THE IMPACTS OF BANK MERGERS AND ACQUISITIONS (M&As) ON BANK BEHAVIOUR

By

Duangkamol Prompitak

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Department of Economics
Birmingham Business School
The University of Birmingham

December 2009

Abstract

This thesis examines the impact of bank mergers and acquisitions (M&As) on lending behaviour by commercial banks. We use the data set of large European commercial banks from 1997 to 2005. Empirical models are formulated to explain the effects of mergers on bank loan pricing behaviour, interest margin setting, credit availability and lending objectives. The analysis provides evidence that mergers have statistically significant influence on reduced lending rates, interest margins and loan supply. In addition, lending objectives for merged and non-merging banks are different, in that merge-involved banks tend to emphasise maximising their utility, while non-merging banks focus on remaining safe. These results suggest that merged banks can obtain efficiency gains through mergers and can pass these benefits to their customers in the form of lower lending rates and interest margins. In addition, diversification gains could arise from consolidations. This is because merged banks focus more on other business activities than traditional intermediary activities. As non-interest income increases in relation to interest income, banks can diversify their business activities and can reduce their non-interest costs. As a result, they can be exposed to lower risk and therefore be less risk averse than non-merging banks.

Dedication

To my dear family

especially my grandmother Lila

Acknowledgements

First and foremost, I offer my sincerest gratitude to my supervisor, Professor David Dickinson, who has supported me throughout my thesis with his patience and knowledge. He has shared thoughtful suggestions and valuable comments on every chapter on my work. His guidance helped me throughout the research and writing of this thesis. Without him, this thesis could not have been completed. Many thanks also go to my second supervisor Mr. Nicholas Horsewood, who has given me constructive suggestions throughout the process of my study.

My sincere thanks also go to my examiners, Professor Philip Molyneux and Professor David Gowland for their time in reading my thesis and their valuable suggestions. Many thanks also go to Mr. Ralph Bailey for being the Chairperson of the examining board which organised the oral examination.

I also would like to thank the Fiscal Policy Office, The Ministry of Finance, Thailand, for giving me permission to commence this thesis in the first instance; their financial support is acknowledged.

I would like to express my thanks to my friends in Birmingham for their support and all the fun we have had over these past four years. My special thanks to my dear friend, Yixin Hou, for her unselfish and patient guidance, and her encouragement in so many ways.

Most importantly, none of this could have happened without my family. My grateful thanks go to my parents, Jumpol and Wannapon Prompitak, who always provide me with support and understanding. Special thanks go to my grandparents, Banyat and Lila Panitchaattra, who were my best counsellors. Although they are no longer with me, they are forever remembered. This thesis stands as a testament to their unconditional love and encouragement.

Finally, I would like to thank everybody who was important to the successful realisation of my thesis, as well as expressing my apology that I could not mention personally one by one.

Any remaining errors are mine.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ARA	Absolute Risk Aversion
BIS	Bank for International Settlements
CR	Concentration Ratio
DID	Difference-In-Differences
ECB	European Central Bank
ESP	Efficient-Structure-Performance
EU	European Union
FE	Fixed Effects
FIML	Full Information Maximum Likelihood
GDP	Gross Domestic Product
HI	Herfindahl Index
M&As	Mergers and Acquisitions
OEA	Other Earning Assets
OLS	Ordinary Least Squares
RE	Random Effects
SCP	Structure-Conduct-Performance
TBTF	Too-Big-To-Fail
TSP	Time Series Processor
USD	US Dollar

Chapter 1

Introduction

Commercial banks have an essential role in the economy. One of their main duties is to collect funds from excess fund sectors and lend to customers with insufficient funds. From these financial intermediary activities, they have an important role in determining the amount and distribution of credit in the economy. Since an increase in bank credit leads to increased investment and in turn to increased employment levels, changes in bank lending behaviour have a marked impact on the economic development of the country. Banks change their lending decisions in response to changes in the structure of the banking market. One of the issues arising in this context is bank mergers and acquisition (M&As). Since market structures can change as a result of mergers, bank mergers can have a significant impact on changes in bank lending behaviour.

The impact of bank mergers in the banking industry has raised concerns among policymakers as to whether bank borrowers can benefit from the consolidations. The consequences of bank M&As on the welfare of borrowers have been investigated from two perspectives: credit availability and loan pricing behaviour. Although several researchers have examined the impacts of bank M&As (comprehensive reviews of the literature are provided in the studies of Berger, Demsetz and Strahan, 1999; and DeYoung, Evanoff and Molyneux, 2009), most of them take their evidence from US bank mergers. Despite the high level of M&A activity in the European banking markets, relatively little research has been conducted so far in this area. In addition, while future bank consolidation is likely to involve large financial institutions across nations, only a limited number of researchers have investigated the consequences of mergers between large banks.

The importance of commercial banks, the emerging trend towards large banks and the lack of evidence on the effects on large European commercial bank lending behaviour of bank M&As make it interesting to examine whether merged banks have different lending behaviour from those which are not involved in the M&A process. This thesis, therefore, aims to answer this question. The main empirical analyses will provide evidence for the most part on whether bank mergers can have any impact on loan pricing behaviour, interest margins, credit availability and lending objectives.

This chapter is organised as follows. Section 1 presents an overview of the thesis. Section 2 discusses previous studies relating to the impact of bank M&As on lending behaviour. This section starts with a general discussion of lending behaviour and goes on to supply empirical evidence of the effect of bank consolidations on banks' decision-making about their lending policy. In addition, because changes in the attitude to risk can affect any changes in bank lending behaviour, the empirical studies examining the relationship between attitudes to risk-taking and bank mergers are also presented in this section. Section 3 describes the data sources, sample data and econometric package used in this thesis.

1.1 Overview of the thesis

The overview of the EU banking market structure and the M&A situation in EU banks during the study period are provided in Chapter 2. Chapter 3 analyses whether bank mergers tend to have a favourable impact on those who borrow from the banks involved in M&As. The chapter starts by identifying the determinants of the bank loan interest rate on the basis of the Monti-Klein (1971) model of the banking firm, in which banks can exert monopoly power. In addition, the impact of market competition on loan price is examined with reference to two alternative hypotheses: the Structure-Conduct-Performance (SCP) and the Efficient-Structure-Performance (ESP) hypotheses. After knowing the factors which influence the decision-making on the price of bank loans, the thesis empirically analyses the impact of bank M&As on the loan interest rate, when every loan interest rate determinant, on the basis of the theoretical framework, is controlled.

Chapter 4 extends the analysis of the impact of bank M&As on loan pricing behaviour by using the alternative approach, namely, the difference-in-differences (DID) estimation technique. In addition, this chapter looks at two more aspects of lending: credit availability and bank interest margins. These three lending behaviours, both before and after mergers and on the part of both merged and non-participant banks, are compared, taking the DID approach.

Chapter 5 applies two portfolio behaviour frameworks in order to examine whether bank mergers have an impact on the business objectives of banks and thus on lending behaviour. These two approaches are the Expected Utility Maximisation framework developed by Parkin-Gray-Barrett (1970) and the Safety First Principle developed by Roy (1952). In the Expected Utility Maximisation approach, banks are assumed to focus on maximising their expected returns. However, since any profit-maximising business, including banking, confronts macroeconomic risks such as the effects of recession and microeconomic risks such as new competitive threats, minimising these risks can be one of the business objectives of a bank, as well as maximising its profit. One of the theoretical approaches explaining the behaviour of those banks which aim to minimise their risks is the Safety First model. In addition, in order to choose which model is most suitable to explain the behaviours of merged banks, the non-nested testing technique of Davidson and MacKinnon (1981) is adopted.

Chapter 6 consists of a conclusion and summary of the findings. In addition, remarks, policy recommendations and suggestions for future research are also discussed in this chapter.

1.2 Review of the literature

This section reviews the studies related to the impact of bank mergers on lending behaviour. Although there may be some other research examining the impact of bank mergers, the literature reviewed in this section is directly relevant to the main objective of this thesis, which is to analyse whether bank M&As can have some influence on the changes in the lending behaviour of merged banks. In addition, this literature also provides sufficient knowledge of the way in which bank decide their lending and how bank consolidations affect the lending decisions of merged banks.

The section includes two main parts. The first part discusses the conventional literature on lending behaviour, focusing on the factors which influence bank loan interest rates and bank interest margins. Then, the empirical evidence of the impact of bank mergers on lending behaviour is reviewed, including pricing behaviour and attitude toward risk.

1.2.1 Bank lending behaviour

One of the determinants of the bank loan interest rate is the structure of the banking market. The impact of the market structure on the bank loan interest rate is generally summarised by two opposing hypotheses. One is the Structure-Conduct-Performance (SCP) hypothesis, which suggests that banks will collude and use their market power to extract rents. The other is the Efficient-Structure-Performance (ESP) hypothesis, which suggests that concentration would increase the overall efficiency of the banking sector. In this framework, concentration is given to the faster growth of more efficient banks than of less efficient banks, or the take-over of the latter by the former. In this case, more efficient banks are expected to price their services more competitively, or, in other words, to offer more favourable prices to their customers.

Studies examining the impacts of market structure on bank loan price yield mixed results. Aspinwall (1970) investigates the relationship between market structure and bank mortgage interest rates in the US banking market in 1965. Estimating a cross-section regression analysis, the results indicate a statistically significant association between lending rates and two market structure measures: the number of lending instructions in the market and the concentration ratio. That is, the lending rate tends to be lower when the number of institutions increases, while it tends to be higher as the market concentration increases. Besides market structure, Aspinwall also shows that other factors influence lending rates. These factors include the demand for credit, a nation's per capita income, credit risk and bank size. Hannan (1991a) uses the data of 300 US banks during the period 1984 to 1986 to test the SCP hypothesis. Based on the Monti-Klein model of the banking firm, the results confirm the relationship between commercial loan rates and market concentration, as predicted by the SCP paradigm. That is, loan interest rates rise higher in more concentrated markets. In addition, Hannan also concludes that, if loan rates are more rigid in concentrated markets and if rates in equilibrium tend to be higher in such markets, then it follows that periods involving sharp rises in interest rates would exhibit a more distant relationship between loan rates and concentration. This is because banks in more concentrated markets adjust their rates upward more slowly than banks in less concentrated markets. In contrast, Petersen and Rajan (1995) investigate the effects of competition between banks on the loan rate and availability of credit. They find that banks with uncertain future cash flows in more concentrated banking markets charge substantially lower loan rates and provide more financing. However, they do not provide any explanation to support the ESP hypothesis. Instead, they surmise that this reduction in loan price results from the fact that banks seemingly smooth loan rates in concentrated markets and as a result provide more credit availability. On the basis of a simple Cournot model of loan pricing, Corvoisier and Gropp (2001) conclude that, in individual euro area countries during the years 1993 to 1999, the increasing bank concentration in the loan market may have resulted in less competitive pricing by banks. The impact depends on the type of product under consideration. In particular, they find the positive effects of market concentration on customer loans, mortgage loans and short-term loans. These results support the SCP hypothesis, which suggests that higher market concentration will result in collusion. However, for long-term loans, the coefficient is statistically insignificant. De Graeve, De Jonghe and Vander Vennet (2007) adopt a heterogeneous approach and apply it to the Belgian banking market to investigate the behaviour of bank retail interest rates. They find that the banks with the largest market share set their loans least competitively. Similarly, Cerqueiro (2009) uses a sample selection model to estimate the effect of concentration on bank lending rates. The results suggest that in 1993 high bank concentration in the US had, on average, a positive relationship with loan rates. In addition, focusing on the risk effect, Boyd and De Nicolo (2005) also find that greater competition reduces loan rates. They show that, in equilibrium, the risk in bank loan portfolios increases with the level of concentration. This risk-shifting mechanism is based on the idea that banks, as concentration increases, charge higher loan rates to their customers. In turn, the higher loan rates worsen the agency problems in the credit market, since they induce firms to take more risk.

Changes in the market interest rate could have a significant impact on bank lending rates. Most of the studies focusing on this topic generally show consistently that the market interest rate and lending price have a positive relationship. This is because an increase in the money market rate raises the opportunity cost of other forms of financing, such as bonds, making lending more attractive and therefore boosts loan demand and increases the interest rate on loans. They also find that changes in the market rates are not fully reflected in the short-term bank lending rate, but the impact in the long term is higher. Examples of these studies are those of Cottarelli and Kourelis (1994), Borio and Fritz (1995), Donnay and Degryse (2001), De Bondt, Mojon and Valla (2002) Heinemann and Schuller (2002), Gambacorta and Iannoti (2005) and Burgstaller and Scharler (2009). In addition, as presented by De Bondt, Mojon and Valla (2002), in the long run, banks tend to set their retail prices in line with their marginal costs, i.e. the funding cost of loans. Moreover, Kashyap and Stein (1997), Cecchetti (1999) and Heinemann and Schuller (2002) bring evidence that the speed of change in the lending price as a result of changed market rates also depends on the competition environment in the market. That is, with low competition, banks are slow to react, while with high competition, banks are forced to react faster – otherwise they risk losing their market share. However, this result is inconsistent with the findings of Adams and Amel (2005), who examine the relationship between banking competition and market interest rates in the US and find that, as market concentration increased, banks in such markets are slower to adjust their lending rate as a consequence of the changes in market rates. The rigidity in loan interest rate adjustment is also examined by Lago-Gonzalez and Salas-Fumas (2005). Using the data of loan interest rates charged by individual Spanish banks between 1988 and 2003, they find that the adjustment speed varies between banks of different types and sizes. That is, loan interest rate rigidity is lower among commercial banks than among saving banks and larger banks show greater interest rate rigidity than small banks. In addition, the rigidity is also greater in markets with higher population growth. De Graeve, De Jonghe and Vander Vennet (2007) find that, in the Belgian banking market, the loan prices of well capitalised and highly liquid banks are least responsive to changes in market rates. In addition, different loan types react differently to these changes in market rate. That is, corporate loans tend to adjust both more quickly and more thoroughly to changes in money market rates in relation to consumer loans.

Besides market structure and money market rates, there is some evidence of other potential factors influencing the pricing of bank loans. This comes from works by Jayaratne and Strahan (1996), Kroszner and Strahan (1999) and Garrett, Wagner and Wheelock (2005), who examine the impact of bank branching deregulation across US states and find that loan rates have substantially decreased since the deregulation. Petersen and Rajan (2002) examine the impact of distance on loan price. Their results show that, in the US, bank loan pricing behaviour sometimes depends on the distance between borrowers and lenders. In particular, borrowers located one mile from the lending bank pay less than borrowers who are close neighbours of the lending bank. Gambarcota (2004) investigates the factors influencing the price setting behaviour of Italian banks. Using data from the period 1993 to 2001 to examine cross-sectional differences in price setting behaviour, he finds that banks with a high proportion of long-term lending tend to change their prices less frequently. In addition, he also finds that macroeconomic conditions, notably government monetary policies, have a significant influence on bank loan pricing behaviour. That is, the changes in permanent income and inflation have a positive and significant effect on the interest rate in short-term lending and that this short-term rate for liquid and well-capitalised banks reacts less to a monetary policy shock. These results are consistent with the findings of Kashyap, Stein and Wilcox (1993), which state that, in the period 1964 to 1989, interest rates on loans in the US depended positively on the real GDP and inflation rate. Moreover, there is some evidence for the impacts of risks on loan interest rate. Slovin and Sushka (1984) investigate the determinants of commercial loan rates in the US banking market. Using data from the period 1952 to 1980, they find that the cyclical change and loan rate have a positive relationship. In addition, Corvoisier and Gropp (2001), Gambacorta (2004) and Hao (2004) finds the consistent results that default risk and liquidity risk also have a positive effect on bank loan pricing behaviour.

Some studies have focused on the difference in loan pricing behaviour between banks with different types of ownership. For instance, Sapienza (2004) examines the impacts of government ownership on bank lending behaviour. Comparing the interest rates charged by Italian state-owned banks with those of Italian privately-owned banks, she finds that, in the period 1991 to 1995, state-owned banks tended to charge lower loan rates than privately owned banks did. However, she argues that the lower loan rates do not signify that state-owned banks are either more efficient, or have lower costs. In addition, state-owned banks generally favour large borrowers. This can be seen from the finding that large firms receive a greater reduction in loan rates from state-owned banks than that received by smaller borrowers. Moreover, the loan pricing behaviour of state-owned banks is also affected by the electoral results of the party affiliated to the bank. In other words, the stronger the political party in the area where the firm is borrowing, the lower the loan interest rates charged. Micco and Panizza (2006) examine whether state ownership of banks is correlated with lending behaviour. Using bank level data over the period 1995 to 2002, they find that bank responses in macroeconomic shocks differ between different types of bank. That is, changes in the loan price of state-owned banks are less responsive to macroeconomic shocks than the changes made by private banks.

Theoretical models employed in the literature for the analysis of interest margin behaviour are based on two theoretical models: the model of the banking firm developed by Monti (1972) and Klein (1971) and the dealership model developed by

Ho and Saunders (1981). Under the Monti-Klein model, banks are assumed to operate in an imperfect competitive market. The bank's interest margin depends on its market power, intermediary costs and risks. In the dealership model, banks are assumed to be risk-averse intermediates, collecting deposits and granting loans. An important factor influencing the size of bank interest margins in this model is transaction uncertainty due to the asymmetric arrival time of the supply of deposits and the demand for loans. Another factor is market structure: in a market with an inelastic demand for loans and supply of deposits, banks tend to exercise their market power and set higher margins.

Most of the empirical studies examining bank interest margin behaviour generally provide results which support the theoretical predictions. As presented by Angbanzo (1997), who uses a sample of the US banking data between 1989 and 1993 to examine the determinants of the net interest margin, default risk, the opportunity cost of non-interest bearing reserves, leverage and management efficiency all have a positive impact on the bank interest margins. However, liquidity risks are negatively related to bank interest margins. Saunders and Schumacher (2000) investigate the impact on interest margins in European countries of the structure of bank competition over the period 1988 to 1955. They find that market structure has an important impact on bank interest margins. In addition, this effect appears to vary across countries. That is, the more segmented the banking system, the larger the monopoly power of existing banks appears to be and the higher their spreads. However, as preasented by Valverde and Fernandez (2007), who examine the determinants of bank margins in European banking markets, if market power increases as output becomes more diversified towards non-traditional activities, this diversification gains can be passed on to banks' customer in terms of lower interest margins. Corvoisier and Gropp (2001) also investigate the relationship between bank interest margins and market concentration. Their results suggest that, overall, concentration tends to increase interest margins. Nys (2003) analyses the determinants of bank interest margins for 12 European countries during the period 1989 to 1999. Their results indicate that default risk, administrative costs and opportunity costs have a positive relationship with the interest margins of most European banks. Maudos and Fernandez de Guevara (2004) examine the factors determining the interest margin in the banking sectors of the European Union. Using the data from the period 1993 to 2000, they find that the fall of bank interest margins is compatible with a relaxation of the competitive conditions. In the Australian banking market, Williams (2007) finds that interest margins are positively related to the degree of market concentration and operating costs. However, unlike other writers, he presents a negative relationship between credit risk and interest margins and this difference is explained by the evidence that banks are unable to price credit risk accurately. Recently, Perera, Skully and Wickramanyake (2010) investigate the impacts of market concentration on the deviation in the interest margins of South Asian banks. Using a generalised least squares method and random effect estimation technique, they find that, overall, market concentration has no significant impact. However, large banks which typically operate in the wholesale banking market have lower interest spreads than smaller banks. This can be explained by the fact that large banks may achieve greater cost savings in the loan market than their smaller counterparts can. Their cost savings may have been achieved through lower credit screening and monitoring costs, resulting from the information advantage which they gain through ongoing client relationships.

Other studies consider other potential factors influencing bank interest margins. Demirguc-Kunt and Huizinga (1998) examine the determinants of bank interest margins using bank-level data for 80 countries between 1988 and 1995. Taking macroeconomic conditions as explanatory variables, they find that bank interest margin behaviour depends on several factors, including bank characteristics, macroeconomic conditions, bank taxation, regulation of deposit insurance, overall financial structure and legal and institutional indicators. Afanasieff, Lhacer and Nakane (2001) also investigate whether macroeconomic or microeconomic factors are the most cogent factors affecting the behaviour of the spread of bank interest rates. Using monthly data for all commercial banks operating in Brazil during the period 1997 to 2000, their results indicate that macroeconomic conditions, including the nation’s inflation rate and growth in output, are the most important factors in explaining the behaviour of bank interest spreads. Brock and Rojas-Suarez (2000) apply a two-step procedure for a sample of five Latin American countries. Their results show that, overall, capital, cost and liquidity risk have positive and statistically significant effects on bank spread. Focusing on the data from four Southeast Asian countries between 1994 and 2001, Doliente (2005) finds that collateral, liquid assets, loan quality, operating expenses and capital have a significant influence on Southeast Asian bank spreads. With particular emphasis on bank ownership structure, Fungacova and Poghosyan (2009) use bank-level data covering Russia’s entire banking sector for the period 1999 to 2007 to examine the determinants of bank interest margins. Their results indicate that, when considering the categories of bank ownership, most of the traditional determinants of bank interest margins differ in their impact. For example, the impact of credit risk is significant only for domestic private banks. State-controlled and foreign-owned banks do not seem to take the credit risk into account in their pricing strategy. In addition, there is a certain similarity across banks, despite different ownership structures, for the impact of being risk averse.

1.2.2 The impacts of bank M&As on lending behaviour

1.2.2.1 Price and credit availability

Studies examining the price effects of bank M&As can be classified into three main groups: the effects of bank mergers on deposit interest rates, on lending prices and on bank loan spreads. In the case of deposit interest rates, most of the studies which focus on US bank mergers find that bank M&As have a negative influence on the deposit interest rates of merged banks. This can be seen from the study of Prager and Hannan (1998), who analyse the price effects of bank mergers which have substantially increased the concentration of a local market. They examine the dynamic changes in deposit interest rates and find that mergers occurring in more concentrated banking markets lead to adverse changes in the short-term deposit interest rate. That is, merged banks do not pass on efficiency gains to their consumers, but instead earn increased monopoly rent and therefore offer lower deposit interest rates. In addition, the deposit rates of banks which did not operate in the markets where such mergers took place change in the same direction. However, the deposit rates of merged banks tend to be decreased by a greater percentage. The evidence of the reduction in deposit rates is consistent with the findings of Park and Pennacchi (2007), who formulate a theoretical model to investigate the setting of interest rates by large multimarket banks which have been created by cross-border mergers. Their model suggests that large banks engaging in M&As tend to reduce their retail deposit rates. In addition, their empirical analysis of data on large US multimarket banks from 1994 to 2005 also supports the predictions of this model. One of the explanations for this finding is that of funding advantages. That is, as banks grow larger, they tend to have greater access to alternative and cheaper sources of funding, implying optimally lower retail deposit interest rates. However, Rosen (2003) argues that this explanation is not specific to banks operating in many markets. Looking at the setting of deposit interest rates by banks in the US over the period 1988 to 2000, his results show that merged banks tend to offer higher deposit interest rates on both cheque accounts and money market deposit accounts. Moreover, a market with more and larger multimarket banks generally has higher deposit interest rates. Hannan and Prager (2004) provide empirical evidence regarding the determinants of deposit interest rates offered by those US banks which engaged in M&As between 2000 and 2002. Their results also indicate that large banks offer lower deposit interest rates than their smaller counterparts. In addition, when the size of the organisation is controlled, banks operating in many local banking markets tend to set lower deposit interest rates than those operating in fewer markets. Craig and Dinger (2008) present a comprehensive empirical analysis of the impact of mergers on changes in deposit interest rates. On the basis of the cheque account interest rates offered by the US banks, their results suggest that during the period 1997 to 2004, large banks as a result of mergers tend to offer lower deposit rates in the short term, or, in other words, in the two years following the bank mergers.

Evidence of the effects of bank mergers on deposit interest rates in European banking markets is rather scarce. Focarelli and Panetta (2003) use Italian data at bank level between 1990 and 1998 to empirically analyse both the short-term and long-term pricing effects of bank M&As. They find that merged banks obtain increased monopoly rent and exert market power by lowering their deposit rates. The largest rate reductions are made in the first years after the mergers. However, in the long run, post-merger deposit interest rates can also be positive. This is explained by the fact that cost efficiency gains through mergers can often take years to achieve. Ashton and Pham (2007) study the influence of bank mergers by focusing on the level of interest payable on retail deposits. Using data from the UK retail bank mergers between 1988 and 2004, their results indicate that merged banks tend to be more cost efficient, which leads to improved deposit interest rates for their consumers. This improvement in cost efficiency is consistent with the findings of Huizinga, Nelissen and van der Vennet (2001), Ayadi and Pujals (2005), Behr and Heid (2008) and Beccalli and Frantz (2009), who examine the impact of bank mergers on the performance of European banks; they find that consolidations create cost efficiency and this gain appears to be transferred to the banks' clients.

Studies which examine the effects of bank mergers on loan interest rates tend to yield mixed results. As noted by Ashton and Pham (2007, p.22), different empirical findings may exist for many reasons, including differences in the market structure of the banking market under consideration. In the context of US bank mergers, Akhavein, Berger and Humphrey (1997) analyse the price effects associated with bank megamergers. Comparing the loan-pricing behaviour of merged and non-merging banks, they find that the changes on lending price which occur following consolidations are notably small and hard to predict. That is, although the loan interest rates of merged banks tend to be lower than those of non-merging banks, this difference is small and not significantly different from zero. However, they suggest that the small price difference could reflect the efficiency gains and better diversification of loan portfolios across geographical markets which come from bank merging. Kahn, Pennacchi and Sopranzetti (2001) use US consumer loan data to examine how merged banks and rival banks operating within the same local markets change their loan prices. They find that different retail banking products are affected dissimilarly by merger actions. In particular, bank mergers tend to have a strong negative influence on automobile loan interest rates, but not on the price of personal loans. That is, personal loan rates rise in markets following a significant merger, while the automobile loan rates charged by banks engaging in domestic mergers tend to be lower. This difference in loan price setting behaviour is the result of the different capacity to manage costs in different kinds of loan. In other words, economies of scale are found in the sourcing of automobile loans, mainly because most of these loans are securitised. This makes it possible for merged banks which achieve economies of scale to pass the benefits on to their borrowers in the form of lower car loan rates. Park and Pennacchi (2007) develop a theoretical model showing that, while large banks tend to hurt retail depositors, they benefit loan customers. That is, if large multimarket banks have a significant funding advantage which is not offset by a loan operating cost disadvantage, their retail loan prices will be lower than those of their smaller rival banks, in particular, in highly concentrated markets. Using US data from large multimarket banks between 1994 and 2005, they also present the empirical evidence to support the model's prediction. This result indicates that the greater market share of large banks tends to increase the competitiveness of small business lending. The reduction in loan interest rates is consistent with the findings of Berger, Rosen and Udell (2007), who investigate large banks' loan pricing behaviour to small businesses as a result of bank consolidations. Their regression results suggest that, given other control variables, banks with over 1 billion USD in total assets tend to charge lower loan interest rates than do banks which have total assets below 1 billion USD. In addition, when the market size structure variable is included in the model, loan interest rates are negatively significantly affected by the banking market size structure, but not by the size of the bank making the loan. This result suggests that, in a concentrated market where large banks have a greater share, bank mergers have no impact on the difference in loan pricing behaviour. In other words, the loan interest rates charged to small businesses by both large and small banks tend to be lower in a concentrated banking market. In contrast, Garmaise and Moskowitz (2006) who analyse the social effects of bank M&As find unfavourable price effects. They use a sample of commercial loans and mergers between large US banks to examine the relationship between bank mergers and the crime rate. They find that bank mergers have a substantial impact on the higher local market concentration which leads to an increase in loan prices. This adverse effect consequently contributes to a lowering of development and investment rates, a decline in real estate prices, greater household poverty and a greater increase in property crime in subsequent years.

In Europe, Sapienza (2002) considers data on Italian loan contracts between banks and companies from 1989 to 1995 to examine the effects of bank mergers on loan contracts. She finds that when markets are overlapping and the market shares of target banks are small, banks involved in M&As tend to lower their loan prices. This is because these banks can obtain efficiency gains from product and service diversification and can pass these benefits on to their borrowers in terms of lower lending rates. This result is similar to the results of Focarelli and Panetta (2003), who also investigate the impact of Italian bank mergers on lending terms. Using bank level data from 1990 to 1998, they find that mergers generate efficiency which in part is passed on to consumers through reduced loan interest rates. Ashton and Pham (2007) use data of bank consolidations from 61 UK retail bank horizontal mergers between 1988 and 2004 to examine the relationship between the price and efficiency effects of bank consolidations. Following the same model as Prager and Hannan (1998), who analyse the impacts of bank M&As on deposit interest rates, they find that, although mergers generate efficiency gains, these benefits are passed on to merged banks' consumers only in the form of higher deposit interest rates. For borrowers, consolidations tend to increase the cost of borrowing. This can be seen from the positively and statistically significant lending price charged by merged banks, which suggests that retail bank mergers have led to significant increases in loan interest rates. In the Spanish banking market, Fuentes and Sastre (1998) analyse the effects of bank consolidations on bank interest rates. Their results demonstrate that, from a short-term to medium-term perspective, bank mergers have no significant effect on loan pricing behaviour. They suggest that this is because the impact of merger operations may take more time to develop. Montoriol-Garrige (2008) investigates the impact of bank M&As on the average interest rates of firms and finds significant impacts of bank consolidations on loan interest rate. Using Spanish bank mergers data from the period 1996 to 2005, they find that consolidations have positive effects on borrowers who maintain their lending relationship with the consolidated banks. Loan interest rates decline after mergers- a decline is permanent and larger for the acquirers. In addition, these writers also provide evidence that the most beneficial mergers, from the borrowers' point of view, are those involving two large commercial banks. Moreover, different market structures have different effects on the setting of banks' loan interest rates. That is, the greater increase in local banking market concentration as a result of mergers, the smaller the decline in loan interest rates.

Focusing on the informational effects of bank mergers and loan interest rates, Panetta, Schivardi and Shum (2004) find that Italian bank consolidations tend to improve the ability of merged banks to screen borrowers. In other words, mergers lead to a closer correspondence between lending prices and the risk that borrowers will default. That is, merged banks tend to charge a higher loan price to risky borrowers, while non-risky borrowers enjoy lower loan interest rates. That information improves to merged banks is contrary to the findings of Ogura and Uchida (2007). Examining the impact of Japanese bank mergers on bankers' acquisition of soft information about borrowers, they find that bank consolidations have a negative impact on the soft information acquired by small banks. However, no significant impact is observed for large banks. That is, for small banks, the increase in organisational complexity upon mergers tends to reduce their ability to acquire soft information. In addition, they also argue that this adverse effect could be economically costly for small banks and their borrowers. Hauswald and Marquez (2006) formulate a theoretical model to investigate the interaction between a bank's use of information acquisition and its role in promoting the efficiency of credit markets. Their model predicts that mergers enable banks to acquire proprietary information both to soften lending competition and to extend their market share. That is to say, as competition increases, banks tend to lower their loan interest rates and reduce their investment in information acquisition. This reduction in informational investment in turn leads to less efficient credit allocation and a deterioration in aggregate loan quality.

The literature focusing on the impact of bank M&As on bank interest spreads is very limited. As reported by Calomiris and Pornrojnangkool (2005), who examine the impact of the merger of Fleet and BankBoston on SME lending rates, bank mergers have the potential impact on loan spreads. These writers find that after the merger the lower pre-merger interest spreads to medium-sized mid-market borrowers in New England disappeared. However, there was no change in post-merger spreads for small-sized mid-market borrowers. Unlike them, Erel (2005) uses a loan level data set for US commercial banks between 1990 and 2000 to analyse the impacts of bank consolidations on loan spreads and finds that, on average, mergers reduce loan spreads. In addition, the decline in spreads tends to be especially large for acquirers with a greater decline of post-merger operating costs.

Most of the studies exploring the potential effects of bank M&As on credit availability focus on their impact on a specific group of borrowers, in particular, small business borrowers. In the context of the US banking market, the results are mixed. As Featherstone (1996) suggests, from examining the effects of bank mergers on agricultural loans from 1987 to 1993, in general, the agricultural loans offered by merged banks did not decrease during the three years after any consolidation. However, small banks tend to increase their agricultural credits after mergers. This increase in credit provided by small banks is consistent with the findings of Strahan and Weston (1996), who investigate the relationship between small business lending and bank mergers. By comparing the changes in merged banks' pre- and post-merger small lending with those of non-participating banks, they find that M&As between small banks tend to increase the credit available to small borrowers. However, other types of merger have little impact. Avery and Samolyk (2004) use bank M&A data in the US banking market between 1993 and 1997 to analyse the impact of bank mergers. They also find that mergers between small banks have a tendency to offer more small business lending in local banking markets. In contrast, Gilbert and Belongia (1988) investigate the impact of bank mergers on agricultural loans offered by large bank holding companies and indicate that consolidations between small commercial banks tend to reduce the supply of agricultural loans. This reduction in credit supply is consistent with the results of Keeton (1996), who investigates the impact of bank M&As on farm and business lending in the Federal Reserve System's Tenth District states for the period 1986 to 1995. He finds that out-of-state acquisitions of banks owned by urban organisations tend to reduce the loans which they offer to small businesses and farmers. However, other banks competing in the same local market have a tendency to increase their small business lending. Peek and Rosengren (1997) use data from 1993 to 1996 to examine the effects of bank consolidations on the willingness of a banking organisation to lend to small customers. Their results show that consolidated banks tend to lower their small business loan portfolio share following a merger. Ahrendsen, Dixon and Luo (2003) estimate the effects of bank mergers on bank agricultural loan-to-asset ratios and also find that, in the period 1994 to 2001, bank consolidations had a negative effect on agricultural loan ratios. Francis, Hasan and Wang (2008) analyse the impact of bank consolidations on the formation of new businesses and conclude that, overall, merged banks make less credit available to new businesses.

In the Italian banking market, according to Sapienza (2002), who investigates the impact of bank mergers by using the data from the period 1989 to 1999, larger banks, as a consequence of consolidation, tend to reduce their credit to small borrowers. This result is consistent with the findings of Bonaccorsi Di Patti and Gobbi (2003, 2007), who take a large sample of Italian corporate borrowers to examine the impact of bank M&As on relationship lending. They make the case that firms borrowing from acquirers and target banks experience a reduction in total credit, or, in other words, relationship termination as a result of mergers has a deep adverse effect on the availability of credit. In the Belgian banking market, Degryse, Masschelein and Mitchell (2006) use information from individual loan contracts to investigate the impact of bank mergers on SME lending and provide evidence of a significant decline in the amount of loans provided to small borrowers after large bank mergers. In addition, Montoriol-Garriga (2008) uses data on Spanish bank mergers from 1996 to 2005 to examine the effects of bank mergers on credit availability and finds evidence that target banks tend to reduce their loans to small borrowers.

