa Galicia
Caixa de Catalunya
Caja de Ahorros del Mediterraneo CAM
Unicaja - Montes de Piedad y Caja de Ahorros de Ronda, Cadiz, Almeria, Malaga y Antequera
Banca Catalana SA
Banco Pastor SA
Banco de Andalucia SA
Banco Atlántico SA
Banco del Comercio SA
Caja España de Inversiones, Caja de Ahorros y Monte de Piedad
Caja de ahorros de Salamanca y Soria - Caja Duero
Banco Urquijo SA
Banco Zaragozano SA
Banco de Valencia SA
Banco de Castilla SA
Banca March SA
Banco Herrero SA
Banco Guipuzcoano SA
Banco de Galicia SA
Banco de Vasconia SA
Banco de Vitoria SA
Banco de Crédito Balear SA
Banco Gallego, SA
Banco Simeón SA
Banco de Alicante SA
Banco Popular Hipotecario
Banco de Asturias SA
Banco de Murcia SA
BANKOA SA
Banca Jover SA
Banco Granada Jerez

UNITED KINGDOM

HSBC Holdings Plc
National Westminster Bank Plc - NatWest
Barclays Bank Plc
Halifax PLC
Lloyds TSB Group plc
Abbey National Plc
Lloyds Bank plc
Midland Bank plc
Bank of Scotland
Standard Chartered Plc
Royal Bank of Scotland plc (The)
Woolwich Plc
Alliance & Leicester PLC
TSB Bank plc
Cheltenham & Gloucester Bank PLC
Lombard North Central Plc
Northern Rock PLC
Ulster Bank Limited
Capital Bank Plc
Bristol & West PLC
Clydesdale Bank PLC
AIB Group (UK) plc
Yorkshire Bank Plc
Robert Fleming & Co Ltd
Co-operative Bank Plc (The)
Northern Bank Limited
RBS Trust Bank
HFC Bank plc
Standard International Holdings S.A.
Beneficial Bank plc
Investec Bank (UK) Limited
Guinness Mahon & Co. Limited
Sun Bank PLC
Bank of Wales plc
Leopold Joseph Holdings Plc
Matheson Bank Ltd
Nationwide Building Society
Bradford & Bingley Building Society
Britannia Building Society
Yorkshire Building Society
Birmingham Midshires Building Society
Portman Building Society
Coventry Building Society
Chelsea Building Society
Skipton Building Society
Leeds & Holbeck Building Society
Derbyshire Building Society

West Bromwich Building Society
Principality Building Society
Cheshire Building Society
Newcastle Building Society
Staffordshire Building Society
Norwich & Peterborough Building Society
National Counties Building Society
Dunfermline Building Society
Nottingham Building Society
Lambeth Building Society
Cumberland Building Society
Stroud & Swindon Building society
Progressive Building Society
Cambridge Building Society
Leek United Building Society
Furness Building Society
Hinckley & Rugby Building Society
Darlington Building Society
Scarborough Building Society
Universal Building Society

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