Some studies, however, have found no significant impact of bank M&As on credit availability. These studies are, for example, Berger *et al.* (1998), Berger *et al.* (2004), Erel (2005) and Berger, Rosen and Udell (2007), who examine the changes in loan portfolios after mergers among US banks and Marsch, Schmieder and Aerssen (2007) and Mercieca, Schaeck and Wolfe (2009), who investigate the impact of bank mergers on SME lending in the countries of Europe. As suggested by the studies of Berger *et al.* (1998) and Berger *et al.* (2004), which analyse the impact of bank mergers on small business lending using US banking data, although merged banks tend to lower their small lending, this reduction is offset by the increase in credits offered by non-merging banks or by new entrants. In addition, Craig and Hardee (2007) apply information at the individual firm level in the US to judge how banking consolidation has affected small business credit; they show that, while larger banks are found to be less likely to offer credit to small borrowers, non-banking institutions are found to make up for this reluctance. Therefore, the total supply of loans as a result of bank mergers is unchanged overall.

1.2.2.2 Risk-taking attitude

While the impact of consolidation on prices and credit availability has been widely investigated, evidence on the effects of consolidation on banks' attitude to risk has been more limited. As suggested by De Nicolo *et al.* (2003, p.24-25), bank mergers can provide differential incentives for banks' risk-taking. On the one hand, consolidations may result in diversification gains, which may reduce bank risk. On the other, consolidations may allow banks to increase their risk exposure.

The studies presenting evidence on consolidations and banks' attitude to risk mainly focus on mergers between US banks. Some of them claim that bank M&As can reduce bank risk. Craig and Santos (1997) examine the dynamics of the risk effects caused by bank consolidations, using the sample of bank acquisition in the US from 1985 to 1991. They find that the post-acquisition risk of newly formed banking organisations is substantially lower than the pre-acquisition risk of acquiring bank holding companies (BHCs). This result indicates that bank M&As could produce less risky organisations and therefore diversification gains can be one of the motives for merging. Boyd and Graham (1988) examine the risk-reduction potential of mergers between BHCs and other financial firms by simulating cross-industry mergers. Using US data from the period 1970 to 1980, they find that diversification benefits can be obtained by some types of merger. Specifically, they find that consolidations between

BHCs and life insurance firms would probably reduce BHCs' bankruptcy risk, while consolidations between BHCs and other financial firms would be likely to increase risk. Lown *et al.* (2000) examine the risk effects of the same types of merger as those of Boyd and Graham (1988). Using US data between 1984 and 1998, they also find the same results. Hughes *et al.* (1999) simulate different consolidation strategies of bank holding companies and find that interstate expansion in the US could lead to reduced insolvency risks. Mishra *et al.* (2005) apply the sample data of 30 US bank mergers to empirically examine the changes in risk for merged banks, focusing on the non-conglomerate types of merger, i.e. banks with banks. They find statistically significant evidence that non-conglomerate types of merger do indeed reduce risk for merged banks. They also suggest that diversification may be a possible motive for bank mergers. Using Italian bank merger data between 1997 and 2001, Chionsini, Foglia and Reedtz (2003) find that credit risk of merged banks is significantly reduced. This is because of diversification of idiosyncratic risk as a consequence of bank mergers.

Another group of writers presents evidence that merged banks tend to take on more risk. Chong (1991), in an event study, finds that US interstate bank mergers increase the volatility of bank stock returns. Amihud, DeLong and Saunders (2002) address the issue of cross-border mergers, covering many countries. Their results show that international mergers between 1985 and 1998 had no systematic effect on the acquiring banks' total risk or stock price risk. One interpretation of this result is that diversification benefits are offset by the particular monitoring problems associated with foreign operations. De Nicolo *et al.* (2003) examine the relationship between consolidations and risk for a sample of large financial firms in the period 1995 to

2000. They find that large merged banks are motivated by moral hazard incentives and therefore exhibit a higher level of risk-taking than smaller banks do. In addition, moral hazard appears to have outweighed the risk reductions achievable through economies of scale or scope, as well as through geographical or product diversification. As Boyd and Graham suggest (1998, p.2), one of the important sources of moral hazard in the banking sector is being Too-Big-To-Fail (TBTF). This is because these banks could take excessive risks with no concern for efficient risk management since governments provide the safety nets to protect them. There is some empirical evidence to show that merged banks take on more risk because of TBTF. O'Hara and Shaw (1990) examine the impact of TBTF banks and find that those which see themselves in this category receive higher returns from investing in riskier activities than institutions to which TBTF status does not apply. They also suggest that becoming TBTF through mergers is valued by market participants and the TBTF perception exists as a motive for M&As. Kane (2000) investigates banking megamergers during the period 1991 to 1998. His findings indicate that the shareholders of the large US merged banks gain value from their increased size. He also concludes that organisations engaging in megamergers hope to become so large and complex that they will benefit from the government's systemic-risk exception. In addition, as said by Shull and Hanweck (2001, p.137), the TBTF policy inevitably provides an incentive for large banks mergers. This is because becoming TBTF can reduce the cost of funding for large banking organisations. This argument is supported by the empirical study of Penas and Unal (2004), who propose a cross-sectional test to investigate motives for merging. They provide tests focusing on identifying the factors which determine the bond returns of merged banks. Using the US bank merger data from 1991 to 1997, they find that the main determinants of merger-related bondholder gains are the gains associated with achieving TBTF status, diversification gains and, to a lesser degree, synergy gains. They also find that credit spreads decline significantly after the merger. They attribute this result to the benefits which banks derive from reaching or getting closer to TBTF status and from attaining a higher degree of diversification. These results provide evidence that bondholders attach a value to banks becoming TBTF through mergers and support the existence of TBTF gains in bank M&As. Rime (2005) analyses the effects of TBTF on banks' credit ratings. Using a sample of large and small banks in 21 industrialised countries between 1999 and 2003, he suggests that giving a bank TBTF status has a significant and positive effect on its credit rating. As banks become larger, they can obtain a rating bonus for being TBTF. Using the US data from the period 1991 to 2004, Brewer III and Jagtiani (2009) test the hypothesis that banking organisations perceive benefits from reaching TBTF status and treat them as a merger motive. Their results imply that large banks obtain advantages not available to other organisations. As a result, they seek to become TBTF and obtain benefits by paying a higher merger premium.

1.3 Data sources, M&A samples and econometric package used

1.3.1 Data sources

In this thesis, the macroeconomic data were collected from the European Central Bank and the Eurostat database. These data include the data of prices, outputs and bank market structure indicators. Banks' information on M&As was collected from the Bureau Van Dijk international database. Bank balance sheet and income statement data were gathered from the BankScope database, which provides in-depth comprehensive bank level statistics for the period 1997-2005. This database is useful for investigating balance sheet and income statements from an individual bank and comparing statistical data with those of peers and rival groups. However, according to Bhattacharya (2003), who examines the quality of the BankScope database by using Indian banking data, the Bankscope data has some strong selective biases. Therefore, using the BankScope data may lead to problems when they are applied to examining macro-level estimations. However, this is not a significant problem for the present thesis, since we use the BankScope data mainly for bank level information and use the data from the European Central Bank for macro level information. In addition, the details of bank market structure and bank M&A situations were gathered from relevant research studies. All of them come from reliable sources, mainly prominent journals.

1.3.2 Sample data

The sample data used in this thesis are the data for the period 1997 to 2005 of large commercial banks, with total assets greater that 100 billion USD and with their headquarters in one of the EU15 countries[1]. The period under scrutiny is of particular interest for three main reasons. First, it covers the upward trend to the point where the M&A activities began to decline. Second, it immediately follows the regulatory

1 The EU15 countries comprise Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden and the UK.

changes associated with the completion of the single market programme in the EU. Finally, it also covers the period before and after the introduction of the euro.

However, it might be argued that examining large banks only was not appropriate for this thesis. The reason for doing so is that our aim is to look at the differences in lending behaviours between banks involved in M&As and non-merging banks. In addition, due to the limitations of the data, we have to restrict our data as much as possible but still obtain reliable results in answer to our main questions. We can do this by using the data from large banks. Thus, it is not necessary to expand our range and examine smaller banks.

The main merger data are the data of the M&A deals carried out by large European commercial banks during the study period. This thesis does not address the difference between mergers and acquisitions. All types of combination are referred to as bank M&As. However, during this time, most of the consolidations were acquisitions whereby one bank purchased a controlling interest in at least one firm but their assets were not integrated and they did not form any new legal entities. In addition, the M&A data do not address the difference between consolidation activities, i.e. whether a bank is a buyer or a target; or the difference in types of consolidation, i.e. whether a deal is a domestic or cross-border merger.

There are 106 large commercial banks in our sample data. 39 banks had engaged in mergers while 67 had not. The 39 merged banks were involved in 59 M&A transactions. Geographically focused, they include 19 cross-border M&As outside the EU15, 15 cross-border M&As within the EU15 and 25 domestic M&A deals. In addition, regarding the type of consolidation, these transactions comprised 43 majority acquisitions in which the acquirers obtained more than the threshold of 49% of the voting rights and 16 minority M&A deals in which the acquirers took less than 49% of the voting rights. For both types, the acquiring bank purchases a controlling equity stake in the target bank and both banks remain legally separate entities.

1.3.3 The econometric package used

To examine the effects of bank M&As on bank lending behaviour, the econometric analysis packages used are the STATA and Time Series Processor (TSP) programs. STATA, which is a powerful program for panel data analysis, is used in Chapters 3 and 4; it also has several extensive tests and correction, such as the correction for heteroskedasticity, which is needed in the analysis in Chapter 3. In Chapter 5, the TSP program is adopted since it has an advantage in estimating non-linear simultaneous models whose errors are jointly normally distributed.

Chapter 2

The European Banking Market Structure and an Overview of Bank Mergers and Acquisitions (M&As) in the European Banking Market

2.1 European banking market structure

In the early 1990s, European banking markets were considered fragmented markets in which there was no clear market leader. In other words, no bank had a significant market share and thus the market was not a concentrated market. However, market structures have been changed following financial deregulation, at both international and national level, and the structure of the financial market has developed (ECB, 2002, p. 8-13). Since 1993, the markets have been more concentrated and most European countries have been dominated by only three to five large banks (Heffernan, 1996, p.102). In 2001, the five largest institutions in most EU countries controlled over 50% of the domestic banking markets (ECB, 2002, p. 16).

The market concentrations of the EU15 countries are presented in Table 2-1. This table demonstrates the relationship between the size of the economy and the level of concentration. That is, with the exception of Ireland and Luxembourg, the concentration levels appear to be greater in small countries, such as Greece and

Sweden, than in large countries such as Germany and the United Kingdom. Moreover, on average, both concentration indicators in 1999 were higher than those in 1990, which illustrates the increasing trend of market concentrations, or, in other words, the decreasing trend of domestic market competition in the banking systems overall.

According to Ayadi and Pujals (2005, p.50), the concentration level for each country in 1999 can be classified as shown in Table 2-2[2]. Belgium, Denmark, Finland, Greece, the Netherlands, Portugal and Sweden are reported to be the most concentrated in assets, credits and deposits. This is because these countries are dominated by a small number of competitors. Their banking markets can be described as tight oligopolistic markets. For example, the Netherlands is dominated by only five main players, namely, ABN Amro, Rabobank, ING, SNS and Fortis. These five banks gained a 93% combined market share of all the market's payment services. For the Scandinavian banking markets, as suggested by Heffernan (2005, p.268), the five largest banks in each country accounted for 96% in Finland, 94% in Sweden and 84% in Denmark, as percentages of the banking sector's aggregate balance sheet.

Austria, France, Ireland, Italy and Spain have intermediate concentration ratios. Most of the banks operating in these countries are savings and cooperative banks. However, in France, the deposit market has the distinction of being highly concentrated. This situation is partly the result of l'épargne règlementée, which forms a large part of the deposits distributed through networks such as Credit Mutuel and Groupe Caisses d'Epargne (Ayadi and Pujals, 2005, p.51). In Spain, the market was dominated by

2 According to Ayadi and Pujals (2005, p.50), the five firms concentration ratio, CR5, if larger than 60% is defined as high concentration level, while a CR5 between 40% and 60%, and below 40% can be described as intermediate and low concentration levels, respectively.

some of the commercial and mutual saving banks which obtained market power in the wave of M&As (Heffernan, 2005, p.265).

Finally, in Germany, Luxembourg and the United Kingdom, the degrees of concentration are relatively low. In Germany, these low ratios result from the highly fragmented character of the banking market. There are several financial institutions engaging in retail and wholesale commercial banking. For example, there are about 600 saving banks with links to local or regional governments and several post offices which accept savings from individuals and small firms as well as some privately owned mortgage banks, mutual building associations and loan associations which arrange mortgages for home buyers (Heffernan, 2005, p.263). In addition, there is no obvious market leader, as can be seen from the fact that, at the end of 1999, the two big savings banks, Sparkassen and Landesbanken, had only 35.5% of the total market share, and only 27.3% of it was attained by commercial banks. Moreover, the combined market share of the big four banks: Deutsche Bank, Hypo Vereinsbank, Dresdner Bank and Commerzbank, was very small, with only 15.3%. In Luxembourg and the United Kingdom, the low degree of market concentrations can be explained by the high number of new entrants, mostly foreign players. According to the Bank of England, in 2000, 306 foreign banks were set up in the United Kingdom, with 55% of all assets. These foreign banks, possessing a 40% share of the market, focus on serving corporate clients rather than the retail market, where the main British banking institutions share almost 60% of deposits and credits to individual customers. The diversification of the market gave the UK banking market its low level of concentration (Ayadi and Pujals, 2005, p.51-52).

Table 2-1: Concentration indicators in the European banking market

Country	Total assets				Total credits				Total deposits			
	1990		1999		1990		1999		1990		1999	
	CR5	HHI	CR5	HHI	CR5	HHI	CR5	HHI	CR5	HHI	CR5	HHI
Austria	34.67	0.036	50.39	0.102	33.90	0.032	43.30	0.073	33.12	0.028	39.60	0.054
Belgium	48.00	Na	77.39	0.155	58.00	na	80.38	0.167	67.00	na	74.70	0.155
Denmark	76.00	Na	77.00	0.136	82.00	na	79.00	0.154	82.00	na	79.00	0.150
Finland	41.00	Na	74.33	0.191	49.70	na	68.02	0.174	46.08	na	63.40	0.190
France	42.50	Na	42..70	0.051	44.70	na	46.40	0.067	58.70	na	69.20	0.133
Germany	14.00	Na	18.95	0.014	13.50	na	15.75	0.012	11.57	na	15.00	0.009
Greece	83.70	0.250	76.62	0.151	87.20	0.248	74.53	0.129	86.78	0.276	81.70	0.183
Ireland	44.20	Na	40.79	0.048	42.90	na	48.22	0.061	43.70	na	51.00	0.070
Italy	19.00	0.014	26.00	0.060	28.90	0.015	47.57	0.059	30.64	0.013	46.10	0.058
Luxembourg	na	Na	26.09	0.024	na	na	34.32	0.042	na	na	28.10	0.028
Netherlands	73.39	0.117	82.25	0.170	76.70	0.129	81.50	0.160	79.50	0.166	83.40	0.188
Portugal	58.00	0.096	72.60	0.123	57.00	0.101	72.90	0.130	62.00	0.119	79.60	0.164
Spain	35.00	0.035	51.90	0.072	31.50	0.033	47.90	0.059	36.28	0.037	45.30	0.054
Sweden	82.68	0.225	88.21	0.195	81.30	0.191	85.30	0.177	90.55	0.234	83.50	0.160
UK	na	0.019	29.07	0.026	na	0.034	30.28	0.036	na	0.024	32.40	0.028

Source: ECB, 2000 cited in Ayadi and Pujals, 2005, p.50.

Table 2-2: Classification of EU countries by concentration levels in 1999

Type of assets	High concentration CR5>60%	Intermediate concentration 40%<CR5<60%	Low concentration CR5<40%
Assets	Belgium, Denmark, Finland, Greece, the Netherlands, Portugal, Sweden	Austria, France, Ireland, Spain	Germany, Italy, Luxembourg, United Kingdom
Credits	Belgium, Denmark, Finland, Greece, the Netherlands, Portugal, Sweden	Austria, France, Ireland, Italy, Spain	Germany, Luxembourg, United Kingdom
Deposits	Belgium, Denmark, Finland, France, Greece, the Netherlands, Portugal, Sweden	Ireland, Italy, Spain	Austria, Germany, Luxembourg, United Kingdom

Source: Ayadi and Pujals, 2005, p.50.

2.2 Overview of M&As in the European banking market

2.2.1 Factors facilitating European banking M&As

The European banking sector had a rapid series of M&As during the 1990s. The number of European banks fell from 12,670 in 1985 to 8,395 in 1999 (ECB, 2000 cited in Beitel, Schiereck and Wahrenburg, 2004, p.1). Similar to the M&As in other economic sectors, the economic rationale, such as the importance of value creation, efficiency and market power, has motivated the process of M&As in EU banks. In addition, according to Walkner and Raes (2005, p.13-19), several factors have combined to facilitate the consolidation in the EU banking. These include the globalisation of the international financial system, technological developments, regulatory reform, the introduction of the euro and the shrinking of country-specific barriers such as language and culture.

One of the phenomena of globalisation with an impact on integrating is the liberalisation of capital movements. An important feature of this liberalisation is the reduced impediment of capital allocation. As a result, several banks have chosen to hold significant assets outside their nations. By doing this, banks can diversify their portfolio, which can lead to a reduction in their risks. Another feature of globalisation is a shift from bank-centred to market-based financing. This shift reflects banks' asset composition. This is because higher-rated borrowers, for example, can turn to direct financing through commercial paper and corporate bond markets and thus have an impact on the decline in banks' interest income relative to their income from more fee-based activities. Because of this decrease, banks are encouraged to look for attractive consolidation opportunities both within and outside their countries.

Another key factor facilitating bank M&As is technological developments, in particular, the advance in information technology, which reduces banks' costs for collecting information, storage, processing and transformation. In addition, technological changes have also broadened banks' activities from their traditional banking activities such as loans and brokerages. As a result, new technologies are said to have increased the optimum bank size, providing a powerful rationale for consolidation.

Regulatory reform is another factor encouraging bank M&As in the European banking market. Many constraints on the banking sector have been relaxed. Governments have issued new styles of regulation, no longer focusing on protective regulations but on market discipline and good governance. Moreover, efforts to promote the Single Market Programme have improved the cross-border regulatory environment. In addition, the introduction of the euro has also eliminated the exchange rate risk on financial flows and created the potential for economies of scale and scope within the banking sector. These changes in regulation have facilitated M&As in the European banking market.

Finally, many developments in recent years have shrunk the barriers against banking consolidation relating to differences in language, cultural preferences and considerations of geographical proximity. For example, the barriers related to geographical distance or the high cost of cross-border information and communication have gone down through the development of information technology and the lower prices for telecommunication following the liberalisation of the European financial sector.

2.2.2 European banking M&A situation

According to PricewaterhouseCoopers (2006, p.3-5), between 1 January 1996 and 31 December 2005, European banks spent 682 billion euros acquiring banking business throughout the world. This amount of money accounts for 816 M&A deals comprising 542 deals or approximately 524 billion euros of domestic consolidation, and 274 M&A transactions or 158 billion euros of cross-border consolidation. Figure 2-1 shows that between 1996 and 1998, the values of domestic banking consolidations increased, attaining their highest point in 1999. These large values occurred through the emergence of ‘mega-banks’ operating on a national scale in the major EU countries. Most of the M&A transactions during this period were large consolidations of more than 5,000 million euros in value; for example, BNP Paribas in France, SCH and BBVA in Spain, and IntesaBCI and Unicredit in Italy.

However, domestic consolidation continuously declined after 1999. The main reason for this reduction is the concern of regulators to preserve competition. M&As within the European banks statistically changed the growth of market concentrations. As presented in Table 2-1, the concentration levels in most countries increased. Apart from Greece, the concentration indicators between 1990 and 1999 show generally increased levels of concentrations, which mean that the consolidation waves have important results in the overall increase in market concentrations, or, in other words, have significant effects on the decline in market competition. That is, bank M&A activities can lead to the co-existence of a few large players at the domestic level and more concentrated banking markets as a result. Therefore, in order to avoid the risks of one bank holding a dominant position at the national level in consequence of bank consolidation, some of the M&A operations among European banks were aborted. For instance, in 2001, the bid for Abbey National by Lloyds TSB failed because of a veto from the national competition authorities in the UK, as did the merger deal between SEB and Swedbank in Sweden, due to the opposition from competition services in the European Commission (Ayadi and Pujals, 2005, p.53).

In order to obtain growth through M&As, many European banks looked at new opportunities in different geographical areas to benefit from the effects of geographical diversification. Many European banks entered into cross-border bank M&A deals both within and outside Europe. Cross-border banking mergers became an increasingly important structural feature of the EU banking sector. According to the ECB (2006, p.12), in 2004, around 30% of the EU banking sector was owned by non-resident banking groups, a rise from around 20% in 1997.

As shown by Figures 2-1 and 2-2, both the total value and total number of cross-border consolidations tended to increase, even though on average domestic M&As accounted for the majority of M&A activities. There have been some particularly prominent cross-border M&A activities, for example, the Spanish company Santander's acquisition of the British bank Abbey National in 2004. In addition, Figure 2-1 also demonstrates that, between 1996 and 2004, although the value of cross-border bank M&A deals outside Europe had closely mirrored that within

Europe, this trend deviated in 2005 when the multi-billion Euro HVB and Antonveneta deals contributed to the value of European cross-border bank M&A deals. This within-Europe consolidation was 2.7 times higher than that for non-European deals.

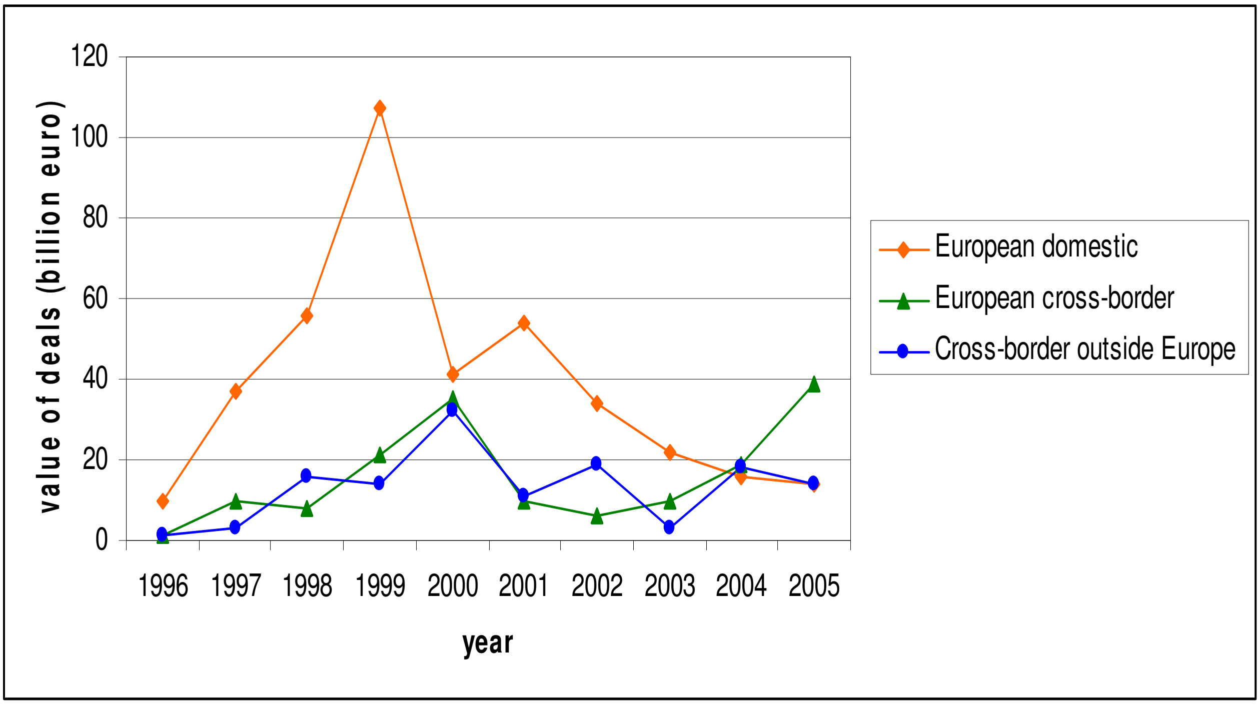
There are several reasons for the increase in cross-border M&A activities in Europe. Besides the limited opportunities for domestic consolidation, since existing concentration gives rise to competition restrictions or there are too few available targets of the right size, the EU's single market programme also encourages increased cross-border bank M&As. All impediments to free trade in goods, services and capital across European frontiers, including free trade in financial services and equal access to financial markets, have been removed[3]. This free capital allocation policy motivates cross-border bank M&As amongst the countries of Europe. Nevertheless, according to the ECB (2008, p.12), demographic change is not a key motivation for international expansion, because the planning horizons referred to by banking groups are shorter than those over which demographic change is expected to have a direct impact on the fundamentals of the banking sector. Thus, demographic change is unlikely to lead to international diversification more than other risks do, for example, the political, legal and operational risks incurred by market expansions.

The cross-border types of merger between 1996 and 2005 can be divided into 141 minority international bank M&A deals undertaken by European banks and 131 majority European cross-border bank M&A deals. Moreover, both types of

3 The main objective of the EC's White Paper on Financial Services Policy (2005-2010) is to remove the remaining economically significant barriers so that financial services can be provided and capital can circulate freely throughout the EU at the lowest possible cost.

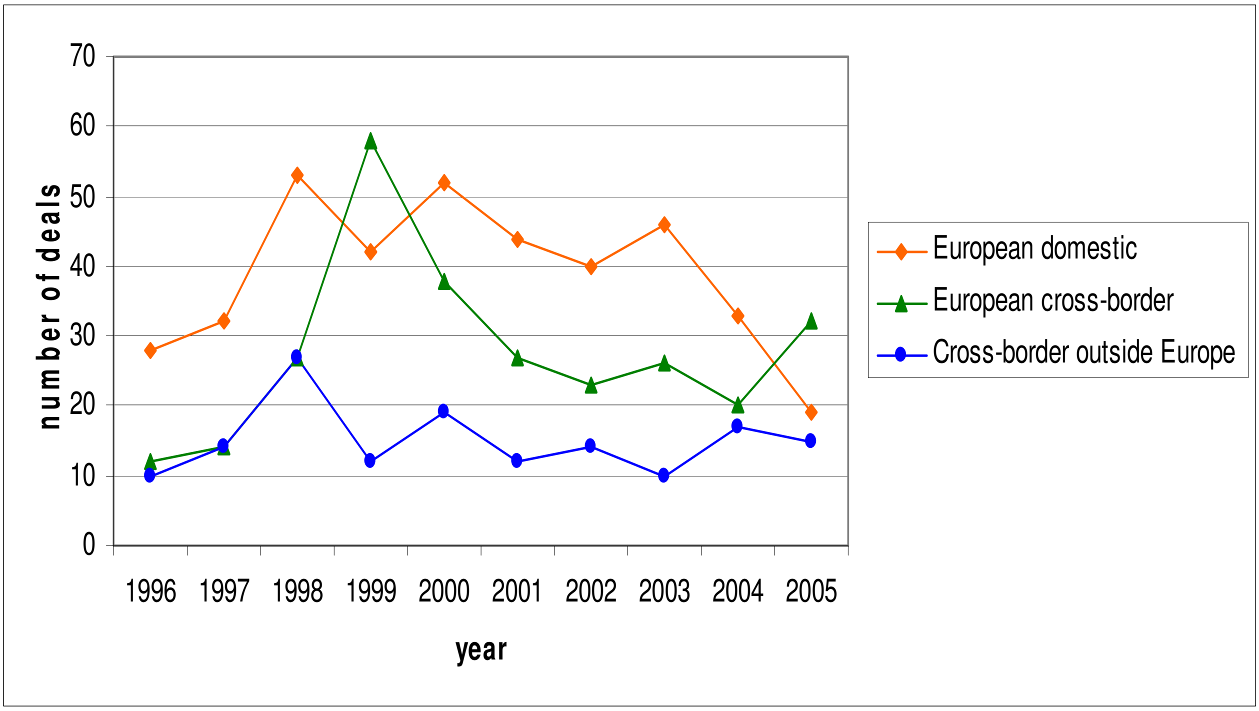
consolidation have tended to increase, according to Figure 2-3. Furthermore, several larger European banks chose to expand their business by acquiring stakes of between 20% and 49%, which gave them some influence over the financial affairs of the target banks, but not control. These strategies managed the transaction risk more effectively, because they allowed bidders the chance to gain access to and learn about a new market as well as recognizing the realities of the M&A market (PricewaterhouseCoopers LLP, 2006, p.14). In addition, the lower control means that the acquirers do not bear all the risks, in particular, the risks incurred from a specific market which are difficult to manage because they are unfamiliar to the banks' managers.

Figure 2-1: Value of European banks' M&A activities, 1996-2005.



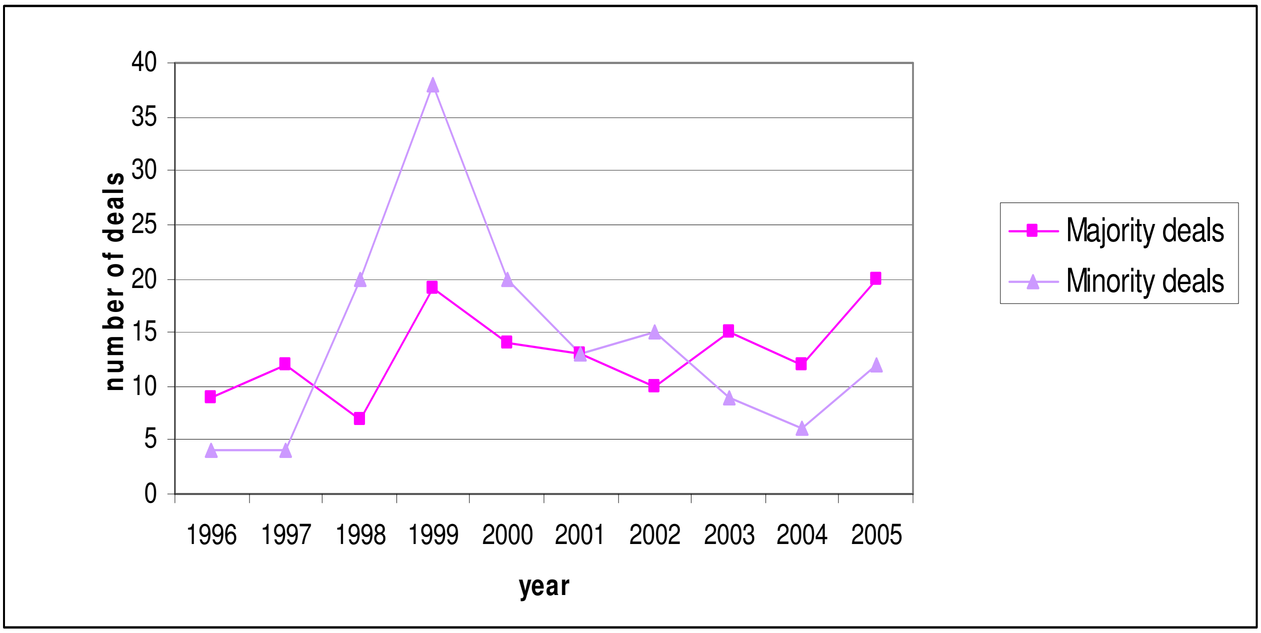
Source: PricewaterhouseCoopers, 2006, p.8.

Figure 2-2: Number of bank M&A deals undertaken by European banks, 1996-2005.



Source: PricewaterhouseCoopers, 2006, p.8.

Figure 2-3: Number of European cross-border bank M&A deals undertaken by European banks, 1996-2005.



Source: PricewaterhouseCoopers, 2006, p.12.

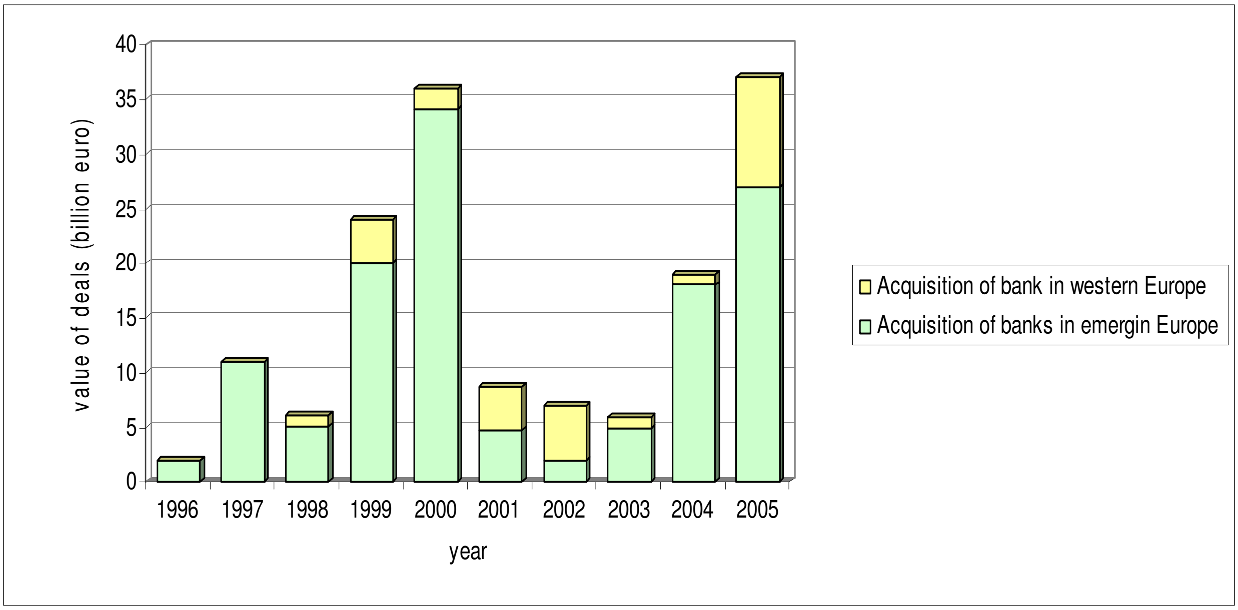
Approximately 83% of the value of bank M&A deals in Europe involved the acquisition of stakes in western European banks. 56% of this total value was accounted for by the 10 largest M&A transactions. Most of which were M&As between banks in neighbouring countries with similar domestic market conditions. These deals are, for example, the consolidation between banks in Scandinavian countries such as the deal of Unidanmark in Denmark and Nordic Baltic Holdings in Sweden, and the consolidation between banks in Benelux countries such as the transaction between Banque Bruxelles Lambert in Belgium and ING in the Netherlands (PricewaterhouseCoopers, 2006, p.10). Although cross-border mergers within European countries are fewer than domestic consolidations, their number is tending to increase. This is because M&As among banks in neighbouring geographical markets not only allow banks to diversify their risk but also to overcome the cultural distance problem, which is one of the most significant factors in M&A failures.

17% of European cross-border bank M&As involved the acquisition of banks in emerging Europe. Although this value seems to be much lower than that of the M&As of Western European banks, the acquisition of banks in emerging Europe has tended to increase (Figure 2-4). Like Western European bank M&As, those in emerging Europe show the key features of regional expansion. Most of the cross-border mergers outside Western Europe are between banks in neighbouring nations; for example, the extension of Austrian, German and Italian banks to the neighbouring markets of the Czech Republic, Croatia, Poland and Hungary (PricewaterhouseCoopers LLP, 2006, p.11).

The increasing trend of cross-border M&As outside Western Europe reflects the attractiveness of the banking markets in the emerging European countries. This is because this type of consolidation offers more attractive growth opportunities, both in terms of economic growth rates and in the increasing penetration of financial services products, than many domestic markets in Western European countries[4]. In addition, the entry of the emerging European countries has also increased the stability of the financial system, as it enables better diversification of the liquidity risk in the European interbank market. Moreover, according to Giannetti and Ongena (2005, p.6-7), the governments of the emerging European countries also encourage investments from foreigners, because of the benefits from foreign banks of stimulated growth in sales, assets and leverages. This can be seen from several privatisation programmes implemented by the emerging European governments in the late 1990s which enabled Western European banks to enter these markets through the acquisition of state-owned banks. Although most of the governments in emerging European countries support cross-border M&As, there is evidence in some countries that domestic competition issues are concerned. For example, in Hungary, foreign bank participation is permitted through joint ventures. However, in order to protect the competitiveness of domestic banks, foreign banks are not allowed to have branches or to operate wholly owned subsidiaries.

4 The emerging European countries include the countries in Central and Eastern Europe, namely Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Slovakia, Slovenia and Yugoslavia (Serbia and Montenegro).

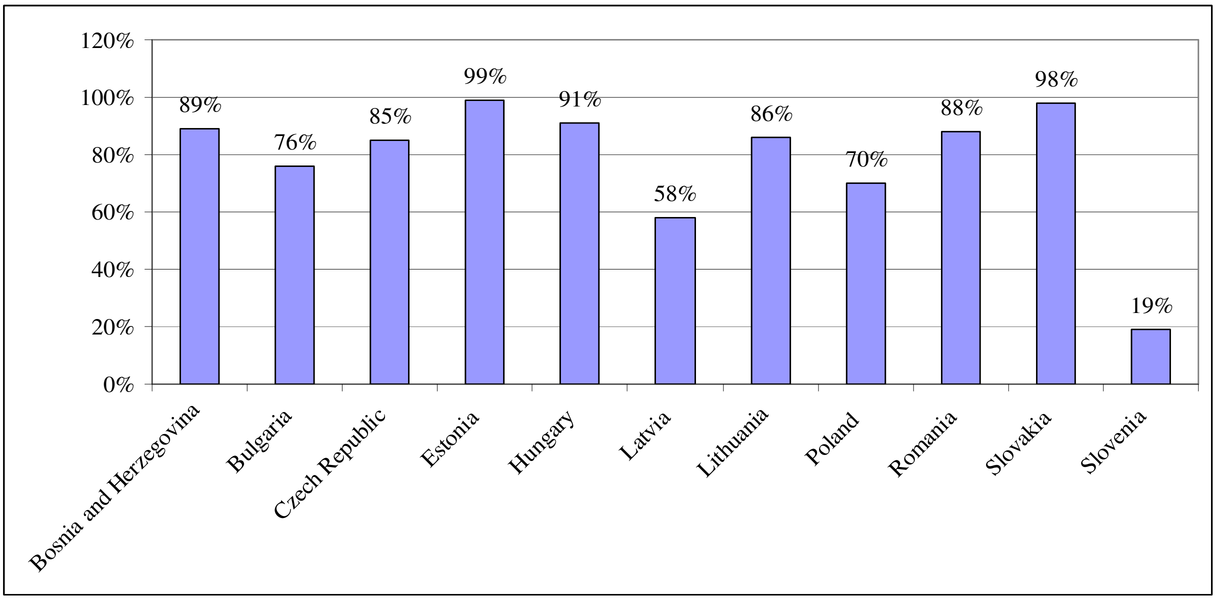
Figure 2-4: Value of European cross-border bank M&A activities in Western and emerging Europe, 1996-2005.



Source: PricewaterhouseCoopers, 2006, p.9.

Moreover, when we look at the emerging European banking markets, we can see the change in their market structures. According to Unicredit Group (2006, p.2), most of the market shares in 2005 were belonged to foreign banks. As Figure 2-5 shows, the market share of foreign-owned banks in these markets was, on average, over 70%, most of all in Estonia and Slovakia, which accounted for 99% and 98% respectively of the market share in assets owned by foreign banks.

Figure 2-5: Market share of foreign-owned banks (% of all banking system assets, 2005)*.

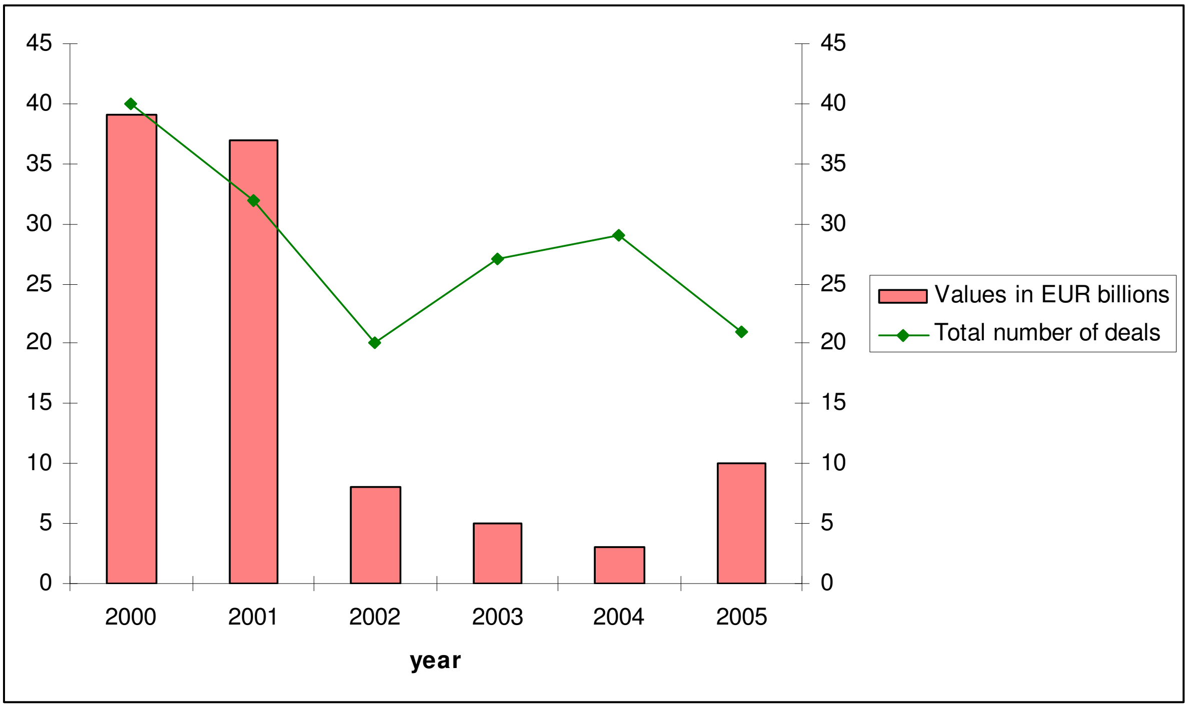


Source, Unicredit Group, 2006, p.14.

* The market shares of Albania, Croatia, Macedonia and Yugoslavia are not available.

In addition, cross-sector M&A activities in the European financial market have been significantly limited. As suggested by the ECB (2008, p.10), mergers between European banks and insurance companies are very low, in terms of both the number and value of deals, compared with the level of transactions in the banking sector. In addition, M&A activities in general between banks and insurers in this period were characterised by a small number of transactions with total values being influenced mainly by a few large individual transactions, for example, the acquisitions of Scottish Widows by Lloyds TSB in 2000 and of the Dresdner Bank by Allianz in 2001. The lower trends of across-activity mergers, in both the number and value of deals between 2000 and 2005, are presented in Figure 2-6.

Figure 2-6: M&A activities between EU banks and insurance firms, 2000-2005.



Source: ECB, 2008, p.10.

Chapter 3

Bank Mergers and Acquisitions (M&As) and Loan Pricing Behaviour

3.1 Introduction

The dramatic increase in mergers and acquisitions (M&As) in the banking markets of many countries in the 1990s has encouraged an interest in the effects of such consolidations on the industry and consumers. One of the main consequences of bank M&As is that, once consolidated, banks can improve their positioning in the overall market. The increase in market power and reduced competition can result from bank M&As when consolidated institutions operate in the same local market. In fact, its larger size can create a dominant position which enables a bank after an M&A to manipulate price levels in certain markets. Such changes in price can involve either decreases when barriers to new entrants are lowered, or increases in the absence of effective competition in the market place.

One of the fundamental policy questions regarding the effects of the change in market structure as a result of consolidations is whether the benefits are social or private and, if social, whether they benefit the banks alone or whether part of the benefits is also enjoyed by the banks' customers. The consequences of bank M&As on consumer welfare have been examined from two standpoints: the availability of loans for specific groups of consumers and bank pricing behaviours. The studies focusing on the impacts of bank M&As on consumer welfare have analysed mostly the change in loan volumes for small- and medium-size borrowers. With regard to the price effect, mergers may either increase concentration and thereby create more unfavourable prices for customers, or alternatively create efficiency savings which are passed on to individual customers through more favourable loan terms. However, very few papers have provided sufficient evidence on the effects on pricing, in particular, in the area of loan pricing, due to a lack of data on the quantities of specific consumer loans made by banks. In addition, most of the studies have been carried out in the United States, and the lessons from these cannot be applied automatically to bank M&As in other markets. This refers in particular to the European banking environment, where M&As in the banking sector significantly increased during the 1990s. The lessons are inapplicable because of fundamental differences in regulations and in the structure of the banking market. In addition, the studies focusing on the European context are mostly country-by-country analyses. However, the banking integration model in Europe may allow M&A processes to lead to the homogenisation of banking behaviour and it is more interesting to consider the European banking market as a whole. The lack of evidence mentioned makes it interesting to examine the effects of bank M&As on commercial bank pricing behaviour, in particular, decision-making on bank loan interest rates, and bearing in mind the data on bank M&As in European banking markets.

This chapter is organised as follows. Section 2 discusses previous research into bank consolidation and the impact of mergers on the price of bank loans. The theoretical framework illustrating the factors affecting loan pricing behaviour, in particular, the

Monti-Klein model of the banking firm operating in an imperfectly competitive loan market and the empirical evidence supporting this theoretical model are described in Section 3. Section 4 presents the empirical models used to examine the effects of bank M&As on bank lending rates. The sample data, including descriptive statistics, are presented in Section 5. Section 6 explains the methodologies used in the analysis. Section 7 reports the results of the regression models. Finally, some conclusions are proposed in Section 8.

3.2 The impacts of bank M&As on loan pricing behaviour: the empirical evidence

Only a few researchers have investigated the impact of bank mergers on pricing behaviour in a dynamic framework which, for example, compares pre- and post-merger prices, or compares the behaviour of merged and non-merged banks in setting prices. In the context of the US banking market, Akhavein, Berger and Humphrey (1997) find that M&As as a whole have small and mixed effects on prices. In contrast, Prager and Hannan (1998) conclude that loan interest rates tend to increase as local concentration in the US market increases as a result of bank M&As. These unfavourable loan rates for borrowers in a concentrated banking market are consistent with the results suggested by Berger and Hannan (1989), Hannan (1991a, 1991b), Kahn, Pennacchi and Sopranzetti (2001) and Corvoisier and Gropp (2001), who provide statistically significant evidence that the loan market is affected by concentration such that the more concentrated the market, the less competitive the pricing for loans. In other words, commercial banks operating in more concentrated markets tend to charge higher loan rates and pay lower deposit rates than those in less concentrated markets. Moreover, Kahn, Pennacchi and Sopranzetti (2001), who examine the effects of bank mergers on personal loan rates and on automobile loan rates, suggest that M&As appear to increase the price of the personal loans charged by all banks in the market. However, automobile loan rates and bank mergers have a negative relationship. Moreover, banks are quicker to adjust automobile loan rates than to change the price of their personal loans and this rigidity in the price of personal loans is higher in more concentrated markets. This difference in the speed of price changes results from the fact that, in the automobile loan market, leader-follower pricing behaviour is more common and it also has less segmentation across banks, which makes it easier for banks to change their automobile loan prices. Berger *et al.* (2005) analyse the impact of bank mergers on the prices for specific clients: loans for small businesses and find that consolidated banks tend to increase lending rates to small businesses which generally have a weak relationship with their banks as these merged.

In the European banking industry, as suggested by Ayadi and Pujals (2005), the empirical evidence implies that there are often significant efficiency gains which result in better conditions for consumers. Using data on loan contracts between Italian banks and borrowing firms, Sapienza (2002) analyses the effects of bank M&As on business lending and finds that, in the case of domestic M&As between banks with a small market share, both merged banks and non-merged participant banks have a tendency to reduce their loan interest rates as mergers occurred. This evidence is consistent with the efficiency gains from this type of M&A. However, when the target bank is large enough to give consolidated banks significant market power in the industry, merged banks tend to increase loan prices to their continuing borrowers.

This suggests that, when M&As produce significant increases in concentration, banks exercise market power and set more unfavourable prices to their customers. Using data on the Spanish bank M&As, Montoriol-Garriga (2008) examines the effects of bank mergers on average loan rates, and finds the positive effects of mergers on lending rates for borrowers who continue the lending relationship with consolidated banks. This decline in loan rates is small when there is a significant increase in local banking market concentration. However, Fuentes and Sastre (1998), who analyse the consequences of bank mergers on loan and deposit interest rates in the Spanish banking market, could find no significant evidence.

Regarding loan price, loan spread is considered as the strategic variable which can be affected by bank M&As. However, the number of the studies in this context is very limited. Using loan-level data set for the US bank M&As, Erel (2005) analyses the impact of the mergers on loan spread and finds evidence that bigger acquirers tend to impose more favourable credit terms on small customers. That is, banks which have grown through mergers tend to reduce their loan spreads, in particular, in the case of non-mega consolidation. This result is contradicted by the study of Calomiris and Pornrojnangkool (2005), which shows that the lower pre-merger interest which had spread to medium-sized borrowers in New England disappeared after the merger of Fleet and BankBoston.

From the above review, it is clear that the studies of the effects of bank mergers on loan interest rate remain controversial**.** According to Focarelli and Panetta (2003), these mixed results may result from the fact that M&As in the short run lead to unfavourable prices to consumers, but in the long run, if banks succeed in reducing costs, efficiency gains from M&As prevail over the market power effects, so that consumers benefit. Thus, studies restricted to a short post-M&A period may fail to estimate the efficiency gains and as a consequence overestimate the adverse price changes.

3.3 The Monti-Klein model of the banking firm

A variety of industrial organisational approaches can be taken to examine the behaviour of bank loan pricing. These models can be divided into two groups in their assumptions about the banking market structure: that it represents perfect competition or is imperfectly competitive. The most popular model of a perfectly competitive banking market is the marginal cost pricing model, in which optimal conditions obtain when prices equal marginal costs and the derivative of prices with respect to marginal costs equals one (De Bondt, 2002, p.8). However, the European banking system can be characterised as an imperfectly competitive market, in which each national market is led by only three to five large banks (Heffernan, 1996, p.102; Berg and Kim, 1998, p.148; and ECB, 2002, p.16). Moreover, the studies of De Bandt and Davis (2000) and Corvoisier and Gropp (2001) show that in the principal European countries competition in the 1990s was monopolistic. Hence, the marginal cost pricing model is not appropriate for our analysis; the second approach, which assumes an imperfectly competitive banking market, is thus more suitable. This imperfectly competitive approach was first originated by Edgeworth (1888). He identified the unique features of banks of holding less than 100% of deposits as reserve and making a profit from the positive margin obtained from the difference between loan and deposit interest rates. In addition, because the optimal level of reserves grows less than proportionately to deposits, larger banks will be more profitable than smaller banks. This imperfectly competitive market structure means that banks can exert monopoly power.

The theory of bank monopoly was formalised by at least two studies. The most popular model was developed by Klein (1971) and Monti (1972) under the well-known theory, the Monti-Klein model of the banking firm. This model views the banking firm in a static setting where demands for deposits and supply of loans simultaneously clear both markets. Although there is a controversy over the separability of decisions about loans and about deposits in the bank optimisation problem of the basic Monti-Klein model, this shortcoming can be overcome by including additional assumptions. One approach is to introduce risks into the model. Most notably, Prisman, Slovin and Sushka (1986), Dermine (1986), Fuentes and Santre (1998) and Corvoisier and Gropp (2001) show that loan and deposit decisions are interdependent if the bank faces the positive probability of risk. In addition, by extending the Monti-Klein model into the context of two-stage game theory, Dvorak (2005) finds that the second stage optimal lending prices of both incumbent and entrant will depend on the first stage optimal prices, which are the function of the associated bank's deposit supply.

The alternative model is the location model of Salop (1979). This model is based on the concept of monopolistic competition, in which product differentiation is generated by transportation costs. The bank optimal pricing behaviour depends on the security price, the transportation cost for loans and the optimal number of banks in the market (Freixas and Rochet, 1998, p.71). However, due to the lack of data, which allows the econometrician to identify the effect on loan prices of the borrower-lender distance, or, in other words, the effect of loan transportation cost, very few empirical studies have investigated price lending behaviour within this framework (Cerqueiro, 2007, p.8). In addition, as stated by Dvorak (2005), the Salop model has less possible range of applicability compared with the Monti-Klein model which can be applied to the study of a great number of diverse problems (Dvorak, 2005, p.2). In the context of bank pricing behaviour, the Monti-Klein model is applied in a number of studies; for example, Corvoisier and Gropp (2001) examine bank pricing behaviour in the EU banking market by assuming that banks behave like Cournot competitors, as suggested by the Monti-Klein oligopolistic version. In order to examine interest rate setting by universal banks in the euro area, De Bondt, Mojon and Valla (2002) apply an equilibrium relationship between the retail and market rates obtained in a simple static Monti-Klein bank where banks hold money market instruments and longer term assets. Fernandez de Guevara, Maudos and Perez (2005) analyse the evolution of price setting in the banking sectors of the European Union based on estimating Lerner indices, obtained from the Monti-Klein model. Nys (2003) analyses the determinants of bank interest margins for 12 selected European countries by using a firm-theoretical approach which uses the framework of the Monti-Klein model. Uchida and Tsutsui (2004) use the Cournot oligopoly based on the Monti-Klein model to derive a setting function for the loan interest rate for the Japanese banking sector. Betancourt, Vargas and Rodriguez (2008) apply the Monti-Klein model to explain the changes in the bank's interest rate policy in the Colombian banking market.

Therefore, if the appropriate assumption of an imperfectly competitive banking market is made, its power in modelling the bank pricing behaviour, as well as the shortcomings of alternative approaches, make the Monti-Klein model of the banking firm a suitable model for examining the impacts of bank M&As on loan pricing behaviour, and it is therefore used in our analysis.

In the Monti-Klein model, a monopolistic bank is assumed to be a financial intermediary which collects savings from households and finances investment needs to firms. The bank holds two types of asset – securities and loans – and one liability, namely deposits. In the securities market, the volume and price of securities are given by government, while in the deposit and loan markets the bank is assumed to set the price. The bank determines whatever interest rate for deposits and loans would maximise its profit. The decision variables are the amount of loans and the amount of deposits with the amount of equity as given. In addition, in granting loans and collecting deposits, the bank has to pay intermediary costs which are assumed to be linear functions of the amounts of loans and of deposits.

Besides the above assumptions, the bank is assumed to issue two types of deposit: demand deposits and time deposits. The supplies of both deposits are supposed to have increasing functions of the returns which the bank offers on these accounts. For demand deposits, the bank has to pay some implicit return in the form of preferential treatment to customers. Although demand deposits have implicit returns, they are assumed to have a significant role in the bank's profit function. This is because the bank has to pay some costs arising from the payment mechanism. With regard to time deposits, the bank is assumed to invest these funds in earning assets. These assets are government securities and loans. Government securities have perfect elasticity of supply because the bank's actions have no impact on the expected return or on the risk characteristics of the securities. Loans are imperfectly elastic in supply to the individual bank because the return on loans depends on the amount of loans issued by the bank.

From the above assumptions, the profit function of the bank in the traditional Monti-Klein model can be expressed as the following equation:

$$\pi = r_L(L)L + rS - r_D(D)D - C(L, D) \tag{3-1}$$

subject to $S+L = D$ (3-2)

where

π is the monopolist bank's profit which is assumed to be concave. It indicates that it is diminishing returns to scale.

r, r_L and r_D are the returns on security, loan and deposit, respectively. The inverse demand function for loans is given by $r_L(L)$, with derivative $r_L{}'(L) < 0$. The inverse supply function of deposits is $r_D(D)$, with derivative $r_D{}'(D) > 0$. The return on security demonstrates the market risk, which is the risk of loss caused by changes in the level or volatility of market prices.

S, L, and *D* are the amounts of security, loan and deposit, respectively.

C is the total intermediate costs of managing an amount *L* of loans and an amount *D* of deposits. This is the convex managing-cost function.

To maximise the profit, the proportion of total funds allocated to the loan is chosen at the point in which the marginal return on loan is equal to the average expected return on government security. The optimal pricing rule is taken in the following form[5]

$$\frac{r_L^* - (r + \frac{\partial C(L,D)}{\partial L})}{r_L^*} = \frac{1}{\varepsilon_L(r_L^*)} \tag{3-3}$$

where

r_L^* is the optimal loan price which maximises the bank's profit.

$\frac{\partial C(L,D)}{\partial L}$ is the marginal cost of issuing loans.

ε_L stands for loan demand elasticity.

Equation (3-3) presents the equalities between the Lerner's indices (price-cost divided by price), $\frac{r_L^* - (r + \frac{\partial C(L,D)}{\partial L})}{r_L^*}$ and inverse elasticity. That is, in the Monti-Klein model, a monopolist bank would set its loan and deposit volumes such that the Lerner's indices equal inverse elasticity.

By rearranging Equation (3-3), the optimal loan interest rate can be written as the following equation:

---

5 These results are the results obtained from the traditional industrial organisation analysis of imperfect competitive market; that is, this pricing rule states that the Lerner index = $\frac{1}{\varepsilon}$, where the Lerner index equals (price – marginal costs)/price.

$$r_L^* = \frac{r + \dfrac{\partial C(L,D)}{\partial L}}{1 - \dfrac{1}{\varepsilon_L}} \tag{3-4}$$

Equation (3-4) suggests that the loan interest rate tends to increase with market rate and marginal cost, while it decreases with loan demand elasticity. In addition, when costs are separable by activity, the optimal loan interest rate is independent of the deposit market. In other words, loan pricing decision-making is not influenced by the bank's deposit characteristics. Loan price tends to increase with the market interest rate and marginal cost of managing loans, while it decreases with loan demand elasticity.

3.3.1 The Monti-Klein model and market competition

The original Monti-Klein model is primarily based on the case of a unique, monopolistic bank, which might apply in countries with only one bank. However, a situation in which there are several banks is more interesting and closer to experience. As suggested by Molyneux, Lloyd-Williams and Thornton (1994, p.454-455) and De Bandt and Davis (1999, p.17), who studied the competition in the European banking market, the banking industry can be characterised by monopolistic competition. This suggests that oligopoly models would be more relevant for the study than a monopolistic model.

In the oligopolistic version, according to Freixas and Rochet (1998, p.59), the Monti-Klein model can be reinterpreted as a model of imperfect (Cournot) competition between a finite number *N* of banks, *n=1,..,N* . By having the same assumptions as the monopolistic model has, with the additional assumption that every bank has the same linear cost function (which is the function of aggregate loan volume, *L,* and aggregate amount of deposit, *D*), the optimal condition for every bank is:

$$\frac{r_L^* - (r + \frac{\partial C(L,D)}{\partial L})}{r_L^*} = \frac{1}{N\varepsilon_L(r_L^*)} \tag{3-5}$$

Comparing Equation (3-5) with Equation (3-3), we see that the only difference between the monopoly case and the oligopolistic version is that the elasticity is multiplied by the total number of banks, *N*. Because the number of banks reflects the intensity of competition in the market, we can see from Equation (3-5) the relationship between competition and the loan interest rate. That is, as the number of banks in the market increases, or when the market is more competitive, a bank tends to reduce its loan price. In contrast, as the number of banks decreases, or when the market is less competitive, the price of loans tends to rise.

Moreover, the Monti-Klein oligopolisitic version model also indicates that the sensitivity of loan interest rates to changes in market interest rate has a negative relationship with the number of banks in the market. That is, the higher the number of banks in the market, the less sensitive the loan interest rate to changes in the market rate. In contrast, loan prices tend to be more sensitive to market interest rates when the number of banks goes down.

The effect of the reactions of a bank's rivals is also examined by Fuentes and Sastre (1998). They assume that banks in the market have different products and prices to offer to lenders and depositors. In other words, there are product and price differentiations in loan and deposit markets. Therefore, the strategies of competitor banks in reaction to a particular bank's actions may also have an impact on the behaviour of the bank's products and prices. The effects of product differentiation and price differentiation are measured by the substitution elasticity of products between banks and their cross-price elasticity respectively. In addition to the factors suggested by the Monti-Klein model, Fuentes and Sastre (1998) indicate that the sensitivity of bank interest rate also depends on the strategic interactions among participants in the same market and the degree to which their products can be substituted for one another. In other words, the more sensitive competitors in products and prices are, the lower the interest rates for the bank to collect from its lenders.

Dvorak (2005) extends the oligopoly version of the Monti-Klein model by analysing bank lending behaviour within the context of game theory. He adopts the standard incumbent/entrant game under the Bain-Sylos-Labini-Modigliani framework (BSM framework). In addition to the Monti-Klein assumptions, the model was set up as a two-stage game in which there are two banks in the market: the incumbent and the entrant. Moreover, any banks which plan to enter the industry have to pay certain fixed setup costs. In the first stage, the incumbent can pre-commit itself to a loan price which it will set in the second stage and this action can be observed by the entrant who uses this information in order to decide whether or not to enter into the market. In the second stage, the incumbent is assumed to set a loan price which maximises its profit, as it has committed itself to do in the first stage. The entrant reacts optimally to the choice of the incumbent. Unlike the traditional Monti-Klein model, Dvorak (2005) claims that loan pricing decisions depend on the deposit market. In other words, the decisions about loans and deposits are interdependent, in contrast to the separability of these two decisions which is suggested by the Monti-Klein model.

There are two prominent theoretical approaches which can be used to explain the role of market concentration on loan pricing behaviour. One is the Structure-Conduct-Performance (SCP) hypothesis. This approach was derived from the neoclassical analysis of markets in order to identify the relationship between industry structure and performance (Shaik *et al.,* 2009, p.1). The SCP paradigm states that a change in the market structure affects the way in which banks behave and perform. The degree of market concentration is inversely related to the degree of competition, because market concentration encourages firms to collude. This hypothesis will be supported if there is a positive relationship between market concentration and performance, regardless of the efficiency of the firm. Therefore, firms in more concentrated industries will earn higher profits than firms operating in less concentrated industries, irrespective of their efficiency. That is, as concentration increases, banks with market power can exert this power to earn more profits by setting relatively high loan prices but low deposit rates[6]. Thus, loan interest rates and market concentration are expected to have a positive relationship.

The other approach rivalling the SCP is the Efficient-Structure-Performance (ESP) hypothesis. This paradigm suggests that the performance of a firm is positively related to its efficiency. When the number of banks is small as a result of consolidation, the

---

[6] According to Heffernan (2005, p.495), this also means that high market power banks can be inefficient, i.e. failing to minimise costs, without being forced out of the market.

more efficient banks will dominate the market. Market concentration emerges from competition where firms with a low cost structure increase profits by reducing prices and expanding their market share. That is, some banks earn super normal profits because they are more efficient than others and not because of collusive activities, as the traditional SCP paradigm would suggest. In the ESP approach, consistent with the SCP paradigm, concentration and profits have a positive relationship. However, the ESP predicts an inverse relationship between prices and concentration. That is, as concentration increases, by taking the ESP approach, more efficient banks earn higher profits by setting lower lending prices and offering high deposit interest rates. Thus, loan interest rates and market concentration are expected to have a negative relationship.

3.3.2 The Monti-Klein model and risks

One of the weaknesses of the Monti-Klein model is that it ignores default risk and liquidity risk. The model assumes that these two risks are exogenous because both deposit and loan repayments are random without notice. Moreover, the bank is assumed to be able to ignore the liquidity risk which arises from a cash deficiency. This is because the bank is required to hold some cash which has implicit returns and is able to adjust its asset portfolio by changing the level of its government securities in order to secure its liquidity position. These assumptions are inconsistent with the characteristics of the banking market which may make the results of the traditional Monti-Klein model inappropriate for explaining bank lending behaviours. Therefore, to make the model more rational, these two risks should be considered.

Prisman, Slovin and Sushka (1986) introduce liquidity risk into the traditional Monti-Klein model. In this mode, deposits are assumed to be the only source of funds and to be sufficient to finance loans. The bank is required to keep some reserves which earn a return at the same rate as the market interest rate. Moreover, the bank can suffer from liquidity risk, which occurs when the bank has to make unexpected cash payments or when there is an unexpected massive withdrawal of deposits. This risk is defined in the model by the random amount in the volume of deposit withdrawals. If the deposit withdrawals are larger than the bank reserve, a liquidity shortage results and the bank has to pay some penalty cost for this shortage. That is, the bank has to pay two kinds of cost: the deposit interest rate and the penalty cost of a liquidity shortage. However, this model ignores the marginal costs of granting loans and collecting deposits.

The optimal conditions of the model indicate that the maximised profit behaviours are similar to the conclusion of the Monti-Klein monopolistic bank model. In addition, for the role of liquidity risk, loan interest rates tend to increase with the liquidity shortage penalty rate, the amount of deposit withdrawal and the uncertainty over the amount of withdrawn deposits. However, in contrast to the Monti-Klein model, this model shows that the bank's decisions on loans depend on deposits. That is, loan interest rate decision making depends on the deposit characteristics. This is because the optimal loan interest rate is the function of the expected cost of the liquidity shortage. This cost depends on the bank reserve, which in turn is the difference between the amounts of deposits and of loans. Thus, loans are also the functions of the deposit volumes.

Besides the liquidity risk, the role of the default risk on bank behaviours is one of the important aspects in the analysis of bank lending behaviour. Default risk is the risk that an asset or a loan will become irrecoverable in the case of complete default, or the risk of an unexpected delay in the debt repayment. Default risk is a common risk for a commercial bank, since every commercial bank, by definition, has a loan portfolio. In order to investigate this effect, Fuentes and Sastre (1998) and Corvoisier and Gropp (2001) introduce default risk into the Monti-Klein oligopolistic version. The models assume that there is a possibility that borrowers may be unable to pay their debts and this risk is measured by the probability of non-performing loans. In addition, an oligopolistic bank is assumed to hold some reserves on which the return equals the market interest rate.

Consistent with the Monti-Klein model, the loan interest rate tends to increase with the market interest rate, marginal cost of managing loans and the aggregate demand for loans, while it decreases with the degree of competition in the banking market and the elasticity of demand for loans, both that of individual bank loan demands and that of the whole banking market. However, unlike the traditional model, Corvoisier and Gropp (2001) find that the optimal loan rate also depends on the deposit interest rate, which is assumed to be exogenously given and on the reserve requirement, which is the difference between the volume of deposits and of loans. This violates the conclusion about the independence in the Monti-Klein model of decision-making about loans from that about deposits. Thus, it can be concluded that when risks are considered, bank decision-making on setting a loan price will also depend on the characteristics of its deposits. In addition, for the role of default risk, both models indicate that loan prices and the expected bank default risk have a positive relationship. That is, banks tend to raise their loan rate as their expected rate of non-performing loans increases.

From the above theoretical models, we can form some conclusions about the factors which affect bank loan pricing behaviour. These factors include the market interest rate, the characteristics of demands for loans, which include the elasticity of the loan demand and the aggregate demand for loans, the characteristics of deposits, including deposit rates and reserve requirements and the intensity of competition, marginal costs and risks. In addition, all these writers agree on the relationships between these factors and loan interest rates. They agree that the lending price has a positive relationship with the market rate, total demand for loans, the bank's deposit position, cost and risks and that it has a negative relationship with the elasticity of demand for loans and the number of competitors, reflecting the intensity of market competition. Moreover, when risks are considered, the decision-making on loan prices depends on a bank's deposit position, for example, its deposit interest rate and the amount of deposits. This conclusion is inconsistent with the result from the original Monti-Klein model, in which loan and deposit positions are independent of each other.

All the loan interest rate determinants based on the Monti-Klein model have been empirically investigated. For the effect of the market interest rate, Slovin and Sushka (1984), Hannan (1991a), Kahn, Pennacchi and Sopranzetti (2001) and Gambacorta (2004) find that the money market rate has a positive relationship with the loan interest rate. However, in Kahn, Pennacchi and Sopranzetti's study, the impact of the market rate is significant for the automobile loan rate only, but not for the rate of personal loans. In addition, Slovin and Sushka (1984), Kahn, Pennacchi and

Sopranzetti (2001) and Gambacorta (2004) suggest that the demand for loans, proxied by the investment rate, personal income, inflation rate and GDP, has a positive effect on the loan price, while in Corvoisier and Gropp (2001)'s paper the elasticity of demand for loans and loan interest rate have a negative relationship. Moreover, the deposit reserve requirement has a positive impact on loan rate, according to the results of Slovin and Sushka (1984). In addition, Hannan (1991a), Kahn, Pennacchi and Sopranzetti (2001) and Corvoisier and Gropp (2001) suggest that the loan rate has a negative relationship with the competition in the banking market. In other words, it has a positive relationship with market concentration measured by the Herfindahl Index, which is calculated from the market share of bank deposits. Moreover, the results of Gambacorta (2004) show that intermediation costs have a positive effect on loan interest rates. Finally, for the impacts of risks on loan price, Slovin and Sushka (1984) find that the cyclical change and loan rate have a positive relationship. In addition, default risk and liquidity risk also have a positive effect on the loan interest rate, as suggested by Corvoisier and Gropp (2001), Gambacorta (2004) and Hao (2004).

3.4 The empirical model

The model used to estimate the impacts of bank M&As on loan interest rate is based on the Monti-Klein oligopolistic model. In this model, banks are assumed to be price takers in the security market, but price setters in the loan and deposit markets. This model assumes that the bank has to retain some reserve which is a proportion of its deposit, and this reserve has a return equal to the market interest rate. In addition to deposits, there is another source of funds, interbank financing, which has the same price as the interbank interest rate. Interbank rates are assumed to be given by the government.

Besides the deposit interest rate and interbank rate, there are three more costs entailed in being a financial intermediate. First, the marginal cost of issuing loans, which includes screening, monitoring and branching costs. Second, the penalty cost arising from the liquidity shortage, which comes from the assumption that deposits can be randomly withdrawn, making the bank unable to raise cash in another retail or wholesale market. Third, the cost of the default risk which is incurred when borrowers are unable to repay their debts.

From the above assumptions, the bank's problem is to choose the quantity of loans in order to maximise its profit, subject to the reserve requirement and balance sheet constraint, as shown by the following equations:

$$\pi = r_L(L)L - r_D(D)D - rIF - C(L,D) - r_p E\left[Max(o, \tilde{x} - R)\right] - \mu r_L(L)L \qquad (3\text{-}6)$$

subject to the reserve requirement condition

$$R = \alpha D \qquad (3\text{-}7)$$

and the balance sheet constraint

$$R + L = IF + D \qquad (3\text{-}8)$$

where

π is the bank's expected profit which is assumed to be concave, indicating that it has diminishing returns to scale.

L and *D* are the amounts of loans and deposits.

r_L and r_D are loan and deposit interest rates which maximise the bank's profit. $r_L(L)$ and $r_D(D)$ are the inverse demand functions of loans and deposits, respectively.

R is the total amount of reserve requirement which the bank has to proportionally maintain by a fraction α from its total amount of deposit, *D*. This proportion is given by the government.

IF is the interbank financing of which the marginal cost is the same as the market interest rate, *r*.

C is the total intermediation costs.

$\tilde{x}$ is the random amount of deposit withdrawal.

r_p is the penalty rate which a bank has to pay if there is a liquidity shortage. This rate depends on the expected value of the deposit withdrawal, which is randomly drawn between zero if there is no unexpected withdrawal and the volume of liquidity shortages. This liquidity shortage is the difference between the amount of withdrawn deposit and the reserves.

μ is the default probability of a loan, which measures the default risk.

Thus, the profit maximising behaviour is according to the following condition:

$$r_L^* = \frac{1}{(1-\mu)} \frac{r + c' + r_p \Pr\left[\tilde{x} \geq R\right]}{1 - \frac{1}{\varepsilon_L}} \tag{3-9}$$

where

$c' = \frac{\partial C(L,D)}{\partial L}$ is the marginal cost of granting a loan.

$\varepsilon_L = \frac{-r_L L'(r_L)}{L(r_L)}$ is the loan demand elasticity.

In addition, to make the model more realistic, the interaction behaviours between competitors in the market are considered. Following Fuentes and Sastre (1998, p.6), these reactions can be directly included in the bank's optimal condition, as the following equation shows:

$$r_L^* = \frac{1}{(1-\mu)} \frac{r + c' + r_p \Pr\left[\tilde{x} \geq R\right]}{1 - \frac{1}{\varepsilon_L + \eta_L^M}} \tag{3-10}$$

where

η_L^M is the degree of rivalry of banks in the credit market.

That is, the optimal loan rate increases with the market interest rate, the marginal cost of granting loans, liquidity risk and default risk, while it decreases with the price elasticity of demand for loans and the bank's rival sensitivity in changing its strategy with respect to the changes in the bank's decision-making. Moreover, it also indicates that loan price depends on the characteristics of bank deposits reflected by the reserve requirement, which is the proportion of the total amount of deposit.

In order to consider the effect of mergers, following Fuentes and Sastre (1998), the impacts of bank M&As can be directly incorporated into the empirical model by an additional merger dummy variable, which reflects the effects on loan rates of bank organisational changes.

Besides merger dummy variables, we use cross-sectional time-series data on banks from different countries with different regulatory and legal issues and also geographic difference, which may affect bank pricing decision-making differently; hence, country dummy variables are also included into the model. This country-specific effect is assumed to be random and uncorrelated to other regressors. In addition, to capture the time trend, year dummy variables are also considered. Moreover, because our samples are scoped for only large commercial banks, a bank-specific effect capturing any fixed characteristics such as sector and type of activity is supposed to have no effect on bank loan interest rates; thus, this individual effect is ignored in the model.

The interaction term between the mergers dummy variable and market concentration should also be incorporated into the model, with the assumption that the changes in bank structure arising from bank mergers may affect a competing bank's position in the market and thus may impact on loan pricing behaviour.

Therefore, the estimated equation according to the above assumptions can be expressed as the following equation:

$$r_{ijt}^{L} = \beta_0 + \beta_1 dep_{ijt} + \beta_2 \cos t_{ijt} + \beta_3 defrisk_{ijt} + \beta_4 liqrisk_{ijt} + \beta_5 merge_{ijt} + \beta_6 r_{jt} + \beta_7 gdp_{jt} + \beta_8 cr5_{jt} + \beta_9 mcr5_{ijt} + c_i + y_t + e_{ijt} \tag{3-11}$$

where

r^L_{ijt} is the loan interest rate of bank *i* operating in country *j* at time *t*. We use the average loan rate following Kahn, Pennacchi and Sopranzetti (2001), who investigate the impact of bank consolidations on consumer loan rates in the US, and Valverde and Fernandez (2007), who examine the determinants of bank margins in European banking markets. This interest rate is an average loan interest rate, as a percentage value, calculated from dividing a bank's interest revenue by the total amount of its issued loans plus the total amount of other earning assets. This artificial rate is used because the income statements of the banks do not distinguish between interest revenue earned on loans and interest earned from other earning assets. In addition, this rate is the real rate, which is adjusted by the amount of default loan (i.e. the interest revenue used here accounts only for the revenue received). The data of interest revenue, loans and other earning assets come from income statements and balance sheet data obtained from the BankScope database.

dep_{ijt} is the ratio of deposits to total assets of bank *i* operating in country *j* at time *t*. This deposit ratio is derived from the banks' balance sheet data obtained from the BankScope database. To remove the variations which could result from the size differences, the bank total deposit is transformed over its total assets. This variable captures bank deposit characteristics and indicates changes in bank financing, as in the study of Ayadi and Pujals (2005). According to Equation (3-10), the impact of deposits on loan pricing is included in the required reserve variable. That is, as the level of deposit increases, the level of bank reserve also increases. The enhanced bank reserve position can lead to the lower chance that the random amount of deposit withdrawal, $\tilde{x}$, will be less than the bank reserve. In other words, as deposits increase, the bank liquidity risk decreases. The bank may then decrease its loan interest rates as the cost of liquidity risk decreases; thus the sign of the ratio of deposits to total assets is expected to be negative.

$\cos t_{ijt}$ is the cost-to-income ratio of bank *i* operating in country *j* at time *t*. This cost ratio is the bank's published cost-to-income ratio obtained from the BankScope database. Cost-to-income has been used in the studies of Corvoisier and Gropp (2001), Focarelli and Panetta (2003), Altunbas and Ibanez (2008), Gambacorta (2004) and Ayadi and Pujal (2005). This cost is an average cost which is a proxy of the marginal cost of issuing loans. Average cost can be used instead of marginal cost because banks normally operate with constant returns to scale and thus marginal and average costs are the same. In addition, this variable also controls for the difference in bank efficiency and productivity. This is because, the lower the efficiency and productivity, the higher the operating cost. Therefore, to offset the increase in this cost, banks tend to increase their revenue by raising their loan interest rates. Thus, the cost-to-income ratio is expected to have a positive relationship with the price of bank loans.

$defrisk_{ijt}$ is the ratio of the loan loss provision to the net interest revenue of bank *i* operating in country *j* at time *t*. This ratio is the reported ratio taken from income statements. This variable is used as a measurement of the bank default risk. Loan loss provision is an expense set aside for loans which will probably not be repaid. One might argue that loan loss provision is a backward- looking measure which is based on the bank's own prior loss experience and might support other alternative measurements such as the nonperforming loans (NPLs) ratio, as in the study of Erel

(2005), or the ratio of bad loans, as in the studies of Focarelli and Panetta (2003) and Sapienza (2002). Using this historical loss rate to justify significant defaults becomes more difficult, in particular, in a prolonged period of benign economic conditions when loss rates decline. This means that in a long-term recovery period if banks use backward-looking provision as a proxy for their default rate, they will have too high a default rate. In this case, provision might not be able to reflect the present situation of bank default and might be an inappropriate measure for its credit risk in a period of recession. In addition, in a contraction period, using loan loss provision as a signal for present defaults can affect the entire economy. That is, during a recession, the credit losses arising from economic downturns are more likely to require banks to recognise more loan losses. As a consequence, the increase in loan loss provision during recessionary periods may lead to lower lending (see Beatty and Liao, 2009 for details). However, after checking our data, we realise that the economic situation in the EU was stable during the period of study. Moreover, as suggested by Wooldridge (2001, p.152), it is normal to have serial correlation when panel data are adopted. This means that, in normal conditions, a past variable can be used to predict a future variable. For this reason, without any recession in our data, using a backward-looking measure can lead to a correct characterisation of bank default. In addition, since it is impossible to obtain information on the actual amount of NPLs in several EU countries, the ratio of loan loss provision to interest revenue which is the most widely publicly available in Europe (Altunbas and Ibanez, 2008, p.220) is considered in this thesis to be the proxy for bank credit risk.

Loan loss provision has been identified in several banking studies as a suitable proxy for credit risk (Rose, 1996, p.196); for example, Ahmed, Takeda and Thomas (1999) and Ismail and Lay (2002) find that loan loss provision has a positive relationship associated with NPLs. Fisher, Gueyie and Ortiz (2000) find a similar result: that higher loan loss provision indicates an increase in risk and deterioration in loan quality. Demirgue-Kunt and Huizinga (1998) and Nys (2003) investigate the determinants of the European banks interest margin and use loan loss provision ratios as the measurement for bank credit risk exposure. In the context of bank M&As, Altunbas and Ibanez (2008) and Ayadi and Pujals (2005) use the relation of loan loss provision to net interest revenue as a default risk indicator in their studies of bank M&As in the EU banking market.

The loan loss provision ratio is expected to have a positive relationship with loan interest rates. This is because an increase in credit risk will raise the marginal cost of debt and equity, which in turn increases the cost of funds for the banks. In order to retain a reserve to cover credit losses, the banks tend to offer higher loan prices for higher-default risk borrowers. That is, the higher ratio refers to the larger amount of expected bad loans on the books and the higher are the risks (Ayadi and Pujals, 2005, p.36). Thus, banks tend to issue loans with higher interest rates for these riskier borrowers.

$liqrisk_{ijt}$ is the ratio of the net loan to the total deposit and short-term borrowing of bank i operating in country j at time t . This ratio is reported in the bank income statements obtained from the BankScope database. Following Nys (2003) and Mercieca, Schaeck and Wolfe (2009), we use this ratio to indicate a bank's liquidity risk. In addition, as suggested by Matz (2007), the higher the lending of a bank, the greater the possibility that the bank cannot survive unexpected deposit withdrawals.

That is, the greater the ratio, the higher liquidity risk the bank suffers; thus banks tend to increase their loan price to offset this risk.

$merge_{ijt}$ is a binary dummy variable capturing the possible differential effect of the merger process on bank loan interest rates. This variable equals 1 in the year of the merger if a bank engages in the M&A process and for 3 years before and 3 years after this merger year, and otherwise equals 0[7]. The economic rationale behind this use of lagged merger dummy variables is that the merging banks can exercise the market power obtained from the merger some time before the merging year and thus can modify their pricing policy even before the merger occurs (Focarelli and Panetta, 2003, p.1163). The leading merger dummy variables are also considered because the change in the merged bank's efficiency may be delayed and thus interest rate changes from mergers can develop over substantial periods of time (Ashton and Pham, 2007; and Marsch, Schmieder and Aerssen, 2007). As suggested by Focarelli and Panetta (2003, p.1153), there is a delay in efficiency adjustment because, first, cost-cutting takes time and cost reductions may also be delayed by reluctance to lay off staff, in particular, in businesses where human capital is important such as financial services. Second, merging different workforces is not an easy task and may take some time. Differences in communication styles, customer needs and distribution channels could impede the exchange of information and hamper the development of a coherent corporate identity, thus aggravating the difficulty of getting two banks to work as one.

---

7 This means that if the bank engages in M&As in year *t*, the merger dummy variable equals 1 for years *t-3, t-2, t-1,t, t+1, t+2 and t+3 and* 0 otherwise.

The 3-year period is not chosen arbitrarily but follows evidence from several past studies which examine the impact of bank M&As on bank behaviour; for example, Berger *et al.* (1998), Calomiris and Karceski (2000) and Focarelli and Panetta (2003), who mention 3 years as the gestation period needed to restructure the merged bank. This is consistent with the results of the interviews conducted by the Federal Reserve Board staff with officials of banks involved in mergers (see Rhoades, 1998, p.285): 'Most of the firms projected that the cost savings would be fully achieved within 3 years after the merger'. Ayadi and Pujals (2005) use the 3-year period to analyse the impact of European bank mergers. This 3-year period is assumed because it is more likely that gains will only appear at least one year after the merger but that all gains should be realised within 3 years. Panetta, Schivardi and Shum (2004) examine the impact of bank mergers in the Italian banking market by using the merge effect with a 3-year lag period.

Alternative time patterns for merger dummy variables have been found in a small number of studies; for example, Ashton and Pham (2007) investigate the price effects of UK retail bank horizontal mergers and set a merger dummy variable equal to 1 if the merger has occurred in either the 2 years before the merger event or in the 6 years following it. However, these time periods were selected randomly without any solid evidence. Montoriol-Garriga (2008) analyses the effects of Spanish bank mergers on average interest rates and loan spreads for small business borrowers by considering accumulated merger dummy variables which equal 1 in all years after the year in which one of the firm's lenders is involved in a merger, and zero otherwise.

The effect on loan prices depends on whether the market power dominates the efficiency effects. That is, the coefficient of this dummy variable can be positive or negative, depending on whether the increased market power outweighs gains in operating efficiency. In other words, if merging banks have a significant geographical overlap in their markets of operation, M&As can lead to an increase in market power which will in turn increase the cost of capital for borrowers. In contrast, M&As may increase the efficiency of banks through synergy gains or through the reoptimisation of loan portfolios and risk diversification. Thus, by holding other variables constant, if the benefits of economies of scale or scope from mergers are passed on to borrowers, the loan interest rate would be expected to go down after the mergers.

r_{jt} is the three-month interest rate in the inter-bank market. It is an annual average amount quoted as a percentage obtained from the Eurostat database. Following Nys (2003), Panetta, Schivardi and Shum (2004) and Banal-Estonol and Ottaviani (2007), this short-term market interest rate is considered the measure of the marginal financial cost to a bank[8]. That is, the increase in the market rate means a higher cost for the funds which the bank lends to its borrowers; hence, as this cost increases, the bank tends to increase the lending price. In addition, the market interest rate is also a control variable for the bank's market risk - the risk that, changes in the market values of assets and liabilities will affect earnings and capital. Higher market interest rates mean higher interest expenses. Thus, to maintain its revenue position, a bank tends to increase its loan price as the market rate increases. Therefore, the market interest rate is expected to be positively correlated with the loan interest rate.

8 In Panetta, Schivardi and Shum (2004), this 3-month inter bank rate is subtracted from the interest rate as an indicator of the bank's risk premium. However, in this thesis we follow the theoretical model, which suggests the market interest rate as an explanatory variable.

gdp_{jt} is the GDP growth rate of country *j* at time *t*. This is the GDP growth rate as a percentage. The GDP growth rate in year t is calculated by dividing the GDP in this year minus the GDP in year t-1 by the value in year t-1. The value of the GDP is obtained from the European Central Bank (2002, 2006). As in Gambacorta (2004) and Matthews, Murinde and Zhao (2007), the GDP growth rate is considered a proxy of bank *i*'s loan demand elasticity. This is because the GDP growth rate reflects the change in macroeconomic factors, which determines the price elasticity of consumer demand. The GDP growth rate is expected to have either positive or negative signs. As suggested by Bils (1989), in boom periods, when higher average income and high GDP growth rate are expected, the average elasticity of consumer demand will tend to be lower. The bank will then tend to increase its mark-up price by increasing its loan interest rate (Fuentes and Sastre, 1998). That is, in this case, the coefficient of GDP growth is expected to have a positive sign. In contrast, GDP growth rate can be negatively correlated with the loan interest rate. According to the theory of the business cycle, the bank can compensate for a riskier environment, presented by a decrease in the country's GDP, by tightening its lending standards, or, in other words, by raising its loan interest rate. In addition, the reason for the negative relationship could be that the better macroeconomic conditions reflect the overall level of development of the banking sector. This development includes better technology, which can affect the increase in the bank's efficiency gains which can be passed to customers by a reduction in the lending price, as suggested by Demirguc-Kunt and Huizinga (1998). Thus, in this case, the better the macroeconomic situation, the lower the loan interest rate.

$cr5_{jt}$ is the five-firm concentration ratio of country *j* at time *t*. This ratio is used in order to feature the bank's market structure, or, in other words, the competitive environment in each country's banking market. This ratio is obtained from the European Central Bank (2002, 2006). It is simply the sum of the market shares, in terms of total assets, of the five largest banks in a national market. That is, $CR_5 = \sum_{i=1}^{5} S_i$ where S_i is the market share of the i^{th} bank, $i = 1,\ldots,5$. This concentration ratio shows the degree to which a banking industry is dominated by a small number of large banks or made up of many small banks. A higher ratio represents an intense concentration, while a lower ratio indicates a more competitive situation in the banking market.

Competition can be measured in various ways. According to Biker, Shaffer and Spierdijk (2009, p.3), the techniques to assess the competitive climate in the banking sector can be divided into two main approaches: structural and non-structural. The structural approach to competition includes the Structural-Conduct-Performance (SCP) paradigm, which predicts that a highly concentrated market causes collusive behaviour among larger banks, resulting in superior market performance, and the Efficiency-Structure-Performance (ESP) hypothesis, which investigates whether it is the efficiency of larger banks that makes for enhanced performance. The most frequently used indices in the structural approach to measure competition are the k-bank concentration ratio (CRk) and the Herfindahl-Herschman Index (HHI) (Bikker and Haaf, 2000, p.4). Because of their advantage in terms of being straightforward to calculate, with suitable data not being particularly difficult to obtain, CRk and HHI have been commonly used in the empirical banking literature, for example, by Berger and Hannan (1989), Berger (1995), Berger and Hannan (1997), Peterson and Rajan (1995), Black and Strahan (2002), Elsas (2005) and Degryse and Ongena (2006).

However, some empirical banking studies argue that structural measures of market structure may be inappropriate proxies for competition, because they do not indicate the connection between concentration and monopoly power (see Shaffer, 2004; and Claessens and Laeven, 2004). They have developed the alternative method, the non-structural approach, because of a need for more precise and consistent measures of market power. This approach includes three alternative measures, namely, the Iwata model, the Bresnahan model and the Panzar and Rosse (P-R) approach. The first two measures are based on the results obtained from the oligopoly profit-maximisation problem. They require market demand and supply functions to be estimated (see Iwata, 1974; and Bresnahan, 1987). Empirical applications of both models are limited due to their high information requirement (Gischer and Stiele, 2009, p. 55). The P-R approach was developed by Panzar and Rosse (1987) to determine the intensity of competition on the basis of the comparative static properties of the reduced-form revenue equation, based on cross-sectional data. They define a statistic, called the H-statistic, to assess the degree of competition in the banking market. This statistic is the sum of the elasticities of gross revenues to unit factor cost. With perfect competition, demand is perfectly elastic, which means that a proportional increase in factor prices induces an identical proportion change in gross revenues, indicated by an H-statistic of unity. Under monopolistic competition, because the demand is inelastic (i.e. revenue will increase less than proportionally to changes in factor prices), $0 < H < 1$. In the case of monopoly, there may be no response or even a negative response of gross revenue to changes in input costs, indicated by an H-statistic which is smaller than zero. The P-R method has been widely applied in empirical banking studies, including those of Molyneux, Lloyd-Williams and Thornton (1994), De Bandt and Davis (2000), Bikker and Haaf (2002), Yildrim and Philappatos (2002) and Claessens and Laeven (2004) (cited in Majid, Zulkhibri and Fadzlan, 2007, p.21).

Although the P-R method is argued as being more suitable for analysing the competitive climate than CRk or HHI, most of the studies investigating bank merger effects, including the present thesis, select structural measures as proxies for bank market competition. They do so because the H-statistic is reliable only if the sample has long-run equilibrium. However, this condition is not easily satisfied (Shaffer, 1983, p.352). As Shaffer suggests, if a sample is not in long-run equilibrium, the H-statistic can negatively bias the findings (see also Shaffer and Thomas 2007, p.764). Even though Shaffer (1982) tried to correct this bias, the main assumption of this new procedure is a fixed number of firms in the market. It cannot estimate correctly in cases where entry or exit has occurred in response to factor price movements within the sample period. Nevertheless, no-entry or no-exit assumption cannot be satisfied in the context of M&As, because the merging of banks will change the number of banks in the market. This invalidity of the H-statistic in the context of bank mergers can be seen from the empirical study of Smith and Trip (2001), who examine the competition and contestability of the New Zealand banking system. Their results indicate that, while the HHI can provide a significant explanation of the effects of a merger between Countrywide Bank and the National Bank of New Zealand, the H-statistic cannot reflect the effects of such a merger (Smith and Trip, 2001, p17). This result implies that the H-statistic may not reveal the true degree of market power when there are mergers in the banking market.

The five-firm concentration ratio CR5 is used in this thesis, rather than other structural measures. This follows the reasoning by Moschandreas (2000), who suggests that CR5 is commonly used to examine bank market competition in the UK while other concentration ratios, such as HHI, the three-firm concentration ratio (CR3) or the four-firm concentration ratio (CR4), are more common in the USA (Moschandreas, 2000, p.14). In addition, CR5 has been chosen following evidence from other studies examining the European banking market structure, such as those by Fernandez de Guevara, Maudos and Perez (2005), Groeneveld and Boonstra (2005), Baert and Vander Vennet (2009) and Casu and Girardone (2005, 2009).

The relationship between the CR5 ratio and loan interest rates can be either positive or negative. If the concentration leads to a bank gaining higher market power, the bank tends to increase its loan interest rate, according to the SCP hypothesis. In contrast, if market concentration occurs as the result of bank efficiency, the bank will reduce its loan interest rate with an increase in market concentration, as suggested by the ESP approach.

$mcr5_{ijt}$ refers to the interaction of the mergers dummy variable and bank market concentration. Since market concentration and mergers are correlated (Sapienza, 2002, p. 345), this variable is included in the model to control for the changes in market concentration as a result of consolidation.

c_i is the unobserved country-specific effects.

y_t is the year dummy variable, capturing the time trend.

e_{ijt} is the error term.

The descriptions of the variables are provided in Table 3-1.

Table 3-1: Description of the variables

Variables	Symbols	Descriptions	Sources
Dependent variables	r^L_{ijt}	The average loan interest rate, as a percentage value, calculated by dividing a bank's interest revenue by the total amount of loans plus the total amount of other earning assets	Author's own calculation. Values of interest revenue, loans and other earning assets are obtained from the BankScope database
Factors influencing loan pricing behaviour based on the theoretical model	dep_{ijt}	Total deposits to total asset ratio	Author's own calculation. Deposit and total assets are obtained from the BankScope database
	$cost_{ijt}$	Cost-to-income ratio	BankScope database
	$defrisk_{ijt}$	Loan loss provision to net interest revenue	BankScope database
	$liqrisk_{ijt}$	Net loan to total deposit and short-term borrowing ratio	BankScope database
	r_{jt}	Annual average 3-month interbank rate in percentage amount	Eurostat database

Table 3-1: Description of the variables (*continued*).

Variables	Symbols	Descriptions	Sources
	gdp_{jt}	GDP growth rate	Author's own calculation. Values of GDP are obtained from ECB (2002, p.65; and 2006, p.65)
	$cr5_{jt}$	Five-firm concentration ratio	ECB (2002, p.54; and 2006, p.54)
Merge effects	$merge_{ijt}$	Merger dummy variable, equal to 1 if bank engages in the M&A process in the year of the merger and for 3 years before and 3 years after this merger year and equal to 0 otherwise	
	$mcr5_{jit}$	Interaction term for mergers dummy variable and bank market concentration	
Fixed effects	c_j	Country-specific dummy variable	
Seasonal effects	y_t	Year dummy variable capturing the time trend	

3.5 Data

3.5.1 Description of the data

In generating the sample, we employ a number of screens. Initially only banks headquartered in the EU15 countries and operating during 1997 and 2005 are included. Second, only large banks with total assets greater than 100 billion USD are considered. Third, the data of the banks in Denmark and Finland are excluded from the analysis. This is because in these two countries none of the large commercial banks engaged in M&As during the study period. Only those banks are selected for which accounting data could be obtained from the BankScope database. In total, this selection leaves 106 banks, comprising 39 banks engaged in M&A processes, with 59 merger deals and 67 non-merging banks. All the merger transactions considered in this study completed the deal during the study period. These merging banks involve transactions which were either full mergers, combining two or more entities to form a new bank, or acquisitions, which include the cases in which a holding company or another bank takes over the acquired institution but the acquirer and the acquired banks remain separate entities. The samples used in this study are the unbalanced panel data, which have different numbers of time observations on each individual bank.

The data used in this section can be classified into three groups. First are the macroeconomic indicators for each country, taken from the European Central Bank (ECB) and the Eurostat database. The concentration ratio obtained from the ECB is calculated by using total assets. The second group is formed from the bank data derived from the Bankscope database, which provides annual income and balance sheet data for banks. Finally, there is M&A information taken from the Bureau Van Dijk international database.

The summary statistics of data are shown in Table 3-2. All of the values of each variable are values of the variable across all banks over the entire time period. However, one might argue that the mean average of loan loss provision ratio is very high and may be inappropriate proxies for credit risk. This high ratio is normal for some developed countries, such as France and the Nordic countries, as suggested by Demirguc-Kunt and Huizinga (1998, p.12).

Table 3-2: Summary statistics of data

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Average loan interest rate (%)	733	6.064206	3.040359	.6104789	29.23
Total deposits to total asset ratio	733	.7296313	.1344367	.1445795	.9651386
Cost-to-income ratio	733	61.45201	15.61084	5.88	98.77
Loan loss provision to net Interest revenue	733	18.05513	14.56363	0	93.04
Net loan to total deposit and Short-term borrowing ratio	733	64.62166	20.38173	.56	99.72
3-month interbank rate (%)	725	1.858745	2.863034	0	13.97
GDP growth rate (%)	651	4.79237	2.67325	-.582643	15.38473
CR5	733	42.36412	18.92292	17	88
Merger dummy	733	.4488404	.4977154	0	1
Merger dummy* CR5	733	19.30914	24.70802	0	88

3.5.2 Data multicollinearity

According to Greene (2003, p.56), one of the problems with data is multicollinearity. This problem occurs when variables are very highly correlated with each other and thus it is difficult to obtain reliable estimates of their individual regression coefficients. A high degree of multicollinearity will lead to high standard errors of the coefficients and low t-statistics. However, multicollinearity does not adversely impact upon the predictive power of the regression model as a whole. This phenomenon is especially common in time-series data because of the presence of lagged variables and common time trends among the explanatory variables.

One method of detecting the possibility of multicollinearity among variables is to provide a data correlations matrix. As shown in Table 3-3, the correlation matrix presents a low degree of correlation among the explanatory variables. In addition, as expected, the correlation matrix between merger dummy variable and the interaction term is relatively large, with a value of 0.8666. According to Friedrich (1982, p.803), including an interaction term can increase the level of collinearity because the interaction term is an exact nonlinear function of the constituent variables, the merger dummy variable and the concentration ratio; thus the correlations of the constituent variables with the product term are usually high. However, this multicollinearity does not pose problems for the interpretation of the regression results. This depends on the regression assumption that the only time that multicollinearity is very severe to the analysis is in the presence of perfect collinearity and thus the model estimation is unable to produce results. Although the interaction term and merger dummy variable have high collinearity, this relationship is not perfectly linear. In addition, for other regressors, the collinearities are low. Therefore, multicollinearity is not an important problem in our analysis.

Table 3-3: Data correlation matrix

	Deposit to total asset ratio	Cost-to-income ratio	Loan loss provision to net interest revenue	Net loan to total deposit and short-term borrowing	Merger dummy variable
Deposit to total asset ratio	1.0000				
Cost-to-Income ratio	0.0843	1.0000			
Loan loss provision to net interest revenue	-0.1180	0.0261	1.0000		
Net loan to total deposit and short-term borrowing	-0.2423	-0.0784	0.0184	1.0000	
Merger dummy variable	-0.0634	0.1988	0.0725	-0.0474	1.0000
3-month interbank rate	0.1923	-0.0531	-0.0409	-0.0748	0.0072
GDP growth rate	0.1920	-0.2017	-0.1913	0.1312	0.0980
CR5	-0.0239	0.0172	-0.2162	0.1031	0.0313
Merger dummy* CR5	0.0379	0.1363	-0.0229	-0.0987	0.8666

Table 3-3: Data correlation matrix (*continued*).

	3-month interbank rate	GDP growth rate	CR5	Merger dummy* CR5
3-month interbank rate	1.0000			
GDP growth rate	0.0519	1.0000		
CR5	-0.0356	0.2509	1.0000	
Merger dummy* CR5	0.0182	0.1625	0.3525	1.0000

3.6 Methodology: the panel data models

Although the nature of the panel data can be ignored and the pooled ordinary least squares (OLS) can be applied, the resulting model might be overly restrictive and can have complicated error processing, for example, heteroskedasticity across panel units and serial correlation within panel units. Therefore, the pooled OLS estimation technique is not often considered to be practical (Baum, 2006, p.219). The two main alternative approaches to the fitting of models using panel data are to use fixed effect regressions and random effect regressions. According to Greene (2003, p.283), for a given panel data set, the general form of panel data model can be expressed as

$$y_{it} = x_{it}\beta + z_i\delta + u_i + \varepsilon_{it} \tag{3-12}$$

where

$i = 1,\ldots,n$ is the number of cross-sectional units and $t = 1,\ldots,T$ is the number of time periods.

y_{it} is the observable dependent variable.

x_{it} is a 1 x k vector of variables which vary between individuals and over time.

β is the k x 1 vector of coefficients on x.

z_i is a 1 x p vector of the time-invariant observable variables which vary only between individuals.

δ is the p x 1 vector of coefficients on z.

u_i is the unobserved individual-level effect.

ε_{it} is the disturbance term.

Equation (3-12) can be estimated by the fixed effect or the random effect models, given the assumption about the unobserved effect, u_i. Both methods are explained below.

3.6.1 The fixed effects model

If u_i is unobserved but correlated with x_{it} then the OLS is biased and inconsistent due to the omitted variable. When the u_i is correlated with some of the regressors in the model, one estimation strategy is to treat them as parameters of fixed effects. However, simply including a parameter for every individual is not feasible, because it would imply an infinite number of parameters in our large-sample approximations. The solution is rather to remove u_i from the estimation problem and still achieve the estimates of β ; this is called the fixed effect estimators, $\hat{\beta}_{FE}$.

To remove u_i, the panel-level averages of each variable are subtracted from each corresponding variable of Equation (3-12). Let $\overline{y}_i = (1/T)\sum_{t=1}^{T} y_{it}, \overline{x}_i = (1/T)\sum_{t=1}^{T} x_{it}$ and $\overline{\varepsilon}_i = (1/T)\sum_{t=1}^{T} \varepsilon_{it}$. In addition, since z_i and u_i are time invariant, $\overline{z}_i = z_i$ and $\overline{u}_i = u_i$, Therefore, the algebra on Equation (3-12) implies

$$y_{it} - \overline{y}_i = (x_{it} - \overline{x}_i)\beta + (z_i - z_i)\delta + (u_i - u_i) + (\varepsilon_{it} - \overline{\varepsilon}_i) \tag{3-13}$$

which implies that

$$\tilde{y}_{it} = \tilde{x}_{it}\beta + \tilde{\varepsilon}_{it} \tag{3-14}$$

The estimates of β, $\hat{\beta}_{FE}$, can then be obtained using the standard OLS.

3.6.2 The random effects model

In the case in which the unobserved effect, u_i, is uncorrelated with other explanatory variables in the regression model, the unobservable individual-level effects are simply parameterised as additional random disturbances. ($u_i + \varepsilon_{it}$) in Equation (3-12) can be referred to as the composite-error term.

By assuming that u and ε are mean-zero processes, uncorrelated with the regressors; that they are each homoskedastic; that they are uncorrelated with each other; and that there is no correlation between individuals or over time, for the T observations belonging to the i^{th} unit of the panel, the composite error process is as follows:

$$\eta_{it} = u_i + \varepsilon_{it} \tag{3-15}$$

with

$E(\eta_{it}) = 0$ as the mean zero process.

$E(\eta_{it}^2) = \sigma_u^2 + \sigma_\varepsilon^2$ as the variance.

$E(\eta_{it}\eta_{is}) = \sigma_u^2, t \neq s$ as the covariance within a unit and

$\Sigma = \sigma_\varepsilon^2 I_T + \sigma_U^2 1_T 1_T'$ as the covariance matrix of the T errors.

Thus the estimated equation is

$$y_{it} = \beta_0 + x_{it}\beta + z_i\delta + \eta_{it} \tag{3-16}$$

where

β_0 is an intercept included to make the assumption that the unobserved effect, u_i, has zero mean.

However, because u_i is in the composite error in each time period, the composite error is serially correlated over time. In order to solve this problem, the generalised least square (GLS) transformation should be derived. This can be done by defining the transformation equation as

$$y_{it} - \lambda\bar{y}_i = \beta_0(1-\lambda) + \beta_k(x_{it} - \lambda\bar{x}_i) + \delta(z_i - \lambda\bar{z}_i) + (\eta_{it} - \lambda\bar{\eta}_i) \tag{3-17}$$

where

$\bar{y}_i = (1/T)\sum_{t=1}^{T} y_{it}, \bar{x}_i = (1/T)\sum_{t=1}^{T} x_{it}$ and $\bar{\eta}_i = (1/T)\sum_{t=1}^{T} \eta_{it}$ are the time averages of the corresponding variables.

$\lambda = 1 - [\sigma_\varepsilon^2/(\sigma_\varepsilon^2 + T\sigma_u^2)]^{\frac{1}{2}}$, $0 < \lambda < 1$.

The errors in Equation (3-17) are serially uncorrelated. This transformation in Equation (3-17) is more advantageous over the fixed effects, in that the random effects allow for explanatory variables which are constant over time. However, the parameter λ is never known, but can be estimated as

$$\hat{\lambda} = 1 - [1/(1 + T(\hat{\sigma}_u^2 / \hat{\sigma}_\varepsilon^2))]^{\frac{1}{2}} \tag{3-18}$$

where

$\hat{\sigma}_u^2 = [NT(T-1)/2 - (k+1)]^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \sum_{s=t+1}^{T} \hat{\eta}_{it} \hat{\eta}_{is}$, is the consistent estimator of σ_u^2, with $\hat{\eta}_{it}$ and $\hat{\eta}_{is}$ as the residuals from estimating Equation (3-16) by OLS.

$\hat{\sigma}_\varepsilon^2 = \hat{\sigma}_\eta^2 - \hat{\sigma}_u^2$, is the consistent estimator of σ_ε^2, with $\hat{\sigma}_\eta^2$ as the square of the usual standard error of the regression from the OLS of Equation (3-16).

The GLS estimator which uses $\hat{\lambda}$ in place of λ in the regression model (3-17) is called the random effects estimator. The random effects estimator is consistent and asymptotically normally distributed.

3.7 Empirical results

In order to fit a model with panel data, first we have to determine whether the fixed effect or random effect estimations should be adopted. In our analysis, the random effect is more attractive because our interest variable, the merger dummy variable, is retained in the regression model and thus the effects of bank M&As on loan price can be investigated. However, in a fixed effect estimation, this would have to be dropped.

The random effect can be used if two preconditions are satisfied. One precondition is that the observations can be described as having been drawn randomly from a given population. This is a reasonable assumption in our case, because the data used in this study are random samplings of bank level data.

The other precondition is that the unobserved effect is distributed independently of the other explanatory variables. The standard procedure is the implementation of the Durbin-Wu-Hausman test, called the Hausman specification test. This test involves taking both the fixed effect and random effect approaches to the model and comparing the resulting coefficient vectors. The null hypothesis is that the unobserved effects are distributed independently of the regressors. Under the null hypothesis, the test statistic has a chi-square distribution with the degree of freedom equal to the number of slope coefficients being compared. This Hausman parameter contrast test takes the following quadratic form:

$$(\hat{\beta}_{FE} - \hat{\beta}_{RE})' \left[\operatorname{cov}(\hat{\beta}_{FE}) - \operatorname{cov}(\hat{\beta}_{RE}) \right]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \sim \chi^2(k_x) under H_0 \tag{3-19}$$

where

$\hat{\beta}_{FE}$ is the vector of fixed effects estimates.

$\hat{\beta}_{RE}$ is the vector of random effects estimates without the coefficients on time-constant variables since in the fixed effect model these variables are dropped and thus cannot be compared.

$\text{cov}(\hat{\beta}_{FE})$ and $\text{cov}(\hat{\beta}_{RE})$ are the consistent estimates of the asymptotic covariance of β_{FE} and β_{RE}, respectively. The difference between these two variances is positively defined so that its inverse can be obtained.

k_x is the number of regressors being compared.

If the null hypothesis is correct, the coefficient estimates of both models will not differ significantly. Both random effect and fixed effect are consistent, but the fixed effect will be inefficient because it involves estimating an unnecessary set of dummy variable coefficients; thus the random effect model is preferred. In contrast, if the null hypothesis is rejected, the random effect estimates will be subject to an unobserved heterogeneity bias and will therefore differ systematically from the fixed effect estimates.

The result of the Hausman specification test is presented in Table 3-4.

Table 3-4: The Hausman specification test

	Coefficients			
	(b)	(B)	(b-B)	Sqrt(diag(V_b-V_B))
	fixed	random	Difference	S.E.
Deposit to total asset	-.8528486	-1.288434	.4355854	.6967859
Cost to income	.0076418	-.0015031	.009145	.0051754
Loan loss provision to net income	.0188878	.023989	-.0051013	.0031441
Net loan to total deposit and short-term borrowing	-.0089747	-.006568	-.0024067	.0062437
3-month interbank rate	.3322811	.3296086	.0026725	.0158783
GDP growth rate	22.94299	22.33045	.6125342	1.296091
CR5	-.049799	-.0167441	-.0330549	.0279851
Merger dummy* CR5	.0277585	-.0033529	.0322114	.0358792

b = consistent under Ho and Ha;

B = inconsistent under Ha, efficient under Ho;

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 13.28

Prob>chi2 = 0.1026

Table 3-4 demonstrates the low chi-square value, with the P-value equalling 0.1026, which indicates that the Hausman test's null hypothesis – that the random effect estimator is consistent – cannot be rejected. In other words, the estimation of the equation with the random effect model can yield consistent results and can be used to examine the effects of bank mergers on bank loan pricing behaviour.

The next step is to consider whether there are any unobserved effects at all. In cases where there is no unobserved effect, the pooled OLS should be used instead of the random effect estimates. The pooled OLS is more efficient in such cases, because we are not attempting to allow for non-existing within-groups autocorrelation and we can take advantage of the finite-sample properties of the OLS, rather than relying on the asymptotic properties of random effects.

The most common test to detect the presence of random effects is the Breusch-Pagan Lagrange multiplier test[9] which regresses the squares of the fitted residuals on a set of regressors. The test statistic has chi-square distribution with one degree of freedom under the null hypothesis of no random effects. As shown in Table 3-5, the large chi-square value rejects the null hypothesis of the absence of random effects within a 1% significance level given when the P-value equals 0. This confirms the existence of unobserved individual heterogeneity and thus the random effect is preferred to the pooled OLS estimators.

9 The Breusch and Pagan Lagrange-multiplier test was later modified by Baltagi and Li (1990) in order to allow for unbalanced data.

Table 3-5: The Breusch and Pagan Lagrangian multiplier test

Breusch and Pagan Lagrangian multiplier test for random effects:		
Loan interest rate[bank,t] = Xb + u[bank] + e[bank,t]		
	Var	sd = sqrt(Var)
Loan interest rate	8.355776	2.890636
e	3.203516	1.789837
u	5.854416	2.41959
Test: Var(u) = 0		
chi2(1) = 304.84		
Prob > chi2 = 0.0000		

The regression results of Equation (3-10), achieved by adopting the random effect estimation with heteroskedastic adjustment of the standard errors, can be presented as in Table 3-6.

Table 3-6: Regression results

Random-effects GLS regression	Number of obs = 644
Group variable (i): bank	Number of groups = 97
R-sq: within = 0.3568	Obs per group: min = 1
between= 0.3177	avg = 6.6
overall = 0.3258	max = 8
Random effects u_i ~ Gaussian	Wald chi2(28) = 578.74
corr(u_i, X) = 0 (assumed)	Prob > chi2 = 0.0000

Average Loan interest rate	Coefficient	Robust Standard Error	z	p > |z|	[95% Conf. Interval]	
Deposit to total asset	-3.147442	1.713591	-1.84	0.066	-6.506018	.2111346
Cost to income ratio	-.0035651	.0081167	-0.44	0.660	-.0194736	.0123433
Loan loss provision to net interest revenue	.0154153	.0113157	1.36	0.173	-.0067631	.0375937
Net loan to total deposit and short-term borrowing	.0140883	.0070463	2.00	0.046	.0002778	.0278988
Merger dummy variable	-1.66865	.6558976	-2.54	0.011	-2.954186	-.3831146
3-month interbank rate	.2304788	.0414191	5.56	0.000	.1492989	.3116587
GDP growth rate	1.32932	3.507845	0.38	0.705	-5.54593	8.20457
CR5	-.0322367	0.157877	-2.04	0.041	-0.631799	-.0012935
Merger dummy* CR5	.0352868	.0124641	2.83	0.005	0.108576	.0597161
year1998	.626039	.3199051	1.94	0.052	-1.247606	.0063986
year1999	-.5624543	.3366706	-1.67	-.095	-1.222316	.0974079
year2000	-.0796523	.3569041	-0.22	0.823	-.7791715	.6198668
year2002	-1.28927	.2982888	-4.32	0.000	-1.873906	-.7046351
year2003	-2.023378	.2935826	-6.89	0.000	-2.598789	-1.447966
year2004	-2.190924	.254989	-8.59	0.000	-2.690693	-1.691154
year2005	-2.556451	.3265763	-7.83	0.000	-3.196529	-1.916374

Austria	-.367856	.6242524	-0.59	0.556	-1.59137	.856541
Belgium	.8269128	.5632966	1.47	0.142	-.2775203	1.931346
Germany	1.571063	.6470267	2.43	0.015	.3029135	2.839212
Greece	-.5827846	.7685838	-0.76	0.448	-2.089181	.0236119
Republic of Ireland	2.0441	.6761633	3.02	0.003	.71884	3.369456
Italy	-.1597717	.574893	-0.28	0.781	-1.286541	.9669979
Luxembourg	4.34662	2.325461	1.87	0.062	-.2111999	8.90444
Netherlands	.6570641	.7571397	0.87	0.385	-.8269024	2.141031
UK	.6304921	.768985	0.82	0.412	-.8766907	2.137675
Portugal	.7204601	.5922174	1.22	0.224	-.4402648	1.881185
Spain	.7659876	.5325038	1.44	0.150	-.2777006	1.809676
Sweden	-1.919003	.7001968	-2.74	0.006	-3.291364	-.5466426
Cons	8.708034	1.986079	4.38	0.000	4.81539	12.60068
sigma_u	1.7181823					
sigma_e	1.6009266					
rho	.53528343	(fraction of variance due to u_i)				

* The standard errors are robust to heteroscedasticity and autocorrelation.

* year 2001 and France are used as base groups.

* Longest time period: 1998-2005.

Table 3-6 demonstrates that the impacts on lending price of deposit characteristics, liquidity risk and market interest rate are statistically significant and have the signs expected. Specifically, the coefficient of deposit to total asset ratio has negative and statistical significance at a 10% significance level. This means that, as the level of deposits increases, the bank tends to reduce its loan interest rate. This is because the increase in deposit means an increase in the bank's reserves. A bank with a high volume of reserves will have less possibility that deposit withdrawal will be greater than reserves, or, in other words, it has a low liquidity risk. Thus, it does not need to set higher loan prices to cover this cost and may lower loan interest rates as the liquidity risk decreases. This result is consistent with the coefficient of the net loan to total deposit and short-term borrowing ratio which is used as the proxy for the liquidity risk. The ratio of the coefficient of net loan to deposit is positive and statistically significant at a 5% significance level, which suggests that the bank will increase its loan price when the liquidity position is worse in order to maintain its liquidity position. A higher loan interest rate will reduce loan demand and thus may reduce the risk that the bank will not have enough liquid assets to meet unexpected deposit claims. This finding is consistent with the results of Prisma, Slovin and Sushka (1986), who find that the coefficient of the net loan to total deposit and short-term borrowing has a positive and statistically significant impact on the loan interest rate.

The market interest rate and loan pricing have a positive relationship, as expected. The coefficient of a 3-month interbank rate is statistically significant at a 1% significance level and has a positive sign. This result suggests that, as the bank has a major role as an intermediary which passes excess funds to borrowers, when the costs of borrowing from other sources than deposits increase the bank may then need to raise its lending price in order to cover this cost for funds. Moreover, in the context of market risk, the increase in market interest rate implies a higher market risk. This is because the increase in market rate means that the bank will begin earning more interest income on its assets and pay more interest expense on its liabilities. However, because liabilities have in general shorter maturities than assets, interest expense typically changes more than interest income in the short run. This can potentially squeeze a bank's profits. Thus, in order to maintain its profit position, the bank tends to increase its lending prices as the market risk increases.

For the effects of market competition, the concentration ratio has a statistically significant and negative coefficient at a 5% significance level. The negative coefficient of the concentration ratio indicates that, as concentration in the market increases, the bank will reduce its loan price. This may be because this concentrated market is the result of highly efficient banks tending to set more favourable loan prices to customers, as supported by the Efficient-Structure-Performance hypothesis. This result is contradicted by the studies of Hannan (1991a), Kahn, Pennacchi and Sopranzetti (2001) and Corvoisier and Gropp (2001), which present a positive relationship between the HHI and loan interest rates. This contradiction may be due to the difference in the interested markets and also the differences in market concentration measurements. In the present thesis, for instance, the CR5 is adopted, while other researchers have adopted the HHI.

The results of the merger effect indicate that M&As are among the factors which affect the varied forms of bank loan pricing behaviours. The coefficient of the merger dummy variable is negative and statistically significant within a 5% significance level. In other words, bank M&As reduce the loan interest rate and merged banks tend to set their loan prices lower than those of non-merging banks. This finding supports the evidence from Kahn, Pennacchi and Sopranzetti (2001) that M&As in the US tend to have strong and negative influence on automobile loan interest rates and Sapienza (2002), who finds lower lending prices in small bank M&As in the Italian banking market. The reason for this negative relationship might be that banks engaging in

M&As can thereby increase their efficiency, for example, from product and service diversification, and these efficiency improvements from mergers are passed on to customers as reduced loan prices. This result is consistent with the findings of Focarelli and Panetta (2003), who examine bank M&As in the Italian banking market and find that bank consolidation in the Italian banking sector increases bank efficiency, which in part has been passed on to consumers through reduced loan pricing. In addition, Erel (2005), who examines the effects of bank M&As in the US banking market on loan spreads, find that, on average, mergers reduce loan spreads following synergy gains created in bank mergers. Montoriol-Garrige (2008), who investigates the impacts of Spanish bank mergers on a firm's average interest rate, also shows that loan interest rates decline after mergers and this decline is permanent and larger for the acquirers. In contrast, this result is perceived to be at odds with the findings reported by Calomiris and Pornrojnangkool (2005) and Ashton and Pham (2007), in which mergers are seen to have a stronger and negative influence on loan interest rates. This difference may exist for many reasons, including differences in the market structure of the banking market considered.

However, the interaction term between CR5 and the merger dummy variable has a statistically significant and positive coefficient within a 1% significance level. This result suggests that merged banks change their behaviours in different market competition situations. Banks involved in mergers which affect the change in market structure have market power and thus set higher loan prices than do banks which are not engaged in M&As. This finding is consistent with the results of Sapienza (2002), who finds that, although mergers benefit borrowers if banks involve the consolidations of banks with small market shares, as the local market share of acquired banks increases, the efficiency effect is offset by market power.

Table 3-6 also shows that costs from issuing loans, default risk and macroeconomic indicators give no important role to the bank loan pricing behaviour. These results are consistent with those of Hannan (1991a), who finds that the cost of intermediation has no influence on loan interest rates. In addition, as suggested by Berger *et al.* (2000), cost-to-income ratio may not be significant in the long-term if a cost-efficient bidder manages to implement his low cost strategy with the broader merged firm. This may also be the case with cross-border M&As, where controlling cost may not be the main strategic advantage sought by the firms involved (cited in Altunbas and Ibanez, 2008, p.17). However, these results are different from those in some studies, for example, that of Gambacorta (2004), who presents the positively statistical significance of the cost of managing loan and credit risk. These differences may exist for many reasons, including differences in the market structure of the banking markets considered.

The coefficients of most of the year dummies are statistically significant. This result suggests that loan interest rates differ in different years. Specifically, using 2001 as a base year, it was found that banks tended to reduce their lending prices and the reduction tended to increase as time passed. For country dummies, most of the country dummy variables are insignificant. This shows that, however differently banks operate in different countries, there are no country-specific effects which make a difference in decision-making on loan interest rates. That is, most of the EU banks tend to have similar loan pricing behaviour. However, it should be noted that the variable gdp_{jt} may already have absorbed all the country-specific effects (Matthews, 2007, p.2034).

3.8 Conclusion

So far, the empirical evidence on the effects of bank M&As on bank lending behaviours is largely limited to the studies based on the availability of loans, in particular, in the context of the US banking industry. Very few papers have provided evidence on bank loan pricing behaviour, especially in the context of the European banking market, and the results of these are mixed.

This chapter investigates the determinants of bank loan interest rates by employing the Monti-Klein model of the banking firm. Based on this model, the optimal loan price depends on macroeconomic factors, market characteristics and bank characteristics. Loan pricing tends to increase with the market interest rate, marginal cost of issuing loans, liquidity risk and default risk and has a negative relationship in the change in the bank's decision-making with the price elasticity of demands for loans and the bank's rivals' interaction.

In addition, this chapter also examines the relationship between bank M&As and bank loan pricing behaviour, with special focus on European banking markets. The main finding presented in this chapter suggests that bank M&As have a significant impact on the different behaviours of banks engaged and not engaged in M&As. Specifically, loan rates normally tend to be adjusted lower by the involved banks than in the uninvolved ones. That is, bank mergers may lead to efficiency gains and these gains are passed on to consumers in the form of lower loan interest rates. These efficiency gains may have been created by changes in lending technologies and the diversification of risk.

Although the results provide significant evidence that borrowers benefit from bank M&As, the market structure issue should be considered. This is because, if consolidations have a substantial impact on banking market structure, consolidated banks can exercise their greater market power by setting higher loan interest rates. Hence, some consumer borrowers may benefit from, while others may be harmed by, bank M&As. Thus, public policy regarding mergers should consider ways in which to protect vulnerable customers. There should be some competition control for domestic M&As which increases the intensity of the domestic banking market and cross-border M&As should be encouraged in order to make the domestic market structure more competitive. In addition, policies to enhance bank efficiency should be proposed. These policies include, for example, the operating of secondary markets, which would facilitate the flow of funds and reduce variability in the cost of funds to the bank and the development of programmes improving the availability of information; thus diminishing the bank's information cost, and hence its total costs, and reducing unpaid debts.

Chapter 4

Difference-in-Differences (DID) Estimation and the Effects of Bank Mergers and Acquisitions (M&As) on Bank Lending Behaviour

4.1 Introduction

Over the past few decades, the banking industry has experienced an extraordinary level of M&As. According to Berger, Demsetz and Strahan (1999, p.141), who comprehensively review the causes of bank mergers, one of the major incentives for bank M&As is that they maximise shareholder value. This value gain can be achieved by increases in the merged banks' market power, efficiency and risk diversification. Consolidation enables costs to be reduced if economies of scale or scope can be made. Larger institutions may be more efficient if redundant facilities and personnel are eliminated after the merger. Moreover, costs may go down if the same bank can offer several products at a lower cost than was possible for separate banks each providing individual products. Increasing the number of services and products can also diversify risk for a consolidated bank. Besides the value incentive, bank managers may also pursue mergers for their own advantage, since to do so reduces their largely undiversified employment risk, provides extra benefits and increases the size or the power of their organisation. Moreover, both shareholders and managers may use consolidations to increase a bank's access to government safety nets, for example, deposit insurance, a discount window or the status of being 'too-big-too-fail'. In addition, a government can also use bank M&As in order to pursue its own objectives, using the merger mechanism in particular as an option for economic policy reforms in its national banks. In this context, the most common purpose of bank mergers is to assist troubled banks, notably those with insufficient capacity, by letting them be acquired by banks in a strong financial position. The merged banks are expected to be safer and sounder once their operation becomes more efficient from economies of scale and scope after M&As.

One of the implications of commercial bank M&As is their impact on lending behaviour. Because commercial banks have an important role as financial intermediaries in the economy and bank loans are the most important source of financing for firms, in particular, where capital markets are not fully developed, changing a bank's lending behaviour as a consequence of mergers may have a substantial impact on the country's entire economic development. This issue has been of concern to policy makers and the impacts of bank M&As on decision-making as regards bank loans have been exhaustively tested by several analysts.

The empirical literature examining merger effects suggests that M&As in banking can have an impact on bank lending behaviour in two different ways. If bank mergers can generate efficiency gains, such as cost savings and revenue enhancing, and greater bank size can yield economies of scale and scope and increase the chances to diversify, borrowers will benefit to the extent that the consolidated banks pass on their efficiency gains to them in the form of reduced costs for loans; this is the view of

Sapienza (2002), Calomiris and Pornrojnangkool (2005), Erel (2005), Berger, Rosen and Udell (2007) and Montoriol-Garriga (2008). In addition, they can increase the supply of credit to their customers, as suggested by the findings of Featherstone (1996), Strahan and Weston (1998)[10] and Avery and Samolyk (2004). However, if mergers do increase market power, consolidated banks can exert their market power to earn higher profits by raising loan interest rates, as suggested by Berger and Hannan (1989), Hannan (1991a), Prager and Hannan (1998), Kahn, Pennacchi and Sopranzetti (2001), Corvoisier and Gropp (2001), Petersen and Rajan (2002) and Berger *et al.* (2005). At the same time they can provide lower credit to their clients, as indicated by the results of Keeton (1996), Peek and Rosengren (1997), Berger *et al.* (1998), Sapienza (2002), Ahrendsen, Dixon and Luo (2003), Craig and Hardee (2007), Degryse, Masschelein and Mitchell (2006), Bonaccorsi Di Patti and Gobbi (2007), Francis, Hasan and Wang (2008) and Montoriol-Garriga (2008).

Most of the empirical studies on bank M&As, including our analysis in Chapter 3, have examined the impact of mergers by estimating the individual effects. In the context of post-merger prices, Prager and Hannan (1998), Corvoisier and Gropp (2001) and Focarelli and Panetta (2003) examine the relationship between a bank's deposit interest rate and M&As. They apply the panel data approach by including the merger dummy variable as an explanatory variable. Similarly, merger dummy variables are also incorporated into the models of Kahn, Pennacchi and Sopranzetti (2001), Sapienza (2002), Panetta, Schivardi and Shum (2004), Berger, Rosen and Udell (2007) and Montoriol-Garriga (2008), in order to analyse the impact of bank

10 Strahan and Weston (1998) find that when the merging parties are both small banks, the credit which the merged banks offer to small borrowers tends to be greater, whereas mergers between larger banks tend to have a negative influence on small business lending.

M&As on loan pricing behaviour. In addition, Erel (2005) and Montoriol-Garriga (2008) examine the effect of bank mergers on interest margins by using the panel data approach. In the context of credit availability, Bonaccorsi Di Patti and Gobbi (2007) examine the individual effect of estimators in describing the impact of bank M&As on the change in the amount of loans provided by Italian banks which have merged, while Montoriol-Garriga (2008) uses the same approach to examine the effect of bank mergers on credit availability in the Spanish banking market. In addition, merge dummy variables are incorporated into the models of Berger *et al.* (1998), Peek and Rosengren (1997), Sapienza (2002), Bonaccorisi Di Patti and Gobbi (2003), Hancock, Peek and Wilcox (2005), Berger, Rosen and Udell (2007), Marsch, Schmieder and Aerssen (2007) and Mercieca, Schaeck and Wolfe (2009), in order to analyse the impact of bank consolidations on credit availability for a specific group of borrowers, i.e. small businesses.

As in Chapter 3, we aim to examine the impact of bank M&As on bank lending behaviour. However, this chapter has a different perspective. We now focus on estimating the causal relationship across time and between groups, ignoring other effects of heterogeneity. This allows us to propose an alternative methodology to test whether banks involved in M&As show different pre- and post-merger lending behaviour and whether the post-merger lending behaviour of these banks is different from that of banks which have not merged. We apply a treatment effect estimation technique, named the Difference-in-Differences (DID) approach, to evaluate the impact of bank M&As on three areas of lending decisions, namely, loan interest rates, interest rate margins, i.e. the spread between a bank's interest earnings and expenses, and the availability of credit[11]. To the best of our knowledge, this is the first and only study to have applied the DID method in the context of bank merger effects.

Although there are other alternative estimation techniques which take account of the policy evaluation issue, such as propensity score matching (PSM) (see Cameron and Trivedi, 2005, p. 871-877 for details), the DID estimation suits our analysis for three main reasons. First, since our objective is to look at discrete changes over time, it is appropriate to use a method heterogeneity which analyses the different behaviours of merged and non-merging banks before and after mergers, and this analysis can be made using the DID methodology. Second, the alternative approach has its disadvantages. As suggested by Todd (2006, p.6), although the PSM is widely used as a tool of policy evaluation due to its simplicity – it does not require the functional form of the outcome equation to be specified – the success of a matching estimator depends on the availability of observable data to construct the conditioning variables. Unfortunately, it is not easy to include the correct and appropriate set of conditioning variables in the model predicting propensity scores. In addition, the outcomes of the treatment effects obtained from the PSM are very sensitive to the different specifications of the conditioning variables and this may make the PSM estimators unreliable. Finally, the DID is attractive because of its intuitive simplicity. It is possible to avoid the endogeneity problems associated with its parallel time trend assumption, which assumes that the time effect is identical for both the treatment and control groups. Specifically, this assumption offers the advantage that any unobserved time-invariant pre-treatment heterogeneity in these two groups is eliminated in the

11 In Chapter 3, we investigate the impact of bank M&As on loan interest rates by applying the panel data random effect estimation method. In this chapter, we also aim to examine the effects of mergers on loan pricing but with a different estimation approach. In addition, this chapter also considers the effects of mergers on bank interest margins and bank credit availability.

estimation. Although one might argue that this identifying assumption might not be satisfied , as Wooldridge suggests (2007, p.130), this shortcoming can be remedied by including other variables to control for unobserved and time-varying characteristics which could produce different trends in the outcomes of the control and treatment groups (see, for example, Alvarez and Lopez, 2008; and Skoufias, Unar and Gonzalez-Cossio, 2008). In addition, in order to ensure the robustness of our DID estimators, we run additional regressions with different explanatory variables for all three specifications. As is clearly shown, the results of the DID estimators are consistent, which confirms their validity. Therefore, its straightforwardness, its ability to provide an unbiased estimator, its potential to offer reliable results, as well as the weaknesses of the alternative approach, make the DID estimation technique an appropriate method for investigating the impacts of bank M&As on bank lending behaviour and it is therefore used in this analysis.

The rest of this chapter is organized as follows. Section 2 outlines the description of the DID approach, including its underlying assumptions. The empirical models are presented in Section 3. The data and methodology are presented in Section 4. This section also provides the specifications for the variables used in our regression models. Section 5 lists and discusses the results, and some conclusions are offered in the final section.

4.2 The Difference-in-Differences (DID) method

The Difference-in-Differences (DID) estimation technique was pioneered by the physician John Snow (1855) in his investigation of the cholera epidemics in London in the mid-nineteenth century (cited in Angrist and Pischke, 2009, p.227). Since then, the DID approach has been widely used; it is the most popular tool to evaluate the effects of treatments of interest on some relevant outcome variables in applied research in economics and other social sciences (Abadie, 2005, p.1). The main reasons for this wide acceptance are its simplicity and its power to avoid the problems of endogeneity, i.e. problems from the unobserved individual effects which arise when making comparisons between various individuals. Most of the economics research studies adopting the DID focus on the effects of interventions on employment and wages. The well-known papers in this context include the studies of Card (1990), which examine the effects of immigration on native wages and employment; that of Card and Krueger (1994), which assesses the employment effects of raising the minimum wage in New Jersey using a neighbouring state, Pennsylvania, as a control group; and that of Anderson and Meyer (2000), which examines the effect of the changes in the unemployment insurance payroll in the state of Washington on a number of outcomes. Other applications of the DID are, for example, the study by Meyer, Viscusi and Durbin (1995), which examines the impact of temporary disability benefits on time out of work after an injury; that of Hotz, Mullin and Sanders (1997), which estimates the effect of teenage pregnancy on the labour market outcomes of mothers; that of Garvey and Hanka (1999), which investigates the effect of anti-takeover laws on firms' leverages; the investigation by Alvarez and Lopez, (2008), which indicates the influence of trade liberalisation policy on firms' sizes and markups; and the work of Skoufias, Unar and Gonzalez-Cossio (2008), which examines the impact of cash transfers on household welfare.

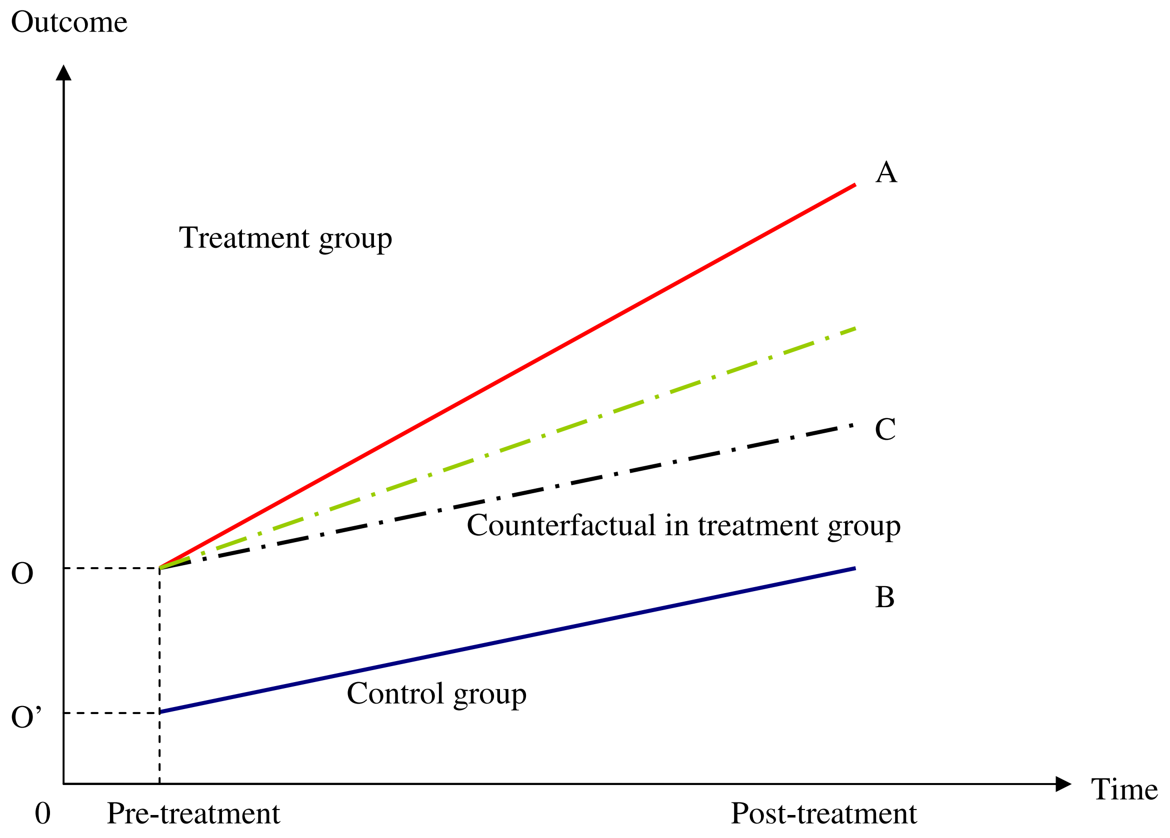
The basic concept behind the DID estimator is to model the impact of policy, called the treatment effect. This can be done by estimating the difference between outcomes measured at two time points for the observations of one group which was intervened by the policies, called the treatment group, and the observations of a group which is not affected by or which did not participate in the policies, called the control group, and then comparing the different outcomes of the two groups – hence the name of difference-in-differences given to this approach.

There are two assumptions with the DID approach. The first assumption is that there is no spillover effect from the treatment to the control group. This means that only the treatment group receives the treatment; the control group does not. The other assumption is the parallel time trend assumption, which states that the treatment and control groups are the same in every respect, apart from the treatment. Basically, the DID assumes away any unobserved time- and state-specific effects. That is, the unobserved differences between treatment and control groups are fixed over time and thus the outcome variables of the treatment and the control groups are assumed to have the same trend. In other words, the analyst must be comfortable in assuming that unmeasured factors, perhaps changes in economic conditions or other policy initiatives, affect both the participants and the non-participants in similar ways.

The treatment effects in the DID model are presented in Figure 4-1. The red line presents the trend of the outcome in the treatment group. The blue line presents the trend of the outcome in the control group and the black dashed line presents the counterfactual trend of the outcome in the treatment group. At the time before treatment, the outcome of the treatment group is equal to distance 0O and the outcome of the control group is equal to distance 0O'. The difference between these two outcomes comes from the unobserved effects, called normal difference. After treatment, the difference between the outcomes for the treatment and the control groups is changed. If post-treatment data are the only data used in the analysis, the estimated standard treatment effect is the distance AB. This estimate is based on the assumption that the only reason for observing a difference in outcomes between the treatment and control groups is the receipt of treatment. However, in the concept of the DID approach, the distance AB does not actually present the impact of treatment. In fact, the difference in the post-outcome, AB, is composed of two effects: the normal difference, which is the difference between the outcomes of the treatment and control groups, according to the unobserved effects, and this difference is fixed in line with the parallel time trend assumption; and the causal effect which is the difference according to the treatment. That is, the DID estimator will take the counterfactual normal difference between the treatment and control groups as the distance CB and estimate the treatment effect as the distance AC.

One of the points which should be addressed here is that the validity of the DID is based on the assumption that, in the absence of treatment, the trend in the outcomes is the same in both the treatment and the control groups. Treatment induces a deviation from this common trend. Although the treatment and control groups can differ, this difference is meant to be captured by the individual fixed effect. That is, in Figure 4-1 the distance OO' has to be equal to the distance CB. If they are different, for example if the trend is greater in the treatment group as shown by the green dashed line, the DID estimate, AC, would be an over-estimate of the treatment group. If there are only two periods, this assumption can never be tested. However, if there are more than two observations of the two groups, it becomes clear whether in other pre-treatment periods the assumption of a common trend seems to be satisfied.

Figure 4-1: A graphical representation of the effects in the DID model



For the DID notation, define $\overline{y}_t^g$ as the mean of outcome *y* in period $t = 0,1$ in group *g* $= T,C,$ when $t = 0$ denotes the pre-treatment period, $t = 1$ denotes the post-treatment period, $g = T$ denotes the treatment group and $g = C$ denotes the control group. The difference in means between the treatment and the control groups post-treatment as the estimate of the treatment effect is

$$\overline{y}_1^T - \overline{y}_1^C \tag{4-1}$$

Notation (4-1) is actually the distance AB in Figure 4-1. However, from the assumption that the treatment and control groups have no differences other than from the treatment and that any differences in the change in means between them is the result of the treatment, the treatment effect in Notation (4-1) has to be subtracted by the time-invariate normal difference ($\overline{y}_0^T - \overline{y}_0^C$), which is the distance CB in Figure 4-1. That is, the estimate of the treatment effect, which is the DID estimator, can be estimated as

$$\text{DID estimator} = (\overline{y}_1^T - \overline{y}_1^C) - (\overline{y}_0^T - \overline{y}_0^C) \tag{4-2}$$

For the regression approach, with the repeated cross section data (in which the individuals observed in the two periods are different, i.e. those in the pre-period who are in the treatment group are observed prior to treatment, but their outcomes after treatment are not observed) and with the panel data (in which the individuals observed in the post-treatment and pre-treatment periods are the same), the DID estimator can be attained by simply imposing a linear model where the group or time-specific effects enter only additively. The estimated linear equation is

$$y_{it} = \beta_0 + \beta_1 D_i + \beta_2 T_t + \delta(D_i \cdot T_t) + \varepsilon_{it} \tag{4-3}$$

where

i is an individual i, $i = 1,\ldots, N$.

$t = 0$ denotes the pre-treatment period and $t = 1$ denotes the post-treatment period.

y_{it} is the outcome for individual *i* in period *t.*

D_i is the treatment status index of individual *i.* This is a dummy variable taking value 1 if the individual is the treatment group and 0 if s/he is in the control group.

T_t is the time period index. The index T_t =1 indicates the post-treatment period and T_t = 0 indicates the pre-treatment period.

ε_{it} is a random error term to capture all unobserved factors for each unit in each time period.

$\beta_0, \beta_1, \beta_2$ and δ are the unknown parameter coefficients where β_0 is a constant term. β_1 interprets the treatment group specific effect accounting for the average permanent difference between the treatment and the control groups. In other words, this is the main effect of the treatment group in the pre-treatment period when T_t = 0. β_2 interprets the time trend of the treatment and the control groups. This coefficient presents the main effect of the post-treatment period for the control group when D_i = 0. δ is the DID estimate. This value presents the true effect of the treatment, because it is the coefficient on the interaction between D_i and T_t which is a dummy viable taking the value 1 only for the treatment group in the post-treatment period.

The estimate of δ in Equation (4-3) can be obtained from the typical estimating Equation (4-3) using the ordinary least squares (OLS) regression. The DID estimate is then the OLS estimate of δ , $\hat{\delta}$ and the standard errors used to form the confidence interval for $\hat{\delta}$ are usually the OLS standard errors. The estimator is unbiased because $E[\hat{\delta}] = \delta$. We can prove this by taking the expectation to Equation (4-2) and getting the estimate of δ as

$$E[\hat{\delta}] = (E[\overline{y}_1^T] - E[\overline{y}_1^C]) - (E[\overline{y}_0^T] - E[\overline{y}_0^C]) \tag{4-4}$$

By assuming that the error term in Equation (4-3) is on average zero, i.e. $E[\varepsilon_{it}] = 0$ and this error term is uncorrelated with other variables in the equation, i.e. $\mathrm{cov}(\varepsilon_{it}, D_i) = 0$, $\mathrm{cov}(\varepsilon_{it}, T_t) = 0$ and $\mathrm{cov}(\varepsilon_{it}, D_i \cdot T_t) = 0$

$$E[\overline{y}_1^T] = \beta_0 + \beta_1 + \beta_2 + \delta \qquad \text{, since } D_i = 1 \text{ and } T_t = 1 \tag{4-5}$$

$$E[\overline{y}_1^C] = \beta_0 + \beta_2 \qquad \text{, since } D_i = 0 \text{ and } T_t = 1 \tag{4-6}$$

$$E[\overline{y}_0^T] = \beta_0 + \beta_1 \qquad \text{, since } D_i = 1 \text{ and } T_t = 0 \tag{4-7}$$

$$E[\overline{y}_0^C] = \beta_0 \qquad \text{, since } D_i = 0 \text{ and } T_t = 0 \tag{4-8}$$

Therefore, the expected value of $\hat{\delta}$ is

$$\begin{aligned} E[\hat{\delta}] &= ((\beta_0 + \beta_1 + \beta_2 + \delta) - (\beta_0 + \beta_2)) - ((\beta_0 + \beta_1) - \beta_0) \\ &= \delta \end{aligned} \tag{4-9}$$

Alternatively, for the panel data, we can also examine the following model and use the differencing method to obtain the DID estimator. The model is

$$y_{it} = \alpha + \eta T_t + \tau D_{it} + c_i + \varepsilon_{it} \tag{4-10}$$

where

y_{it} is the outcome for individual *i* in period *t*.

T_t is the time period index. The index T_t =1 indicates the post-treatment period and $T_t = 0$ in the pre-treatment time period.

D_{it} is a dummy variable taking value 1 if the individual receives the treatment in the post-treatment period and 0 otherwise.

ε_{it} is a random error term to capture all unobserved factors for each unit in each time period.

c_i is an unobserved individual fixed effect.

α , η and τ are unknown coefficients where α is a constant, η is the effect of time on all individuals and τ is the treatment effect.

The DID estimator can be obtained by taking the differences between pre-treatment and post-treatment observations. The regression equation can be expressed as

$$(y_{i1} - y_{i0}) = (\alpha - \alpha) + \eta(T_1 - T_0) + \tau(D_{i1} - D_{i0}) + (c_i - c_i) + (\varepsilon_{i1} - \varepsilon_{i0}) \tag{4-11}$$

since in the post-treatment period, i.e. t = 1, the index T_t =1 and in the pre-treatment period, i.e. $t = 0$ the index $T_t = 0$

$$(y_{i1} - y_{i0}) = \eta + \tau(D_{i1} - D_{i0}) + (\varepsilon_{i1} - \varepsilon_{i0}) \tag{4-12}$$

or

$$\Delta y_i = \eta + \tau \Delta D_i + \Delta \varepsilon_i \tag{4-13}$$

By assuming that the change in treatment status is uncorrelated with changes in the idiosyncratic errors, ε_{it}, the OLS applied to Equation (4-13) is consistent. The leading case is when $D_{i0} = 0$. In other words when, for all *i,* there are no individuals exposed to the treatment in the pre-treatment period. Then the OLS estimator is

$$\hat{\tau} = (\overline{y}_1^T - \overline{y}_0^T) - (\overline{y}_1^C - \overline{y}_0^C) \tag{4-14}$$

Equation (4-14) is the DID estimate as in the pooled cross-sectional case, except for the notation that in this case we differentiate the means of the same units over time.

4.3 The empirical model

To the panel data relating to two time periods, one before and one after the merger, we can apply either Equation (4-3) or Equation (4-13) to examine the impact of bank M&As on bank lending behaviour. However, because using the differencing method will reduce the number of observations, the DID model in Equation (4-3) is preferred.

Define y_{ijt} as the interest outcome of bank *i* operating in country *j*, at period *t*.[12] The regression model can be presented as

$$y_{ijt} = \beta_0 + \beta_1 M_i + \beta_2 T_t + \delta(M_i \cdot T_t) + \lambda X_{ijt} + \varepsilon_{ijt} \tag{4-15}$$

12 In this chapter, the interest outcomes include the loan interest rate, credit availability and interest rate margin.

where

y_{ijt} is the outcome for bank *i* operating in country *j* in period *t.*

t = 1 presents the post-merger period and *t* = 0 presents the pre-merger period.

M_i is a merger dummy indicator which is 1 (unity) if bank *i* engages in M&As and 0 otherwise.

T_t is the time period dummy variable. T_t =1 if *t* = 1 and T_t = 0 if *t* = 0.

X_{ijt} is the time-varying variables which have an impact on the interest outcome, with *t* = 1 and *t* = 0. According to Wooldridge (2001, p.130), incorporating the additional covariates into the DID model can help with the assumption that the merged and non-merge banks have the same trend. This is because these additional factors will help in controlling the difference in outcomes from other effects besides the merger effect and other unobserved fixed effects which are already assumed to be included in the error term.

ε_{ijt} is a random error term.

Without other control variables, as in the basic DID model, the DID estimator, δ, which presents the merger effect, will equal

$$\delta = (\overline{y}_{t=1}^{Merge} - \overline{y}_{t=0}^{Merge}) - (\overline{y}_{t=1}^{Non-merge} - \overline{y}_{t=0}^{Non-merge}) \qquad (4\text{-}16)$$

where

$\overline{y}_{t=1}^{Merge}$, $\overline{y}_{t=0}^{Merge}$, $\overline{y}_{t=1}^{Non-merge}$ and $\overline{y}_{t=0}^{Non-merge}$ are the average outcomes of merging banks and non-merging banks when *t=0* and *t=1*, respectively.

In order to have proper control variables, X_{ijt} in Equation (4-15), we must identify which variables are relevant as determinants of each of the areas of bank behaviour by our banks of interest. As in Chapter 3, this chapter also adopts the Monti-Klein model of the banking firm to determine which control variables have an impact on bank lending behaviour. As mentioned in Chapter 3, bank loan pricing behaviour can also be explained by alternative theoretical models, such as Salop's location model. However, due to the power of the micro-model of the banking firm in explaining bank pricing behaviour, in particular, when the market is imperfectly competitive, and also because of the limitations of the alternative approaches, the Monti-Klein model is deemed a suitable model for determining the bank lending rate. In addition, the Monti-Klein model is a suitable model to identify the determinants of a bank's credit supply. This is because this theoretical model explains not only banks' price setting behaviours, but also their portfolio structures. In other words, the model proposes the optimal decision under which the equilibrium scales of the bank's loan supply and the level of loan interest rate are both endogenously determined. To maximise profit, the bank takes into consideration the effect of the volume of loans upon the determination of its corresponding rate (Garcia, 2006, p.6). Therefore, the factors influencing bank pricing behaviour could also have an impact on the availability of the bank's credit. The validity of the Monti-Klein model to explain the amount of credit a bank is granted can be seen from the empirical study of Tyrowicz (2006). This study employs the Monti-Klein model, which uses quantity of credits instead of price as a decision variable, to examine a Polish bank's credit supply behaviour and presents the significant results.

As suggested by Saunders and Schumacher (2000, p.815), Nym (2003, p.4) and Doliente (2005, p.54), besides the banking firm approach which is taken here, there is an alternative framework which may be used to study the determinants of bank interest margins. This framework is the dealership approach developed by Ho and Saunders (1981). The model estimates bank interest margins as a function of the competition and interest rate risk, with further extensions by a number of other researchers, such as Allen (1988), Angbazo (1997) and Maudos and Fernandez de Guevara (2004), for different sources and types of risk. The model views the bank as a dynamic dealer which sets interest rates on loans and deposits to balance the asymmetric arrival of loan demands and deposit supplies. The dealership approach has been the reference framework for most empirical studies of the determinants of bank margins. However, as stated by Zarruk (1989), since the model is intended for the analysis of the trading activities of security dealers, it thus fails to reflect some relevant aspects of the bank's operation (cited in Nys, 2003, p.6) and therefore it is not suitable for our analysis. In contrast, the Monti-Klein model is designed to explain both sides of the bank's balance sheet, which includes all the bank's main activities. It is a complete model in which the decision-making on deposits and loans is thoroughly explained and it can consider all the relevant characteristics of the bank's businesses. For these reasons, this chapter employs the Monti-Klein model, which is capable of explaining a bank's pricing behaviour, to determine the factors which influence the spread of bank interest rates.

According to Equation (3-6) in Chapter 3, a monopolistic bank is assumed to choose the volume of loans and deposits in order to maximise the following profit function

$$\pi = r_L(L)L - r_D(D)D - rIF - C(L,D) - r_p E\left[Max(o, \tilde{x} - R)\right] - \mu r_L(L)L \qquad (4\text{-}17)$$

subject to the reserve requirement condition

$$R = \alpha D \qquad (4\text{-}18)$$

and the balance sheet constraint

$$R + L = FI + D \qquad (4\text{-}19)$$

where

π is the bank's expected profit.

L and D are the levels of loan and deposit

and $r_L(L)$ and $r_D(D)$ are the inverse demand functions of loans and deposits, respectively. In other words, r_L and r_D are the loan and deposit interest rates which correspond to the optimal volume of loans and deposits, respectively.

R is the reserve requirement on the bank to maintain proportionally a fraction α of its total amount of deposit, when $0 < \alpha < 1$.

IF is the interbank financing of which the marginal cost is the same as the market interest rate, r.

C is the total intermediate cost.

$\tilde{x}$ is the random amount of deposit withdrawal. If this withdrawal happens to be higher than reserves, i.e. $R < \tilde{x}$, the bank will need to be refinanced at a penalty rate r_p.

μ is the default probability of loans, which measures default risk.

In order to maximise its profit, the monopolistic bank will choose its loan and deposit volumes such that

$$\frac{(1-\mu)r_L - r - c_L^{'} - r_p \Pr[\tilde{x} \geq R]}{(1-\mu)r_L} = \frac{1}{\varepsilon_L} \tag{4-20}$$

and

$$\frac{(1-\alpha)r - r_D - c_D' - r_p \Pr[\tilde{x} \geq R]}{r_D} = \frac{1}{\varepsilon_D} \tag{4-21}$$

where

c_L' and c_D' are the marginal cost of issuing loans and gathering deposits, respectively.

$\varepsilon_L = -\dfrac{r_L L'(r_L)}{L(r_L)} > 0$ is the elasticity of demand for loans.

$\varepsilon_D = \dfrac{r_D D'(r_D)}{D(r_D)} > 0$ is the elasticity of supply of deposits.

From Equation (4-20) and Equation (4-21), we can obtain the corresponding loan and deposit prices as

$$r_L{}^* = \frac{1}{(1-\mu)} \frac{r + c_L^{'} + r_p \Pr[\tilde{x} \geq R]}{1 - \dfrac{1}{\varepsilon_L}} \tag{4-22}$$

and

$$r_D* = \frac{(1-\alpha)r + c_D^{'} + r_p \Pr[\tilde{x} \geq R]}{1 + \frac{1}{\varepsilon_D}} \qquad (4\text{-}23)$$

Therefore, as we can see from the optimal condition, Equation (4-20), the bank chooses the volume of loans such that the Lerner index equals the inverse elasticity of demand for loans. This Lerner index is a measure of the net margin rate, that is, the price minus the cost, divided by the price. Therefore, the determinants of credit availability include the market interest rate, loan operating cost, default risk, liquidity risk, the elasticity of demand for loans and the deposit characteristic, as included in the reserve requirement condition, which is a fraction of the total amount of deposits. These factors are the same as the determinants of the optimal loan interest rate, as presented in Equation (4-22).

The control variables used in the regression model of interest margins are from the optimal conditions, Equation (4-22) and Equation (4-23). Because the interest rate margin is the difference between the loan and deposit interest rates, i.e. $m\arg in = r_L * - r_D *$, the bank's interest margin decision-making depends on the factors influencing these two prices. Therefore, the control variables used in the regression model for interest margins include the risk-free interest rate, intermediary cost, default risk, liquidity risk, the elasticity of demand for loans, the elasticity of supply of deposits and the deposit characteristics.

4.4 Data and variables

4.4.1 Data

The information used in this chapter is the same data set as that used in the previous chapter. That is, we employ for our analysis the data of the large commercial banks operating in the EU15 countries between 1997 and 2005. There are 106 banks in the observations. These include 67 non-merging banks and 39 banks which engaged in M&A activities. All of the M&A transactions considered in this study were completed during the study period. The samples used are the unbalanced panel data, which have different numbers of time observations for each bank.

In the context of the DID approach, the treatment group consists of the banks which engaged in M&As in the post-merger year but were not involved in M&As in the pre-merger year, while the control group consists of the banks which did not engage in M&As in either the pre- or the post-merger year. The pre- and post-merger outcomes of these two groups are to be compared. Therefore, we have to choose suitable pre- and post-merger periods. In order to do this, we look at the number of merging banks in each year. We see that if we consider the merger dummy variable by using the 3-year period criteria as in Chapter 3, the highest number we could obtain for our sample is 88 banks, comprising 67 non-merging banks and 21 merged banks[13]. According to King, Keohane and Verba (1994, p.143), with a small number of observations – not hundreds or thousands – it might be troublesome to distinguish our

13 This was the case when the pre-treatment period was 1997 and the post-treatment period was 2001 (or 2002, or 2003).

estimated zero treatment effect from a small but non-zero causal effect, and the most straightforward solution in this situation would be to increase the number of observations. Therefore, we consider an alternative merger dummy variable. Following Sapienza (2002), we use the accumulative merger dummy variable. This variable takes the value of 1 in all the calendar years after a merger, and zero otherwise. Therefore, with the constant number of non-merging banks, the post-merger year should be the year which has the highest accumulated number of banks engaging in M&As, whereas the pre-merger year should be the year which has the lowest accumulated number of participant banks. That is, the post-merger year should be the latest year in our analysis, namely 2005, while the pre-merger year should be the earliest year, 1997. By choosing 2005 as the post-merger year and 1997 as the pre-merger year, we can observe 104 banks altogether. Because only two banks in our sample merged in 1997, the treatment group includes 37 banks which were involved in M&As during the period 1998 to 2005 but not in 1997. The control group is thus the 67 banks which did not engage in M&A in either period.

4.4.2 Definitions and specifications of the variables

4.4.2.1 Dependent variables

The empirical model, Equation (4-15) is estimated for three lending behaviours: loan interest rate, interest margin, and credit availability. As in Chapter 3, the loan interest rate, $LOANR$, is the bank loan interest rate. This is an artificial interest rate which is computed by dividing a bank's interest revenue by its total amount of issued loans plus its total of other earning assets. The data of interest revenue, loans and other earning assets come from income statements and balance sheet data obtained from the BankScope database. We use this artificial interest rate following Kahn, Pennacchi and Sopranzetti (2001), who investigate the impact of bank consolidation on consumer loan rates in the US, and Valverde and Fernandez (2007), who examine the determinants of bank margins in European banking markets. This interest rate is used instead of the exact rates and is a proxy of the loan interest rates charged by banks, because the income statements of the banks do not distinguish between the interest revenues earned from loans and those earned from other earning assets.

The bank interest margin, *NIM*, is the bank's published net interest margin. This rate is reported in bank income statements obtained from the BankScope database. It is used as the proxy for the bank's interest margin, as is done in the studies of Demirguc-Kunt and Huizinga (1998) and Saunders and Schumacher (2000), who investigate the determinants of bank net interest margins and the work of Dolient (2005) which examines the impact of market or institutional imperfections on the behaviour of bank interest margins.

The bank credit availability, *LNLOAN*, is measured by the natural log of the bank total loans. This total loan volume is derived from the banks' balance sheet data obtained from the BankScope database. In this database, loans are sometimes categorised by type, for example mortgage loans, consumer loans and corporate loans, and sometimes by maturity, for example three-month loans, six-month loans and one-year loans. As in Bonaccorisi Di Patti and Gobbi (2007) and Marsch, Schmieder and Aerssen (2007), the logarithm value rather than the real value is applied in order to reduce the heteroskedasticity problem.

4.4.2.2 Explanatory variables

As explained above, the control variables considered in this chapter are determined on the basis of the Monti-Klein model of the banking firm. Most of the explanatory variables applied in this chapter are the same as those used in Chapter 3[14], excepting only the measures of loan demand elasticity and the merger dummy variable. In Chapter 3, the GDP growth rate is used as a proxy for the bank's loan demand elasticity. Unfortunately, given that 1997 is the earliest year in our sample - the pre-treatment year in our analysis - no data of the GDP growth rate for 1997 are available. Therefore, an alternative measurement is used in this chapter. Following Demirguc-Kunt and Huizinga (1998) and Focarelli and Panetta (2003), we consider the GDP per capita at nominal values, *GDPCAP*, as a proxy for the loan demand elasticity. This is the ratio which divides the value of the GDP by the country's population (in thousands) for the same year. The values of the GDP and the population total were obtained from the ECB (2002, p.65; and 2006, p.65). For the merger dummy variable, as previously stated, the larger the number of observations, the more reliable the analysis. Therefore, to increase the number of observations, we apply in this chapter a different merger dummy variable. Following Sapienza (2002), we use the accumulative merger dummy variable, *MDUMMY*, which has a value equal to 1 in all the calendar years after a merger, and otherwise is zero. The coefficient of this dummy shows the counterfactual of merger effects.

In addition, there is an additional control variable to those shown in Chapter 3: *EDEP*, the ratio of deposits to GDP, used as a control variable for the elasticity of supply for

14 The full specifications for these variables are provided in Chapter 3.

deposits in the interest margin regression. Because the price elasticity of the deposit supply depends on cyclical macroeconomic factors, the potential impact on the price elasticity of the economic cycle can be captured by including the GDP as an explanatory variable (Fuentes and Sastre, 1998, p.9). Although there are alternative measurements, such as the interest insensitivity in deposit accounts used in the study of Khawaja and Din (2007), determining the interest spread in Pakistan's banking industry, due to the limitations of the data which do not separate types of deposit account according to interest sensitivity, the total ratio of deposits to GDP, *EDEP*, is considered in this analysis as a proxy for the elasticity of supply for deposits. The data of aggregate deposits of each nation and the GDP were obtained from the ECB (2002, pp.57, 65; and 2006, pp.57, 65).

As in Chapter 3, following Ayadi and Pujals (2005), the ratio of deposits to total assets, *DEPTA*, is used to capture the bank deposit characteristics. Bank total deposit is transformed over the bank's total assets to remove the nominal variations which could result from the size differences among banks. The data of deposits and total assets are from balance sheet statements obtained from the BankScope database. The cost-to-income ratio, *COST*, is the reported cost-to-income-ratio taken from income statements. This ratio is used by several studies, for example, those of Corvoisier and Gropp (2001), Focarelli and Panetta (2003), Gambacorta (2004), Ayadi and Pujal (2005) and Altunbas and Ibanez (2008), to measure the marginal cost of issuing loans and also to control for the difference in bank efficiency and productivity. As in Chapter 3, the default risk could be indicated by the ratio of loan loss provision to net interest revenue, *LLOSS*, obtained from bank income statements. Although there is some debate about the appropriateness of using loan loss provision as a credit risk measure, since it is impossible to obtain information on NPLs in several European countries, the ratio of loan loss provision to net interest revenue, which is the figure most widely published in Europe (Altunbas and Ibanez, 2008, p.220), is applied in this chapter as a proxy for the bank's default risk. In addition, the validity of loan loss provision as a default risk measurement is confirmed by the studies of Ahmed (1999), Demirguc-Kunt and Huizinga (1998), Fisher, Gueyie and Ortiz (2000), Ismail and Lay (2002), Nys (2003), Ayadi and Pujal (2005) and Altunbas and Ibanez (2008). Following Nys (2003) and Mercieca, Schaeck and Wolfe (2009), the ratio of net loan to total deposit and short-term borrowing, *NLD*, is used to measure a bank's liquidity risk. This ratio is reported in the bank income statements obtained from the BankScope database. It shows the extent to which a bank is dependent on volatile liabilities. The higher ratio indicates higher dependency and the high risk of suffering from unexpected deposit withdrawal, or, in other words, high liquidity risk. The three-month inter-bank interest rate, *SHRT3*, is considered a measurement for the market interest rate. It is an annual average amount quoted as a percentage, obtained from the Eurostat database. This three-month rate is the interest rate applied between banks with an original maturity of three months. The same three-month inter-bank interest rate is also used in the studies of Nys (2003), Panetta, Schivardi and Shum (2004) and Banal-Estonol and Ottaviani (2007) to capture a substitution effect, that is, substituting marketable assets for loans. The market structure is proxied by the five-firm concentration ratio, *CR5*. This ratio was obtained from the studies of the ECB (2002, p.54; and 2006, p.54). It is the sum of the market shares, in terms of total assets, of the five largest banks in a national market. We use this ratio following the reasoning by Moschandreas (2000, p.14), who suggests that the five firm concentration ratio is commonly used to investigate bank market competition in the

UK, and by other studies examining the European banking market structure such as those by Fernandez de Guevara, Maudos and Perez (2005), Groeneveld and Boonstra (2005), Baert and Vander Vennet (2009) and Casu and Girardone (2005, 2009). In addition, as suggested by Sapienza (2002, p. 345), there could be a relationship between the merger effect and market competition. Therefore, the interaction term for these two variables, *MCR5*, is also included as a proxy for this correlation.

Moreover, concerning the DID method, we have to consider the time effect. This effect can be controlled by the dummy variable, *YDUMMY*. This is the post-merger index, which is the binary index equalling 1 if the year is the post-merger period, and zero otherwise. The coefficient of this variable presents the time trend effect, in the absence of M&As. Finally, the DID effect of bank M&As is examined by the dummy variable, *DID*. This is the M&As effect, which equals 1 if a bank engages in M&As in the post-merger year, and zero otherwise. Its coefficient presents the true effects of bank mergers, comparing pre- and post-merger behaviour and between merged and non-merged banks.

4.4.2.3 Checking for robustness

To the best of our knowledge, this is the first and only study to have applied DID methodology to investigate the impact of bank M&As on bank lending behaviour. In order to ensure the robustness of our DID estimates, we run different regressions for all three dependent variables. In the DID approach, the effect of the difference between the outcomes of merged and non-merging banks is the merger effect alone; in other words, this model ignores other individual fixed effects which capture unobserved heterogeneity. Therefore, the chosen variables to assess the robustness included in each model are time-variant variables or interaction terms. The variables used for our robustness check are not chosen arbitrarily, but follow the evidence in past studies. A different measurement for loan demand elasticity is applied. As in Focarelli and Panetta (2003, p. 1163), the rate of inflation, *CPI*, is included in the model. This rate is the annual average inflation rate obtained from Eurostat (2009, p.108-109). In addition, as suggested by Maudos and Fernandez de Guevara (2004), BIS (2009, p.1) and Breuer *et al.* (2008, p.20), since credit risk and market risk are correlated, the interaction term for these two variables, *LLOSS*SHRT3,* could be incorporated into the models.

The descriptions of the variables and their sample means for group of merged banks and non-merging bank group and for both pre- and post treatment periods are shown in Table 4-1 and Table 4-2 respectively.

Table 4-1: Description of the variables

Variables	Symbols	Descriptions	Sources
Dependent variables	*LOANR*	The average loan interest rate, as a percentage value, calculated by dividing a bank's interest revenue by the total amount of loans plus the total amount of other earning assets	Author's own calculation. Values of interest revenue, loans and other earning assets are obtained from the BankScope database
	NIM	Net interest margins as a percentage value	BankScope database
	LNLOAN	The natural log of bank total loans	Author's own calculation. Loan volumes are obtained from BankScope database
Explanatory variables	*DEPTA*	Total deposits to total asset ratio	Author's own calculation. Deposit and total assets are obtained from the BankScope database
	COST	Cost-to-income ratio	BankScope database
	LLOSS	Loan loss provision to net interest revenue	BankScope database
	NLD	Net loan to total deposit and short-term borrowing ratio	BankScope database
	SHRT3	Annual average 3-month interbank rate in percentage amount	Eurostat database
	GDPCAP	GDP per 1,000 populations	Author's own calculation. Values of GDP and the number of population are obtained from ECB (2002, p.65; and 2006, p.65)

Table 4-1: Description of the variables (*continued*).

Variables	Symbols	Descriptions	Sources
Explanatory variables	*CR5*	Five-firm concentration ratio in terms of bank's total assets	ECB (2002, p.54; and 2006, p.54)
	EDEP	Deposit to GDP ratio	Author's own calculation. Values of aggregate deposit and the GDP are obtained from the ECB (2002, p.57, 65; and 2006, p.57, 65).
	CPI	Annual average inflation rate obtained as a percentage amount	Eurostat (2009, p.108-109).
	MCR5	Interaction term for mergers dummy variable and bank's market concentration	Author's own calculation
	LLOSS SHRT3*	Interaction term for credit risk and market risk	Author's own calculation
	YDUMMY	Post-merger index equals 1 if year is the post-merger period, and zero otherwise	
	MDUMMY	Merger dummy index equals 1 in the whole calendar year after a merger, and zero otherwise	
	DID	DID estimator equals 1 in the post-merger year if banks engage in mergers, and zero otherwise	

Table 4-2: The sample means of variables: 1997 as the pre-merger period and 2005 as the post-merger period.

Variables	1997		2005	
	Non-merging banks	Merged banks	Non-merging banks	Merged banks
LOANR (%)	6.637725	8.260833	4.055096	3.908512
NIM (%)	2.000833	2.039972	2.605294	1.502559
LNLOAN	9.01774	10.08268	10.13371	11.0886
DEPTA	.7617908	.7449746	.6647148	.692665
COST	62.78	67.73242	54.95471	62.64212
LLOSS	15.91152	20.95515	12.79941	12.79727
NLD	62.27394	58.10061	67.83618	63.51212
SHRT3 (%)	4.933333	6.412121	.7	.3457576
GDPCAP	19.56418	18.31617	26.79879	25.99169
CR5	38.83607	44.70328	38.4878	43.34146
EDEP	.049866	.2278254	.102824	.3929318
CPI %)	1.886473	2.12647	2.184721	2.363761
MCR5	0	0	38.4878	43.34146
*LLOSS*SHRT3*	70.6297	132.9646	8.3818	5.915318
YDUMMY	0	0	1	1
MDUMMY	0	1	0	1
DID	0	0	0	1

Source: BankScope (Bureau Van Dijk) and own elaboration.

4.5 Empirical results

4.5.1 The impacts of bank M&As on loan interest rate

Table 4-3 presents the results of the DID estimator for the effects of bank M&As on bank loan pricing behaviour, when their associated standard errors and t-statistics appear under coefficient estimates between round brackets and square brackets respectively.

The merger effect, shown by the coefficients of the *DID* variable in specification (1), is negative and statistically significant at a 5% significance level. Without other control variables, the DID estimator equals the difference between the average means of the merging banks minus the difference between the average means of the non-participating banks. That is, -1.76969 = (3.908512-8.260833) - (4.055096-6.637725). This result is consistent with the main finding in Chapter 3, which suggests that banks engaging in M&A activities tend to set their lending rate lower than that of non-merging banks.

In addition, the negative relationship also supports the findings by Kahn, Pennacchi and Sopranzetti (2001) that mergers have a strong and positive influence on the US automobile loan rate; by Sapienza (2002), who reports lower loan interest rates in M&As in the Italian banking market; and by Montoriol-Garriga (2008), who shows that interest rates charged by consolidated banks in the Spanish banking market decrease after mergers. In contrast, this result contradicts the findings of Calomiris and Pornrojnangkool (2005), who analyse the effect of the merger between Fleet and

BankBoston on small business lending and Ashton and Pham (2007), who empirically study the effects of bank M&As in the UK retail banking market: both sets of findings indicate that bank consolidations have a significant negative impact on loan interest rates. As suggested by Ashton and Pham (2007, p. 22), the effects of bank M&As are mixed as the result of many factors, in particular, the differences in the market structure of the banking market in question.

Moreover, the analysis also shows that, before merging, the merged bank group sets its loan interest rate 1.62% higher than that of the non-merging bank group. This is shown by the positive and statistically significant coefficient of the merger index. In addition, in the absence of M&As, banks tend to set their loan price 2.58% lower as time passes. This is suggested by the negative and statistically significant coefficient of the year dummy variable. All the effects can be observed in Figure 4-2. The pink dashed line presents the counterfactual of the treatment group, which is the normal difference occurring from the unobserved effects. The distance between point B on this line and point C on the blue line presents the real impact of bank M&As, which equals 1.76%.

With other control variables, the coefficient of the *DID* variable in specification (2) also appears statistically significant and negative at a 10% significance level. In addition, as expected, the coefficients of *COST* and *SHRT3* appear statistically significant and positive at a 10% significance level. These positive signs suggest that, as the cost of issuing loans and market risk rises, merged banks tend to cover their expected loss and maintain their revenue positions by increasing their loan prices. The higher loan rates will reduce loan demand and thus reduce these intermediary costs and risks.

Although market concentration has no effect on a bank's decision-making with regard to loan pricing, the interaction term *MCR5* has a negative and statistically significant coefficient within a 5% significance level. This result suggests that, if mergers have a substantial effect on the increase in market concentration, merged banks can gain in efficiency from M&As, for example from efficiencies of cost and profit, and can pass their gains on to consumers by reducing the price of loans. However, these results are different from the suggestion of Montoriol-Garriga (2008, p.24) that, although merged banks tend to charge lower loan prices, there is also a small decline in the loan rate when the concentration in the local banking market significantly increases. As noted above, these dissimilar results are derived from the differences in the data under consideration.

GDPCAP has negative and statistically significance at a 1% significance level. This negative correlation can be explained by the fact that as the GDP reflects the overall level of development of the banking sector, the higher the GDP, the better developed the banking sector. According to Demirguc-Kunt and Huizinga (1998), banks operating in a developed banking industry can gain in efficiency and can pass this gain on to their customers in term of a reduced loan interest rate.

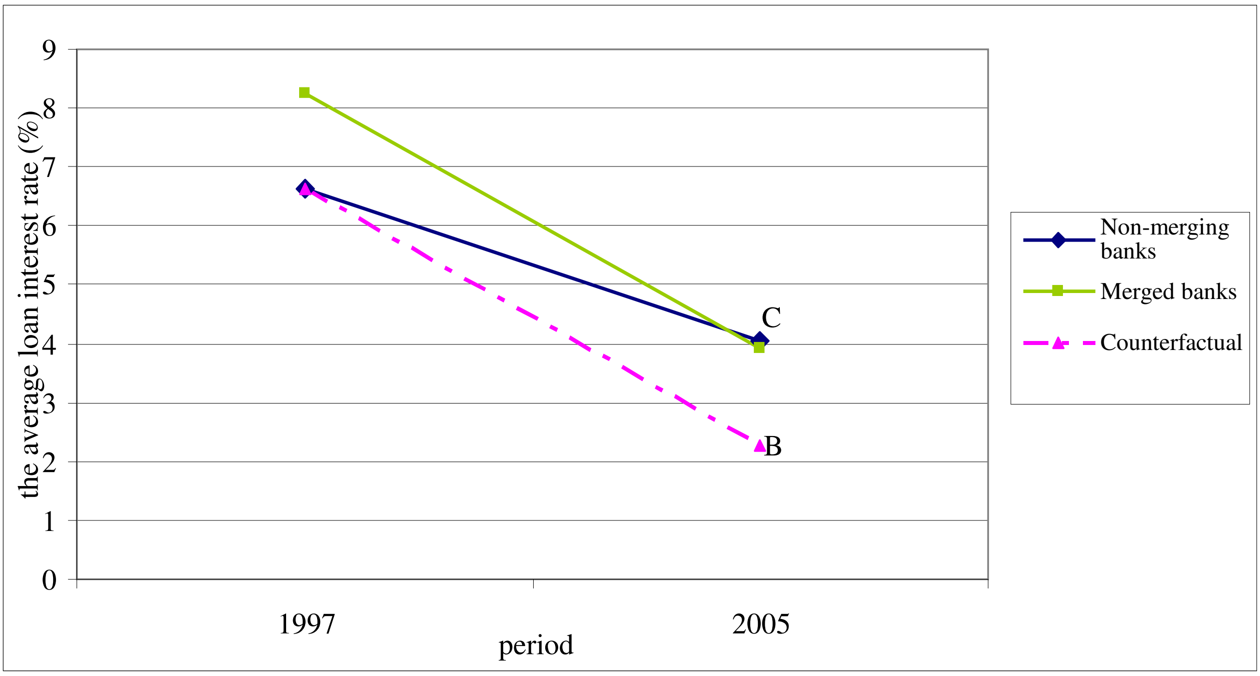
For the robustness check, as we can see from the results in specifications (3) to (5), the coefficients of the *DID* variables are all negative and statistically significant at a 10% significance level. The consistency of the DID estimator suggests that the DID approach can provide reliable explanations and can therefore be a suitable method to use in examining the impact of bank mergers on bank loan pricing behaviour. Although some of the coefficients of other control variables are insignificant and/or different from those in Chapter 3, this may have resulted from the difference in the time period under review. While this chapter focuses on only two periods, in Chapter 3 all the study periods are considered. In addition, as suggested by the results in Table 3-6, most of the year dummies are statistically significant. This means that the time effects are significant. Thus, the studies of different time periods can provide different results.

Table 4-3: Bank M&As and loan interest rate.

LOANR	(1)	(2)	(3)	(4)	(5)
YDUMMY	-2.58263***	-1.177201*	-2.378321**	-1.170011*	-2.359662**
	(.5810766)	(.6558499)	(.83663)	(.6647184)	(.8458626)
	[-4.44]	[-1.79]	[-2.84]	[-1.76]	[-2.79]
MDUMMY	1.623107***	1.984232**	3.04426***	1.991166**	3.061187***
	(.5853969)	(.8361329)	(.889071)	(.844089)	(.8971925)
	[2.77]	[2.37]	[3.42]	[2.36]	[3.41]
DID	-1.76969**	-1.35125*	-1.45417*	-1.358554*	-1.473044*
	(.824827)	(.7488919)	(.8229481)	(.757558)	(.8323612)
	[-2.15]	[-1.80]	[-1.77]	[-1.79]	[-1.77]
COST		.0273829*	.0041001	.0273402*	.0040131
		(.0144108)	(.0149351)	(.0144803)	(.0150022)
		[1.90]	[0.27]	[1.89]	[0.27]
LLOSS		.0092937	.0012363	.010676	.0048036
		(.0125993)	(.0138025)	(.0214781)	(.0235412)
		[0.74]	[0.09]	[0.50]	[0.20]
NLD		.0047691	.0104827	.0049355	.0109076
		(.0100675)	(.0109936)	(.0103228)	(.0112681)
		[0.47]	[0.95]	[0.48]	[0.97]
DEPTA		-1.206298	-.6867587	-1.207065	-.6899452
		(1.519611)	(1.684422)	(1.52592)	(1.691264)
		[-0.79]	[-0.41]	[-0.79]	[-0.41]
SHRT3		.1691586*	.10674	.1743328	.1199743
		(.0869737)	(.119457)	(.1088487)	(.1391724)
		[1.94]	[0.89]	[1.60]	[0.86]
CR5		-.0177784	.0234285	-.0176779	.0236466
		(.0154729)	(.0143244)	(.015588)	(.0144288)
		[-1.15]	[1.64]	[-1.13]	[1.64]
		-.03544**	-.0442031**	-.0354344**	-.0441813**
MCR5		(.016077)	(.017527)	(.0161436)	(.0175977)
		[-2.20]	[-2.52]	[-2.19]	[-2.51]
GDPCAP		-1.26383***		-1.263396***	
		(.2386616)		(.2397096)	
		[-5.30]		[5.27]	
CPI			.5312249*		.5313897 *
			(.2968177)		.(2980095)
			[1.79]		[1.78]
*LLOSS*SHRT3*				-.0003254	-.0008387
				(.0040859)	(.0044741)
				[-0.08]	[-0.19]
CONS	6.637725***	22.85275***	5.023368**	22.83106***	4.983553**
	(6.637725)	(3.794607)	(1.811195)	(3.820013)	(1.830821)
	[16.04]	[6.02]	[2.77]	[5.98]	[2.72]
R^2	0.3780	0.5510	0.4621	0.5510	0.4613
Observations	184	182	182	182	182

*** 1% significance level
** 5% significance level
* 10% significance level

Figure 4-2: The effects of bank M&As on loan interest rates in the DID model.



4.5.2 The impacts of bank M&As on bank margin

The results of the DID estimators of the effects of mergers on the bank interest rate margin are presented in Table 4-4. From Table 4-2, we see that, as time passes, merged banks tend to have a lower margin, equal to 1.10%. However, this reduction does not show the real impact of consolidation. The merger effect can be observed in Figure 4-2. Without other control variables, in the absence of M&As, banks tend to increase their interest margin, although this increase is very small, at only 0.039%. This time effect is shown by the trend of the average interest margin of non-merging banks (the blue line). In the pre-merger period, the merged banks have a 0.60% higher interest margin than the control banks. In the DID approach, this difference is called the counterfactual and is assumed to be fixed over time. The pink dashed line presents the counterfactual trend. The distance between point B on this line and point C on the blue line shows the real merger effect, which states that banks engaging in M&As tend to set a lower interest margin. In Table 4-4, this merger effect is represented by the coefficient of the *DID*. This DID estimator is actually the difference between the average means of the merged banks minus the difference between the average means of the non-merging banks. That is, -1.14187 = (1.50256-2.03997) - (2.60529-2.00083). This negative relationship between bank M&As and interest margins is consistent with the findings of Evernett (2003) and Erel (2005), who find that mergers reduce loan spreads and this reduction being greater for banks with a larger reduction of post-merger operating costs. However, this result is inconsistent with the results of Calomiris and Pornrojnangkool (2005), who report that the lower pre-merger interest margins disappeared after mergers.

With other control variables, the coefficient of the *DID* in specification (2) is also negative and statistically significant at a 1% significance level. As with the results in the previous section, market risk has a positive and statistically significant coefficient within a 1% significance level. In addition, the coefficient of the credit risk variable, *LLOSS*, is also positive and statistically significant at a 10 % significance level. This means that when banks expect a higher default risk and market risk, they will increase their interest rate margins in order to maintain their profit position. The positive relationship of market risk and interest margins is consistent with the finding of Angbazo (1997), that banks exposed to the risk of a higher interest rate will set larger intermediation margins; and of Maudos and Fernandez de Guevara (2004), that the higher volatility of market interest rates has a significant impact on the increase in interest margins, although the effect is very small. In addition, consistent with the results in the previous section, the coefficient of *GDPCAP* is negative and statistically significant at a 1% significance level. As explained above, this can occur when the development of the banking sector increases, reflecting the higher GDP rate, because banks operating in this developed industry can gain in efficiency and can pass the benefits on to their clients in terms of a reduction in their interest margins.

Again, when we check the robustness of our DID estimator, we can see that, as we include other control variables in the DID regression model presented in specification (3) to (5), the coefficients of the DID variables are all negative and statistically significant at a 1% significance level. From this empirical consistency of the estimated effects, we can confirm that the DID approach performs well in examining the impacts of bank consolidations on the behaviour of bank interest margins, and can be used as an alternative estimation approach in this context.

Table 4-4: Bank M&As and bank interest margins.

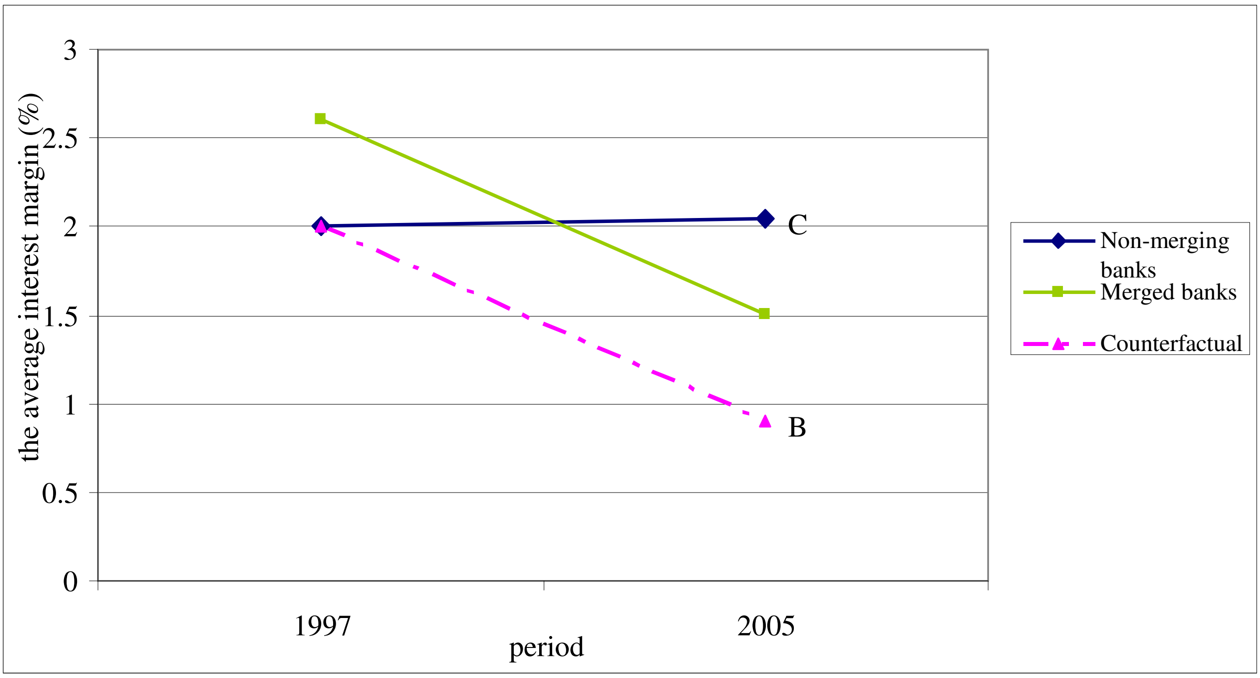
NIM	(1)	(2)	(3)	(4)	(5)
YDUMMY	.0391389	.9031695***	.7695523**	.9347769***	.8428703**
	(.2799518)	(.3299131)	(.3721907)	(.3307197)	(.3747466)
	[0.14]	[2.74]	[2.07]	[2.83]	[2.25]
MDUMMY	.6044608**	.7841515**	.7969108**	.8082065**	.9879309**
	(.2840389)	(.386512)	(.3870669)	(.3866547)	(.3890886)
	[2.13]	[2.03]	[2.06]	[2.09]	[2.54]
DID	-1.141874***	-.9884293***	-.993561***	-1.031443***	-.9983262***
	(.4016917)	(.3840226)	(.3758209)	(.3854665)	(.3805538)
	[-2.84]	[-2.57]	[-2.64]	[-2.68]	[-2.62]
COST		.0023662	.0105036	.0023263	.0074925
		(.0069149)	(.0063721)	(.0069071)	(.0066458)
		[0.34]	[1.65]	[0.34]	[1.13]
LLOSS		.0122488*	.0122752*	.0023736	.0009997
		(.0063985)	(.0062491)	(.0108287)	(.0106264)
		[1.91]	[1.96]	[0.22]	[0.09]
NLD		-.0034174	.0087499*	-.003605	-.0025138
		(.0029084)	(.0050678)	(.0029098)	(.0021766)
		[-1.18]	[1.73]	[-1.24]	[-1.15]
DEPTA		-.5811755	.5004278	-.6174164	-.5519451
		(.9419626)	(.7460197)	(.9414271)	(.9746838)
		[-0.62]	[0.67]	[-0.66]	[-0.57]
SHRT3		.1256332***	.1416966***	.164523***	.1691461***
		(.0450809)	(.0524008)	(.0566807)	(.0613585)
		[2.79]	[2.70]	[2.90]	[2.76]
CR5		.0050256	.0024679	.0054625	.00693
		(.0063061)	(.0062017)	(.0063107)	(.006311)
		[0.80]	[0.40]	[0.87]	[1.10]
		-.0115686	-.0055137	-.0109029	-.0087094
MCR5		(.0082498)	(.007877)	(.0082614)	(.0079727)
		[-1.40]	[-0.70]	[-1.32]	[-1.09]
GDPCAP		-.048848***		-.0463377**	
		(.0179042)		(.0180212)	
		[-2.73]		[-2.57]	
EDEP		-.1973787	-.0687408	-.2015753	-.1220724
		(.2710526)	(.2706996)	(.2707667)	(.2725361)
		[-0.73]	[-0.25]	[-0.74]	[-0.45]
CPI			.0644226		-.0087094
			(.1334644)		(.0079727)
			[0.48]		[-1.09]
*LLOSS*SHRT3*				-.0023133	-.0025887
				(.0020477)	(.0020121)
				[-1.13]	[-1.29]
CONS	2.000833***	3.024116***	1.921463*	2.811042**	2.959583***
	(.1979558)	(1.136868)	(.9963877)	(1.151119)	(.9453346)
	[10.11]	[2.66]	[1.93]	[2.44]	[3.13]
R^2	0.0976	0.3036	0.3261	0.3110	0.3255
Observations	184	178	178	178	178

*** 1% significance level

** 5% significance level

* 10% significance level

Figure 4-3: The effects of bank M&As on bank interest margins in the DID model.



4.5.3 The impacts of bank M&As on credit availability

Table 4-5 presents the results of the DID estimator for the effects of bank M&As on credit availability. The results show that the DID estimators in every specification are insignificant. As suggested by Ashenfelter and Card (1984, p.23), the size of the DID estimators depends on two critical factors: the assumption about the time period and the assumption about the presence or absence of choice variables. Therefore, the insignificance of our DID estimators may be the result of the violation of the parallel time trend, in that the trends of both the control and the treatment groups are not fixed over time, and/or due to the fact that there are some missing control variables which should be included in the model to control for the time effect.

Table 4-5: Bank M&As and credit availability.

LNLOAN	(1)	(2)
YDUMMY	1.10841***	.4473916
	(.3344184)	(.4388727)
	[3.31]	[1.02]
MDUMMY	1.121812***	.9984029*
	(.3393007)	(.5509599)
	[3.31]	[1.81]
DID	-.0873157	-.4327037
	(.4798437)	(.5099914)
	[-0.18]	[-0.85]
COST		.0148223
		(.0093366)
		[1.59]
LLOSS		.0062089
		(.0084517)
		[0.73]
NLD		.0022953
		(.0069385)
		[0.33]
DEPTA		.1486146
		(1.012277)
		[0.15]
SHRT3		-.1401658**
		(.0616289)
		[-2.27]
CR5		.0045165
		(.0084764)
		[0.53]
MCR5		.005384
		(.0107605)
		[0.50]
GDPCAP		.0269123
		(.023097)
		[1.17]
CONS	8.999162***	7.718341***
	(.2364695)	(1.346442)
	[38.06]	[5.73]
R^2	0.2272	0.2885
Observations	184	182

*** 1% significance level
** 5% significance level
* 10% significance level

Since finding data on an unobserved effect is impossible, to satisfy the parallel time trend assumption we need to consider different pre- and post-merger periods. As suggested by Ashenfelter and Card (1984, p.10), while the DID estimator is available for the long span of treatment data, the underlying assumption of this estimator is clearly violated. This means that the DID estimators are more reliable when comparing the policy change just before and just after an intervention. This is because the identifying assumption that the counterfactual difference is fixed is more likely to hold over a short time window than a long one, and, moreover, with a long time window, other things are likely to occur which confound the effect of the treatment change. Because too few observations can lead to incorrect outcomes (King, Keohane and Verba, 1994, p.143), we choose the periods which provide the greatest number of observations. Assuming 2001 as the pre-merger period and 2002 as the post-merger period, we can observe 81 banks in total. These include 14 banks engaging in M&As in 2001 but not in 2002; thus 67 banks are in the non-merging bank group.

In addition, as mentioned by Ashenfelter and Card (1984, p.23), besides the assumption about the timing, the assumption about the control variables is also a critical influence on the size of the DID estimator. As we can see from the results in specification (2) in Table 4-5, although the control variables are included in the model, the coefficient of the *DID* remains insignificant. This shows that there may be other control variables which should be considered. As suggested by Furlong (1992), Gambercota and Mistrulli (2003), and Jacques (2008),[15] bank capital position has an

---

15 The first two studies present empirical analyses, while the third formulates a theoretical model.

important influence on bank credit supply[16]. Of most concern in this issue is the capital adequacy requirement, which is a bank regulation controlling the way in which banks must handle their capital. Therefore, following Furlong (1992), we include the capital-to-asset ratio, *CAPTA*, in our regression model. This ratio is from the income statement data obtained from the BankScope database. In addition, in order to check the robustness of the DID estimators, the inflation rate and the interaction between market risk and credit risk are also included in the model.

The sample means of the variables for both treatment and control groups, and for both pre- and post treatment periods are presented in Table 4-6.

16 The commonly used frameworks introduced by the Basel Committee on Banking Supervision housed at the Bank for International Settlements (BIS) are known as the Basel Accord.

Table 4-6: The sample means of the variables: 2001 as the pre-merger period and 2002 as the post-merger period.

Variables	2001		2002	
	Non-merging banks	Merged banks	Non-merging banks	Merged banks
LNLOAN	9.553028	10.75028	9.971623	10.47789
DEPTA	.7284783	.7040909	.7306667	.716087
COST	61.9037	64.05	63.97711	69.94
LLOSS	14.56804	23.19864	16.84978	26.55435
NLD	65.7337	63.54454	66.87578	64.54652
SHRT3 (%)	1.163043	0.4581818	.9624444	.3530435
GDPCAP	24.88259	22.14733	25.64776	23.17613
CR5	44.63913	37.5	42.85333	40.18261
CPI %)	2.545217	2.673636	2.413333	2.594783
CAPTA	5.581522	6.578182	5.709333	5.953913
MCR5	0	37.5	0	40.18261
*LLOSS*SHRT3*	10.9981	11.00095	12.55601	9.147356
YDUMMY	0	0	1	1
MDUMMY	0	1	0	1
DID	0	0	0	1

Source: BankScope (Bureau Van Dijk) and own elaboration.

As presented in Table 4-7, the DID estimators are all negative and statistically significant at a 5% significance level when the control variables are included in the model. The negative and statistically significant coefficients suggest that banks engaging in M&A activities tend to reduce the availability of their credit. This result is consistent with the findings of Sapienza (2002), who investigates the impacts of M&As in the Italian banking market and finds that, upon merging, banks tend to reduce their credit to small borrowers. Using US banking data, Francis, Hasan and Wang (2008) claim that less credit is available to new business formations from merged banks. In the Spanish banking market, Montoriol-Garriga (2008) finds that target banks increase the likelihood of terminating a lending relationship and provide less credit to their small clients. In contrast, the results of Avery and Samolyk (2004) suggest that bank consolidation involving mergers between smaller banks tends to provide greater loans for small businesses in local banking markets. Moreover, Berger *et al.* (1998), Berger *et al.* (2004), Erel (2005), Berger, Rosen and Udell (2007), Marsch, Schmieder and Aerssen (2007) and Mercieca, Schaeck and Wolfe (2009) find few or insignificant effects from bank mergers on the availability of credit to small businesses. The insignificant results may result from the fact that, although merged banks lower their credit availability, this reduction may be offset by the increase in loan volumes from non-merging banks, as supported by empirical evidence from Berger *et al.* (1998) and Berger *et al*. (2004). These writers show that while consolidated banks tend to lower their credit, there is a significant increase in the volume of loans from non-merging banks; Craig and Hardee (2007) also show that, although larger banks are found to lower the probability that small businesses will obtain credit, non-bank institutions are found to make up for this effect.

Table 4-7: Bank M&As and credit availability: 2001 as the pre-merger period and 2002 as the post-merger period.

LNLOAN	(1)	(2)	(3)	(4)	(5)
YDUMMY	.4185947	.5415426**	.5301971**	.5571512**	.5493763**
	(.3151524)	(.2494295)	(.2480517)	(.2463955)	(.2453095)
	[1.33]	[2.17]	[2.14]	[2.26]	[2.24]
MDUMMY	1.197251***	2.364348***	2.483996***	2.345374***	2.431751***
	(.3896272)	(.5564028)	(.5696667)	(.5494488)	(.5635458)
	[3.07]	[4.25]	[4.36]	[4.27]	[4.32]
DID	-.6909807	-.8874782**	-.8870494**	-.9340872**	-.9327027**
	(.5479464)	(.4305642)	(.4296911)	(.4257346)	(.425232)
	[-1.26]	[-2.06]	[-2.06]	[-2.19]	[-2.19]
COST		-.0115604*	-.012028*	-.0087929	-.0092141
		(.0067257)	(.0067445)	.(0067776)	(.0068132)
		[-1.72]	[-1.78]	[-1.30]	[-1.35]
LLOSS		-.0009763	-.0016551	.007182	.0064736
		(.0083545)	(.0083926)	(.0091656)	(.0092449)
		[-0.12]	[-0.20]	[0.78]	[0.70]
NLD		.0081444	.008636	.0076187	.0079428
		(.007059)	(.0069518)	(.0069745)	(.0068784)
		[1.15]	[1.24]	[1.09]	[1.15]
DEPTA		2.662158***	2.575797***	2.63824***	2.586953***
		(.8269201)	(.779455)	(.8165524)	(.7702632)
		[3.22]	[3.30]	[3.23]	[3.36]
SHRT3		.154266**	.135288**	.2965955***	.2801999***
		(.0657668)	(.0644852)	(.0952654)	(.0967667)
		[2.35]	[2.10]	[3.11]	[2.90]
CR5		.0146483**	.01763**	.0151219**	.0173251**
		(.0072451)	(.0082787)	(.0071573)	(.0081823)
		[2.02]	[2.13]	[2.11]	[2.12]
MCR5		-.0176911	-.0198542*	-.0172097	-.0187915*
		(.0108146)	(.011095)	(.0106805)	(.0109769)
		[-1.64]	[-1.79]	[-1.61]	[-1.71]
GDPCAP		-.0036816		-.0018357	
		(.0190705)		(.0188512)	
		[-0.19]		[-0.10]	
CAPTA		.3153466***	.3144583***	.2824534***	.2828614***
		(.0401412)	(.0395045)	(.0427827)	(.0421433)
		[7.86]	[7.96]	[6.60]	[6.71]
CPI			-.0887188		-.0660472
			(.1209781)		(.12009)
			[-0.73]		[-0.55]
*LLOSS*SHRT3*				-.0100347**	-.0098007**
				(.0049145)	(.0049252)
				[-2.04]	[-1.99]
CONS	9.553028***	12.70527***	12.66708***	12.12639***	12.14696***
	(.2216186)	(1.305286)	(1.052)	(1.319602)	(1.071922)
	[43.11]	[9.73]	[12.04]	[9.19]	[11.33]
R^2	0.0820	0.4785	0.4806	0.4957	0.4969
Observations	136	136	136	136	136

*** 1% significance level
** 5% significance level
* 10% significance level

4.6 Conclusion

The central contribution of this chapter is to use the DID estimation technique to examine the impacts of bank M&As on bank lending behaviour. This approach is widely used to investigate the effect of policies, due to its simplicity and its advantage of letting each group's baseline outcome serve as the group's own control to account for unmeasured time invariant effects when pre- and post-merger data are available. Although it is widely used in several empirical analyses, it is rarely applied in empirical banking studies, and to the best of our knowledge, this is the first and only study to have made use of the DID approach to examine the effects of bank mergers. In addition, we also provide a robustness check which shows that the DID estimators are reliable and could be used as an alternative approach to investigate the impact of bank mergers.

The DID model is formulated to analyse the differences between the loan interest rate, interest margin and credit availability of merged and of non-merging banks, and also the differences before and after mergers. Consistent with the results in Chapter 3, the DID estimators for price-effects are negative and statistically significant. These results make it clear that merged banks tend to lower their loan interest rates and that their interest rate margins also decrease. These findings support the hypothesis that bank consolidations can benefit consumers. As banks merge, they can obtain efficiency gains through technological improvement, risk diversification and efficiencies of scale and/or scope, and they pass these gains on to their customers in terms of more favourable prices.

For post-merger credit availability, although the DID estimator is not significant in the long run, the DID estimation presents the negative and statistically significant estimator of the periods just before and just after the merger periods, together with the additional control variables. The reason for the difference in the results when using different time periods may be that consolidation in the banking industry is a source of temporary shocks to the credit supply of corporate borrowers, in particular, when mergers are followed by the termination of a relationship (Bonaccorsi Di Patti and Gobbi, 2007, p.693). In consequence, the impact of mergers can be observed only in the short run and there may be no long-run effect on credit availability. This behaviour is different from the long-term impact of mergers on pricing behaviour. This is because, as Montoriol-Garriga suggests (2008, p. 9), the reduction in lending price is permanent. This permanent price cut reflects, for instance, fundamental operational improvements in the consolidated banks, rather than some strategy to extend the market share in the short term. Therefore, we can obtain significant results for the price effect in our long-term analysis.

The negative coefficient in the loan supply model suggests that merged banks tend to lower the amount of their lending. This adverse effect can be explained by the fact that merging institutions may shift their focus to other operations, such as fees and commissions, and reduce lending in all the markets which they serve (Avery and Samolyk, 2004, p. 292). This suggestion is consistent with the result that merged banks tend to reduce their interest margins. Since the margin reflects the bank's income from its intermediary functions, as banks focus on other banking activities, the interest income declines, while the growth of other activities leads to the potential for non-interest income to generate profit.

The lower loan supply from merged banks also suggests that, although borrowers can benefit from the reduced cost of bank loans and lower interest margins, they can be affected by bank M&As when there is significantly less credit available. This effect tends to be severe when there is no offset effect from the non-merging banks increasing their supply of loans. Because bank lending is one of the most important factors for economic growth, above all in developing countries which have no other sources of funds, a loss of bank credit could affect economic development overall. In addition, this loss of credit could impact on social benefits. As suggested by Garmaise and Moskowitz (2006, p.529), as bank size increases through mergers, the resulting large banks tend to provide unfavourable credit conditions, which may lead to an increase in crime. They also conclude that state branching deregulation can lead to more credit supply, resulting in less future property crime. Therefore, in evaluating the impacts of bank M&As, policy makers should consider not only the economic consequences but also the overall effects, including the social impact.

Chapter 5

Bank Mergers and Acquisitions (M&As) and Bank Lending Objectives: a Non-nested Test

5.1. Introduction

As financial intermediaries, most commercial banks make lending their principal business activity. According to Ruth (1999, p.2), the primary source of commercial banks' income is the loans which they make. The profitability of most banks depends on their loan portfolio. However, lending is also one of the greatest sources of risk. This is because, as banks increase their total of loans, they have to accept the higher costs resulting either from problem loans or the higher probability of a liquidity shortage. This means that there are two issues which they should consider regarding their lending decisions: to maximise profit or minimise risk. It is interesting to examine these two different lending objectives in the context of bank mergers. This is because having different objectives alters lending behaviour. In addition, as banks' lending is the most important source of their finance, changes in lending behaviour may affect the entire development of the economy. Therefore, in this chapter we aim to examine whether mergers have a substantial impact on banks' lending objectives. In addition, in order to obtain a clear answer, we compare the lending objectives of merged banks and those of non-merging banks.

In Chapters 3 and 4, we applied the Monti-Klein model of the banking firm to examine the impact of bank mergers on lending behaviour. Although this model can explain banks' optimal resource allocations and the changes in banks' lending behaviour as a result of M&As, it does not explain the changes in banks' lending objectives or shows whether merged participants have different objectives, in particular as regards attitude to risk, from those of non-merging banks. Therefore, we adopt a different perspective and apply an alternative framework, portfolio theory, which treats banks as rational investors or portfolio holders, in order to analyse whether banks' attitude to risk changes in consequence of M&As. The portfolio approach is suitable in this context because, as suggested by Nawrocki (2004, p.235), it is the application of decision-making tools in conditions of risk to the problem of managing risky investments including lending. In addition, as banks have to determine all their assets and liabilities in a way which satisfies their balance sheet constraints, a framework such as the portfolio approach which takes all the contents of a portfolio into consideration, is a suitable alternative approach to examining banks' lending objectives.

As noted above, in general, there are two main lending objectives: to maximise profit or to minimise risk. Therefore, in relation to these different objectives, in order to examine whether merged and non-merging banks have different purposes in lending, we apply two different approaches to portfolio selection which make different assumptions about banks' objectives, and investigate which approach is better at explaining the behaviour of merged banks. The first model is the model of Parkin, Gray and Barrett (PGB) (1970). This model was designed to explain the portfolio selection behaviour of commercial banks. It is based on a Markowitz-type expected utility maximisation framework (1952), in which the bank is assumed to choose its assets and liabilities in order to maximise its utility or profit in the mean-variance procedure by finding the optimal trade-off between the expected portfolio return and the risk associated with future investment outcomes. Although there are other approaches, such as Konno's Mean Absolute Deviation (MAD) model (1989), which also assumes a maximising profit objective, the PGB suits our analysis because of its simplicity and its assumptions about choice and non-choice assets, which we can apply. In addition, although one might argue that the PGB's assumptions about normally distributed and quadratic utility function are not appropriate, as Levy and Markowitz (1979) and Kroll, Levy and Markowitz (1984) demonstrate, while the individual return distributions are non-normal, the optimal diversified portfolios will be very close to a normal distribution. Since the optimised portfolios can be approximated by a normal distribution, the quadratic utility function can be used to maximise investor utility (cited in Nawrocki, 2004, p. 242). Moreover, as noted by Lee (2006, p.70), although Konno's model can overcome the PGB model by requiring no assumptions on return distribution, it suffers from significant estimation error in particular with large investors, as in our sample. Therefore, its simplicity, its ability to explain banks' lending objectives, not least with our large sample of bank data and also the weakness of the alternative model, make the PGB the most appropriate model for our analysis.

The second portfolio selection framework considered in this chapter is Roy's (1952) Safety First Principle. This model assumes that the objective of the bank is to minimise the probability that the return from its chosen portfolio falls below a predetermined disaster point, which is a measurement of risk. Although there are other alternative models in the context of the safety first rule, for example the model of Stutzer (2000, 2003 cited by Haley and McGee, 2006, p. 175), since these models are all based on the same assumption that investors aim to survive through selecting a portfolio which minimises the probability of disaster, they would all behave similarly and make similar decisions in portfolio selection. Therefore, Roy's Safety First Principle is the one applied in the present chapter because of its potential to provide the same explanation as do alternative approaches and its simplicity, involving nothing more than a mean-variance-based upper bound on the underperformance probability. It also has been widely used in several empirical works. These are, for example, studies of insurance companies, by Cramer (1955) and Kunreuther and Hogarth (1992); of the problem of revenue raising under uncertainty, by Dickinson, Driscoll and Ford (1984); to the behaviour of hedge fund and commodity fund investments, by Edwards and Caglayan (2001); to the change in bank's risk premium and productivity when subject to loan default, by Huang (2004); and to stock holding behaviour by Haley, Paarsch and Whiteman (2009).

In order to compare the two portfolio approaches, the non-nested hypothesis testing technique developed by Davidson and Mackinnon (1982) is applied. This technique is appropriate in this context because both the Expected Utility Maximisation and the Safety First Principle assume different emphases and objectives, and therefore the estimated equations derived from these two models also differ in their functional forms. In theory, this means that neither of them is more general than the other and neither of them can be a case of the other. In other words, neither of them can be nested within the other. Therefore, to determine whether banks engaging in M&As may have different objectives from those of non-merging banks, the first step is to derive the optimal loan demand estimating equations according to the two approaches. Then the non-nested test is applied in order to analyse which model better explains the lending behaviour of merged and non-merging banks. The results of this analysis will provide the answer to whether these two groups have different lending objectives, or, in other words, whether consolidations have an impact on banks' lending objectives.

This chapter is organized as follows. Sections 2 and 3 introduce the Expected Utility Maximisation approach and the Safety First Principle respectively. Both theoretical frameworks and their applications will be the focus of each section. Then Section 4 discusses the non-nested testing technique used to compare these two different models with the two groups of data: merged and non-merging banks. Section 5 describes the data and variables. The empirical models and methodology used in the analysis are presented in Section 6. Section 7 reports the empirical results and finally some conclusions are proposed in Section 8.

5.2. The Expected Utility Maximisation model

5.2.1 Literature review

Parkin, Gray and Barrett (1970) formulate a model which aims to explain the portfolio behaviour of commercial banks in the UK banking market. This model is constructed within the expected utility maximisation framework. Each bank is assumed to have risk averse behaviour, with a utility function in the form

$$U = a - ce^{-\beta\pi} \tag{5-1}$$

where

U is the utility per single decision period.

π is the real profit per decision period.

a and c are parameters , where $a \neq o; c > 0$.

β > *0* is the degree of Absolute Risk Aversion (ARA).

A bank's profit has several components, such as yields on assets and the costs of borrowing. However, these elements are uncertain. Therefore, the real profit is also uncertain. In other words, the real profit is random. That is, in this model, the bank does not know its real profit. However, the mean of this profit, μ_π, and its variance, σ_π^2, are assumed to be known. Specifically, they assume that $\pi \sim N(\mu_\pi, \sigma_\pi^2)$.

Therefore, the bank maximises the expected value of the utility function, Equation (5-1), which is

$$E(U) = a - c\exp\left[-\frac{\beta}{2}\mu_\pi + (\frac{\beta}{2})^2\sigma_\pi^2\right] = a - c\exp(-\frac{\beta}{2})\left[\mu_\pi - \frac{\beta}{2}\sigma_\pi^2\right] \tag{5-2}$$

Because a, b, c are parameters, maximising Equation (5-2) is equivalent to maximising $\mu_\pi - \frac{\beta}{2}\sigma_\pi^2$. Thus, the bank's problem is to choose the optimal level of assets and liabilities to maximise

$$W = \mu_\pi - \frac{\beta}{2}\sigma_\pi^2 \tag{5-3}$$

To obtain the bank's optimal portfolio, μ_π and σ_π^2 have to be defined.

The actual profit is considered in a matrix form, as

$$\pi = r'A \tag{5-4}$$

where r' is the ($1 \; x \; n$) vector of real yields and borrowing rates and A is the (n x 1) vector of the actual level of assets and liabilities when liabilities are measured negatively.

Since the actual yield rates and the actual levels of assets and liabilities at the end of the decision period are assumed to be unknown, we can define the actual yield r as

$$r = e + u \tag{5-5}$$

where e is the (n x 1) vector of expected yields and u is the (n x 1) vector of errors in forecasting.

Similarly for the levels of assets and liabilities, the actual assets and liabilities is

$$A = \hat{A} + v \tag{5-6}$$

where $\hat{A}$ is the (n x 1) vector of expected assets and liability levels and v is the (n x 1) vector of random error.

Thus, by using the above definitions of r and A in terms of expected components and errors, the bank's actual profit function, Equation (5-4), can be rewritten as

$$\pi = (e + u)^{'}(\hat{A} + v) \tag{5-7}$$

or

$$\pi = e^{'}\hat{A} + e^{'}v + u^{'}\hat{A} + u^{'}v \tag{5-8}$$

Since $\mu_{\pi} \equiv E(\pi)$, the expected profit can be specified as

$$\mu_{\pi} = e^{'}\hat{A} + e^{'}E(v) + \hat{A}^{'}E(u) \ + E(u^{'}v) \tag{5-9}$$

By assuming that u and v are independently distributed with mean vectors equal to zero and constant covariance matrices, i.e., $E(v) = E(u) = E(u^{'}v) = 0$, Equation (5-9) simply becomes

$$\mu_{\pi} = E(\pi) = e^{'}\hat{A} \tag{5-10}$$

Now, we have to define the variance of the bank's profit, σ_{π}^{2}. Since we know $\sigma_{\pi}^{2} = E\left[(\pi - E(\pi))^{2}\right] = E\left[(e'v + \hat{A}'u + u'v)^{2}\right]$, and make assumptions about the distributions of u and v, the variance of the expected profit is

$$\sigma_{\pi}^{2} = e^{'}Ve + \hat{A}^{'}\Omega\hat{A} + \Psi \tag{5-11}$$

where $V = E(vv^{'}), \Omega = E(uu^{'})$ are the covariance matrices, and $\Psi = E(u^{'}vv^{'}u)$.

Parkin, Gray and Barrett (1970, p. 235) suggest, however, that the element of e and $\hat{A}$ do not need to be specified. This is because the bank is not free to determine the volumes of each and every asset and liability in its portfolio in every decision period and that $\hat{A}$ should be divided between the choice assets and the exogenous non-choice assets with corresponding rates of return. To facilitate this issue, the bank's portfolio is defined as

$$A^{'} = (L \;\; T \;\; C \;\; B \;\; A^{V} \;\; S \;\; R \;\; Z \;\; -D^{D} \;\; -D^{T}) \tag{5-12}$$

where

L is call loans.

T is Treasury Bills.

C is commercial bills.

B is government bonds.

A^{V} is advances.

S is special deposits.

R is cash.

Z is other balancing items.

D^D is demand deposits (current account).

D^T is time deposits (deposits and other accounts).

The choice items include *L, T, C* and *B*, while the rests are specified as non-choice items. However, although *L* is defined as a choice asset, Parkin, Gray and Barrett (1970, p.235) argue that it is not selected deterministically. This is because some assets must take up the effects of departures from their expected levels of the actual values of the exogenous items and it is always call loans which serve this purpose. Thus, there is an error in the expected level of call loans while the errors of other choice assets are all equal to zero.

In addition, A^V is determined as a non-choice variable because in about half the period of the study, bank advances were controlled by the Bank of England and there were some non-price instruments which banks had to use in order to achieve the desired level of advances. Moreover, because the level of the banks' cash holding is defined by the legal minimum (cash ratio constraint) and is linked uniquely to deposits which are exogenous, *R* is considered as a non-choice item.

Thus, the definitions of $\hat{A}$, v, e and u are

$$\begin{array}{lllllllllllll}
\hat{A}' & = (\hat{L} & \hat{T} & \hat{C} & \hat{B} & : \hat{A}^V & \hat{S} & \hat{R} & \hat{Z} & -\hat{D}^D & -\hat{D}^T) = (\hat{A}_1' : \hat{A}_2') \\
v' & = (v_1 & 0 & 0 & 0 & : v_5 & v_6 & v_7 & v_8 & v_9 & v_{10}) = (v_1' : v_2') \\
e' & = (e_1 & e_2 & e_3 & e_4 & : e_5 & e_6 & 0 & 0 & 0 & e_{10}) = (e_1' : e_2') \\
u' & = (u_1 & u_2 & u_3 & u_4 & : u_5 & u_6 & 0 & 0 & 0 & u_{10}) = (u_1' : u_2')
\end{array} \qquad (5\text{-}13)$$

Moreover, the bank's objective function, Equation (5-3), is assumed as maximal, subject to the following constraints:

1) The balance sheet constraint holds, which means that the sum of assets and the sum of liabilities are always equal, or in other words, the sum of choice items and non-choice items equals zero. That is

$$i_1'\hat{A}_1 + i_2'\hat{A}_2 = 0 \qquad (5\text{-}14)$$

where i_1' and i_2' are appropriate summation vectors.

2) The bank's cash holdings and deposits must satisfy the following constraint:

$$\hat{R} \geq \beta(\hat{D}^D + \hat{D}^T) \qquad (5\text{-}15)$$

During the study period, the parameter β was equal to 0.08 implying that at least 8% of deposits must be held in cash. In particular, from examining the balance sheet of the sample banks, Parkin, Gray and Barrett (1970, p.236) argue that this cash ratio is always binding and effective. In addition, since cash was uniquely linked to the total deposits, which are assumed to be exogenous, cash is treated as given.

3) The special deposits are treated as given by the Bank of England and must equal the proportion of the bank's deposits, that is:

$$\hat{S} = \delta(\hat{D}^D + \hat{D}^T) \tag{5-16}$$

Additionally, because special deposits are a function of the exogenous total deposit variables, the bank's special deposits are defined as a non-choice asset and considered as given.

4) The sum of liquid assets must satisfy

$$\hat{R} + \hat{L} + \hat{T} + \hat{C} \geq \psi(\hat{D}^D + \hat{D}^T) \tag{5-17}$$

The parameter ψ was 0.3, implying that at least 30% of total deposits must be held in liquid assets. In addition, from examining the actual balance sheets, Parkin, Gray and Barrett (1970, p.236) argue that the liquid asset ratio was never binding, with the result that the liquidity constraint, Equation (5-17), can be dropped.

Thus, the bank portfolio choice problem is to choose $\hat{A}_1$ given $\hat{A}_2$, e, V and Ω, to maximise the objective function, Equation (5-3), subject to the balance sheet constraint, Equation (5-14). That is, the bank's problem is to $\underset{\hat{A}_1}{Max} W = \mu_\pi - \frac{\beta}{2}\sigma_\pi^2$ subject to $i_1^{'}\hat{A}_1 + i_2^{'}\hat{A}_2 = 0$.

Substitute Equation (5-10) and Equation (5-11) into the objection function, and form the Lagrange to ascertain the solution vector

$$\begin{pmatrix} \hat{A}_1 \\ \lambda \end{pmatrix} = \begin{pmatrix} \beta\Omega_{11} & -i_1 \\ -i_1^{'} & 0 \end{pmatrix}^{-1} \begin{pmatrix} e_1 & -\beta\Omega_{12}\hat{A}_2 \\ & i_2^{'}\hat{A}_2 \end{pmatrix} \tag{5-18}$$

where

λ is the Lagrangian multiplier.

$\beta\Omega_{11}$ is nonsingular, i.e. a square and linear independent matrix, due to Ω_{11}, a sub-matrix of the covariance matrix Ω, being positively defined. In addition, $-\frac{1}{\beta}i_1^{'}\Omega_{11}^{-1}i_1$ is nonzero. Thus, $\begin{pmatrix} \beta\Omega_{11} & -i_1 \\ -i_1^{'} & 0 \end{pmatrix}^{-1}$ can be found.

That is, the solution for $\hat{A}_1$ is

$$\hat{A}_1 = \frac{1}{\beta}Ge_1 - G\Omega_{12}\hat{A}_2 - Hi_2^{'}\hat{A}_2 \tag{5-19}$$

where

$G = \Omega_{11}^{-1} - \frac{\Omega_{11}^{-1} i_1 i_1^{'} \Omega_{11}^{-1}}{i_1^{'} \Omega_{11}^{-1} i_1}$ is a symmetric with zero row and column sums, since Ω_{11} is a covariance matrix.

$H = \frac{\Omega_{11}^{-1} i_1}{i_1^{'} \Omega_{11}^{-1} i_1}$ with a column sum of -1.

Since

$G\Omega_{12}\hat{A}_2 \equiv G\left[\Omega_{1AD} \vdots \Omega_{1SD} \vdots \underset{\sim}{0} \vdots \underset{\sim}{0} \vdots \underset{\sim}{0} \vdots \Omega_{1TD}\right]$ and $Hi_2^{'}\hat{A}_2 \equiv H\hat{A}^V + H\hat{S} + H\hat{R} + H\hat{Z} - H\hat{D}^D - H\hat{D}^T$,

thus,

$$-G\Omega_{12}\hat{A}_2 - Hi_2^{'}\hat{A}_2 = -(G\Omega_{1AD} + H)\hat{A}^V - (G\Omega_{1SD} + H)\hat{S} - H\hat{R} - H\hat{Z} + H\hat{D}^D + H(G\Omega_{1TD} + H)\hat{D}^T \tag{5-20}$$

That is, the sum of the coefficients of the second and third terms of Equation (5-19) can be defined in a matrix form as

$$H^* \equiv -\left[(G\Omega_{1AD} + H) \vdots (G\Omega_{1SD} + H) \vdots (G\Omega_{1TD} + H) \vdots H\right] \tag{5-21}$$

Also, define,

$$\hat{A}_2^* = (\ \hat{A}^V \ \ \hat{S} \ -\hat{D}^T \ -\hat{D}^{D*}\ ) \tag{5-22}$$

where

$$\hat{D}^{D*} = \hat{R} + \hat{Z} - \hat{D}^{D} \quad (5\text{-}23)$$

Therefore, for an individual bank, the optimal choice asset Equation (5-19), can be rewritten as

$$\hat{A}_1 = \frac{1}{\beta} G e_1 + H^* \hat{A}_2^* \quad (5\text{-}24)$$

Equation (5-24) shows that the bank's decision-making on the choice asset is determined by the expected returns on these choice items and the expected values of the non-choice items, but it is not related to the returns on non-choice items.

In the n-bank case, Parkin, Gray and Barrett assume the following additional assumptions:

1) All banks have the same e and u. That is, they are supposed to hold the same expectations about the interest rate and they all have the same subjective covariance matrix of forecasting errors.

2) The forecasting error on $\hat{A}_2^* = 0$ in aggregate across banks with the following equation

$$\sum_{i=1}^{n} \hat{A}_{2i}^* = \sum_{i=1}^{n} A_{2i}^* \quad (5\text{-}25)$$

where n is the number of banks.

Thus, by summing the n banks, the aggregate demand equation is

$$\tilde{A}_1 = B^* G e_1 + H^* A_2^* \tag{5-26}$$

In addition, by assuming that the expected yields for choice assets are given without error by $\overline{r}_1$, which are the quarterly averages of actual yields centred on the date of observation of the balance sheet, Equation (5-26) becomes

$$\tilde{A}_1 = B^* G \overline{r}_1 + H^* A_2^* \tag{5-27}$$

where

$$\tilde{A}_1 = \sum_{i=1}^{n} \hat{A}_{1i}$$

$$A_2^* = \sum_{i=1}^{n} A_{2i}^*$$

$$B^* = \sum_{i=1}^{n} \frac{1}{\beta_i}$$

Equation (5-27) describes the ideal optimal portfolio behaviour of banks; however, it is unobservable. Thus, to estimate the demand equations, there is an additional assumption that the actual behaviour of banks deviates from the optimal behaviour stochastically (ε). That is, the optimal aggregate demand can be defined as

$$\tilde{A}_1 = B^* G \overline{r}_1 + H^* A_2^* + \varepsilon \tag{5-28}$$

where ε is a vector of the normally distributed random variable with mean zero, i.e. $\varepsilon \sim N(0,\sigma_I^2)$.

Including seasonality and a data dummy, Equation (5-28) becomes

$$\tilde{A}_1 = B^* G\overline{r_1} + H^* A_2^* + JD + \varepsilon \tag{5-29}$$

where

J is a (4 x 4) matrix of coefficients.

D is a (4 x 1) vector of seasonal dummies.

Equation (5-29) presents the commercial bank asset demand functions in which the coefficients B^*, G, H, J are directly estimable. In addition, it shows that the bank's optimal choice asset holding depends on the expected rates of return on choice items and the expected level of non-choice items, and this model can easily be applied to the empirical estimation.

5.2.2 The application of the Expected Utility Maximisation model to bank lending behaviour

The previous section has reviewed the model of Parkin, Gray and Barrett (PGB) and seen how they derive a theoretical model for a commercial bank's portfolio decision-making. In this section, we present an empirical application based on this theoretical model to analyse the impact of bank M&As on bank lending behaviour.

The commercial bank is assumed to hold two types of asset, namely, loans and other earning assets, and two liabilities, deposits and equities. As in the PGB model, both of these assets are choice items whose levels can be chosen by the bank at the beginning of each period in order to maximise their expected utility, given these assets' interest rates. Loans are assumed to yield a flat term structure and other earning assets are assumed to bear a uniform rate of return.

On the liability side, deposits are considered as a choice item with a flat return. Equity has to be chosen at the beginning of the period and is assumed to be long-term and unchanged during the decision period. In particular, it is the bank's exogenous non-choice asset and equity holders earn dividends at the end of every period.

There is some debate about defining deposits as a choice item. According to the BankScope database, deposits are composed of domestic non-interest-bearing deposits, domestic interest-bearing deposits and short-term borrowing. Although the first two deposits looked like items whose volume is decided by depositors and thus they should be considered as non-choice items, their proportions are small compared to short-term borrowing, where the bank unquestionably chooses the volume as its business funding. This means that the marginal effect of the choice items is higher than that of the non-choice items. Hence, deposits should be categorised as the choice items for the bank.

Besides the above assets and liabilities, to ensure that the bank's balance sheet is balanced according to the general accounting rule, the bank is assumed to have balancing items to cover the discrepancy between its assets and its liabilities. This balancing item is assumed to have no interest. It is treated as an exogenous non-choice item and also has no effect on the bank's portfolio decision-making, except for balancing the bank's balance sheet.

Thus, the bank's balance sheet, when deposits and equities are treated as negative assets, can be defined as

$$L + O + D + E + B = 0 \tag{5-30}$$

where L, O, D , E and B are the levels of loan, other earning assets, deposits, equity and balancing items, respectively.

Following to the PGB model, we can specify the bank's portfolio combination as

$$\begin{aligned}
\hat{A}' &= (\hat{a}_{L,t} \quad \hat{a}_{O,t} \quad \hat{a}_{D,t} \; : \; \hat{a}_{E,t} \quad \hat{a}_{B,t}\ ) = (\hat{A}_1' \; : \; \hat{A}_2') \\
v' &= (v_{L,t} \quad v_{O,t} \quad v_{D,t} \; : 0 \quad v_{B,t}\ ) = (v_1' \; : \; v_2') \\
e' &= (e_{L,t} \quad e_{O,t} \quad e_{D,t} \; : \; e_{E,t} \quad e_{B,t}) = (e_1' \; : \; e_2') \\
u' &= (u_{L,t} \quad u_{O,t} \quad u_{D,t} \; : \; u_{E,t} \quad 0) = (u_1' \; : \; u_2')
\end{aligned} \tag{5-31}$$

where

$\hat{a}_{L,t}$, $\hat{a}_{O,t}$, $\hat{a}_{D,t}$, $\hat{a}_{E,t}$ and $\hat{a}_{B,t}$ are the expected levels of loans, other earning assets, deposits, equity and the balancing item at period t.

$e_{L,t}$, $e_{O,t}$, $e_{D,t}$, $e_{E,t}$ and $e_{B,t}$ are the expected rate of returns on loans, other earning assets, deposits, equity and the balancing item, at period t .

$v_{L,t}$, $v_{O,t}$, $v_{D,t}$ and $v_{B,t}$ are the variances of the expected levels of loan, other earning assets, deposits and the balancing item. The variance of equities is zero, since these are assumed to be unchanged in the decision period.

$u_{L,t}$, $u_{O,t}$, $u_{D,t}$ and $u_{E,t}$ are the variance of the expected yield on loans, securities, deposits, and equities, respectively. Since the balancing item is assumed to have a zero rate of return, the variance of its expected yield is thus equal to zero.

From Equation (5-19), the solution for the choice asset holding, $\hat{A}_1$ is

$$\hat{A}_1 = \frac{1}{\beta} Ge_1 - G\Omega_{12}\hat{A}_2 - Hi_2^{'}\hat{A}_2 \tag{5-32}$$

where,

$\Omega_{12} = (\Omega_{1E} \quad \Omega_{1B})$ is the variance-covariance vector between the errors of the rate of returns on choice assets and the error of returns on non-choice items, and $\hat{A}_2 = \begin{pmatrix} \hat{a}_{E,t} \\ \hat{a}_{B,t} \end{pmatrix}$.

That is, the second term of Equation (5-32) can be rewritten as

$$G\Omega_{12}\hat{A}_2 \equiv G\,(\Omega_{1E} \quad \Omega_{1B}) \begin{pmatrix} \hat{a}_{E,t} \\ \hat{a}_{B,t} \end{pmatrix} \tag{5-33}$$

Since $u_{B,t} = 0$, the variance-covariance vector between the errors of the rate of returns on choice assets and the error of returns on the balancing item, Ω_{1B}, is zero. Thus, the second and third terms of the right-hand side of Equation (5-32) can be rewritten as

$$-G\Omega_{12}\hat{A}_2 - Hi_2^{'}\hat{A}_2 = -\{G(\ \Omega_{1E}) +\ H\}\begin{pmatrix}\hat{a}_{E,t}\\ \hat{a}_{B,t}\end{pmatrix} \tag{5-34}$$

Define

$$Z \equiv -\{G(\ \Omega_{1E}) +\ H\} \tag{5-35}$$

Thus, the bank's optimal solution for its choice assets can be defined as

$$\hat{A}_1 = \frac{1}{\beta}Ge_1 + Z\begin{pmatrix}\hat{a}_{E,t}\\ \hat{a}_{B,t}\end{pmatrix} \tag{5-36}$$

Equation (5-36) can be transformed to an empirically testable form, as

$$\hat{A}_1 = bGe_1 + Z\hat{A}_2 + \varepsilon \tag{5-37}$$

where

$b = \frac{1}{\beta}$, which can be used as the measurement for the risk aversion parameter. In particular, an increase in b represents a higher degree of risk aversion, and the converse is also true.

G is the (3 x 3) matrix of the coefficients of the expected rates of returns on the choice assets.

Z is the (3 x 2) matrix of the coefficients of the expected values of non-choice items.

ε is the (3 x 1) vector of the error terms.

Because regressing a large number of interest rate variables can raise problems of multicollinearity, there are three restrictions regarding to the properties of *G* and *Z* coefficient matrices. First is the symmetry assumption, which requires that the *G* matrix of coefficients should be symmetric. This means that, in the case of two choice item, *a* and *a'* , the unit change in the rate of return on *a* will affect the change in demand for asset *a'*, which equals the change in demand for asset *a* affected by a unit change in the rate of return on asset *a'*. The second restriction is the Cournot Aggregation condition. This restriction states that all changes in assets and liabilities following a change in returns must keep the balance sheet in balance, i.e. $i'G = 0$. Finally, there is the Engle Aggregation condition, which says that a change in the stock of a non-choice item will affect the changes in the demand for choice items, and this must add up to the initial change, i.e. $i'H = -1$.

The full expression of Equation (5-37) can be written as

$$\begin{pmatrix} \hat{a}_{L,t} \\ \hat{a}_{O,t} \\ \hat{a}_{D,t} \end{pmatrix} = b \begin{pmatrix} g_{LL} & g_{LO} & g_{LD} \\ g_{LO} & g_{OO} & g_{OD} \\ g_{LD} & g_{OD} & g_{DD} \end{pmatrix} \begin{pmatrix} \hat{e}_{L,t} \\ \hat{e}_{O,t} \\ \hat{e}_{D,t} \end{pmatrix} + \begin{pmatrix} Z_{LE} \\ Z_{OE} \\ Z_{DE} \end{pmatrix} \hat{a}_{E,t} + \begin{pmatrix} Z_{LE} \\ Z_{OE} \\ Z_{DE} \end{pmatrix} \hat{a}_{B,t} + \begin{pmatrix} \varepsilon_{L,t} \\ \varepsilon_{O,t} \\ \varepsilon_{D,t} \end{pmatrix} \qquad (5\text{-}38)$$

The empirical expression for the bank's portfolio allocation can be defined by the following three equations

$$\tilde{a}_{L,t} = [\, \tilde{e}_{L,t} \quad \tilde{e}_{O,t} \quad \tilde{e}_{D,t} \;:\; \tilde{a}_{E,t} \quad \tilde{a}_{B,t} \,]\, \lambda_L + \varepsilon_{L,t} \qquad (5\text{-}39)$$

$$\tilde{a}_{O,t} = [\, \tilde{e}_{L,t} \quad \tilde{e}_{O,t} \quad \tilde{e}_{D,t} \;:\; \tilde{a}_{E,t} \quad \tilde{a}_{B,t} \,]\, \lambda_O + \varepsilon_{O,t}$$

$$\tilde{a}_{D,t} = [\, \tilde{e}_{L,t} \quad \tilde{e}_{O,t} \quad \tilde{e}_{D,t} \;:\; \tilde{a}_{E,t} \quad \tilde{a}_{B,t} \,]\, \lambda_D + \varepsilon_{D,t}$$

where

$\tilde{a}_{L,t}$, $\tilde{a}_{O,t}$, $\tilde{a}_{D,t}$ $\tilde{a}_{E,t}$ and $\tilde{a}_{B,t}$ are the observed levels of loans, other earning assets, deposits, equity and the balancing item at period *t*.

$\tilde{e}_{L,t}$, $\tilde{e}_{O,t}$ and $\tilde{e}_{D,t}$ are the observed rates of the banks' choice items at period *t*.

λ_L, λ_O and λ_D are the coefficient vectors for the corresponding choice items.

$\varepsilon_{L,t}$, $\varepsilon_{O,t}$ and $\varepsilon_{D,t}$ are the error terms for the corresponding choice items.

5.3 The Safety First Principle

5.3.1 Literature review

Roy (1952) introduces a rule of decision-making in the context of portfolio selection behaviour under uncertainty, known as the Safety First Principle. In this model decision-makers have in mind some disaster level of returns and they behave so as to minimise the probability of the target variable's falling below this threshold of disaster. In other words, the Safety First Principle focuses essentially on risk, which is represented by the probability of returns falling below the disaster level.

In order to choose the optimal bundle of assets, the investor must take care that the gross return should not be less than some critical value d, which is assumed to be a constant and may vary among investors. With every possible action, there is the expected value of the gross return m, which is not certain. Thus, there is a quantity σ such that the prediction of m is expected to be wrong, or that, in other words, σ is the standard error of m.

In the Safety First model, m and σ are assumed to be known and can be obtained from information about the past. For all feasible choices of action, given the values of m and σ, there is a functional relationship called the efficient mean-variance frontier in which all of the possible portfolios on this frontier are efficient. The relationship can be presented as

$$f(\sigma, m) = 0 \tag{5-40}$$

Because the investor knows nothing about the precise probability of the final return's being a predetermined disaster level d or less, Roy applies the Bienayme-Tchebycheff inequality in order to set the upper bound of this probability. The Bienayme-Tchebycheff inequality function gives an upper limit on the probability of exceeding any given number of standard deviations, independent of the sharp of the function, provided its variance is known (James, 2007, p.44).

Thus, by assuming that the final return is a random variable ξ, the upper bound of this probability is in terms of the mean value, the variance of the actual return, and the critical value, and can be expressed as

$$P(|\xi - m| \geq m - d) \leq \frac{\sigma^2}{(m-d)^2} \tag{5-41}$$

which is similar to

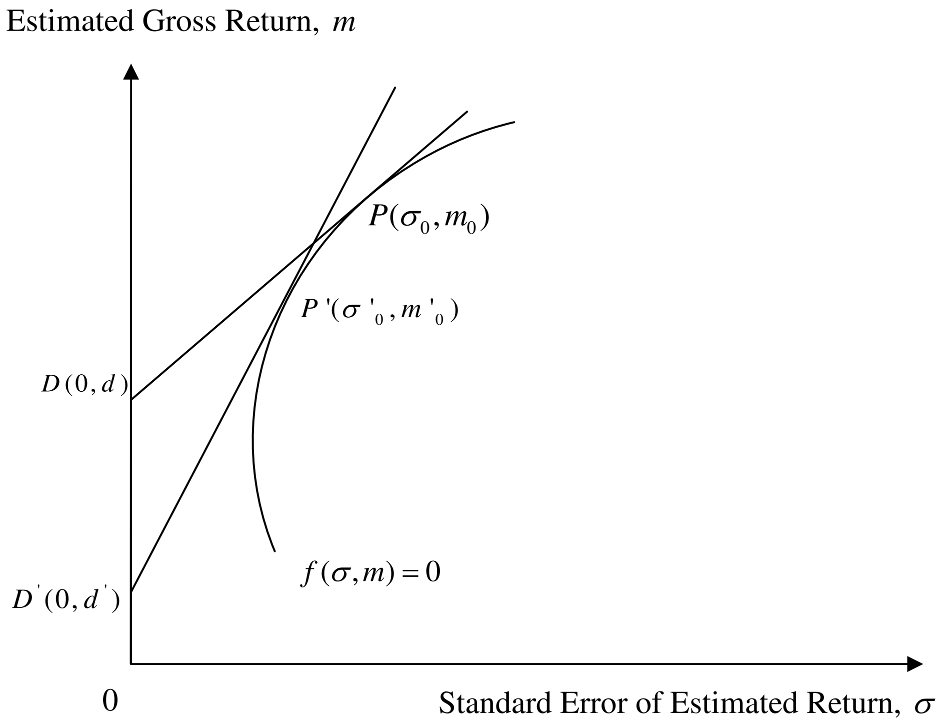
$$P(m-\xi \geq m-d) = P(\xi \leq d) \leq \frac{\sigma^2}{(m-d)^2} \tag{5-42}$$

According to Roy, the investor's objective is to minimise the probability of disaster, $P(\xi \leq d)$, which can be operated on minimising the upper bound of the probability distribution, $\frac{\sigma^2}{(m-d)^2}$, equivalent to maximising $\frac{(m-d)}{\sigma}$. In addition, the true principle of Safety First can be obtained, as closely as possible, from the maximisation of this quantity. Specifically, if ξ is normally distributed with mean m and standard deviation σ, this approach is similar to minimising the probability of disaster itself.

Roy claims that the procedure can be regarded as a generalisation of profit maximisation in an uncertain world if σ is the same for all values of m, which makes the maximisation of $\frac{(m-d)}{\sigma}$ equivalent to maximising the expected gain. However, minimising the chance of disaster can be interpreted as maximising the expected utility if the utility function has only two values, for example, one if disaster does not occur and zero if it does.

To explain the implications of the above argument, the mean-standard deviation analysis based on the Safety First Principle can be presented by a graphical demonstration. In Figure 5-1, the $f(\sigma, m) = 0$ curve describes the efficient set consistent with the Safety First model. If the investor wants to avoid an outcome of d or worse, the optimal portfolio is at the point P where the positive slope line drawn from the point $D(0, d)$ is tangential to the $f(\sigma, m) = 0$ curve. At point P, the upper bound of the probability of disaster, $\frac{\sigma^2}{(m-d)^2}$, is minimised, or $\frac{(m-d)}{\sigma}$ is maximised. This means that the investor can have the upper bound of the probability of d or worse happening as low as possible from taking the action which is expected to have the gross return m_0. In addition, for a lower disaster level, for example, $d^{'}$, $\frac{\sigma^2}{(m-d)^2}$ is lower than that of d. This shows that the lower the disaster level, or in other words, the steeper the slope of the line *DP*, the lower the probability of disaster.

Figure 5-1: The graphical determination of the best σ, m combination



Roy extends his model to describe the optimal distribution of resources between different assets by assuming that the investor has the total amount of resources equal to k. For the n assets case, these resources are held in the form of each asset with the amounts of $x_1, x_2, ..., x_{n\partial}$, and the expected yields at the end of the period $p_1, p_2, ..., p_n$, respectively. However, due to the assumption of uncertainty about returns on assets, the expected yields have the standard errors $\alpha_1, \alpha_2, ..., \alpha_n$ and the correlations between the prices of each pair of assets γ_{ij} where $i = 1, 2, ..., n$ and $j = 1, 2, ..., n$. Therefore, m and σ can be calculated as

$$m = \sum_{i=1}^{n} x_i p_i \tag{5-43}$$

$$\sigma^2 == \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j \gamma_{ij} \alpha_i \alpha_j \tag{5-44}$$

and

$$k = \sum_{i=1}^{n} x_i \tag{5-45}$$

From Equations (5-43) to (5-45), the outer boundary or the envelope curve which represents the best combination of σ and m can be obtained. By assuming a as a column vector $(\frac{p_1}{\alpha_1}, \frac{p_2}{\alpha_2}, ..., \frac{p_n}{\alpha_n})$, b for the column vector $(\frac{1}{\alpha_1}, \frac{1}{\alpha_2}, ..., \frac{1}{\alpha_n})$ and W as the correlation matrix of the elements γ_{ij} with its inverse matrix W^{-1}, the efficient set is a hyperbola with the following equation:

$$\left[\frac{(a'W^{-1}a)(b'W^{-1}b) - (a^{-1}W^{-1}b)^2}{b'W^{-1}b}\right](\sigma^2 - \frac{k^2}{b'W^{-1}b}) = (m - k\frac{a^{-1}W^{-1}b}{b'W^{-1}b})^2 \tag{5-46}$$

Roy shows that the upper bound of the probability of disaster is equal to

$$\frac{1}{\left[a-(\frac{d}{k})b\right]' W^{-1}\left[a-(\frac{d}{k})b\right]} \tag{5-47}$$

or

$$\frac{|W|}{\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{(p_i-\frac{d}{k})}{\alpha_i}W_{ij}\frac{(p_i-\frac{d}{k})'}{\alpha_j}} \tag{5-48}$$

where W_{ij} is the cofactor of γ_{ij} in the matrix W and $|W|$ is the determinant of W.

In addition, the required values of $x_1, x_2, ..., x_{n\partial}$ can be given by the equations

$$x_i=\frac{\lambda}{\alpha_i}\sum_{j=1}^{n}\frac{(p_j-\frac{d}{k})}{\alpha_j}\frac{W_{ij}}{|W|} \tag{5-49}$$

where λ is chosen so that $\sum_{i=1}^{n} x_i = k$.

Equations (5-47), (5-48) and (5-49) show the significant role of the ratio $\frac{d}{k}$, named by Roy the critical price ratio. Because d is the minimum level of expected return and k is the total amount of resources held by the investor, the ratio $\frac{d}{k}$ can be considered as the minimum expected return per unit of total assets, or price. In addition, if the resources are committed to one kind of asset and the asset price at the end of the period falls to or falls below this critical price, then the disaster will come about. This means that, for every asset whose price is higher than this critical price, the investor should hold some of the resources in this form. In contrast, if the estimated price is less than the critical level, then the investor should either reject this asset or should contract the liabilities in this form. Therefore, the investor can use the critical price as a benchmark for deciding what counts as an asset or a liability.

By using the critical price ratio as a criterion for the eligibility of assets and liabilities, Equation (5-49) can be rewritten to obtain the optimal proportion of resources held in a particular asset as

$$x_i = \lambda \frac{(p_i^{''} - \frac{d}{k})}{(\sigma_i^{''})^2} \tag{5-50}$$

where $p_i^{''}$ is the expected rate of return of a particular asset i when the prices of all other assets are equal to the critical price and $\sigma_i^{''}$ is the standard error of this asset's expected price when the prices of all other assets are equal to the critical price.

In addition, in a special case in which all the correlation between the prices of assets are expected to be zero, Equations (5-49) and Equation (5-50) become

$$x_i = \lambda \frac{(p_i - \frac{d}{k})}{(\sigma_i)^2} \tag{5-51}$$

This result suggests that the investor holds the assets which have the expected prices exceeding the critical price $\frac{d}{k}$, with the contracts liabilities for the items whose expected prices are less than $\frac{d}{k}$. Furthermore, in the case that all of the assets have the same expected prices, the investor is not indifferent as to which assets are held. This is because the uncertainty about the returns can be reduced by spreading the resources equally among all the assets, even though the investor cannot affect the expected return by varying the asset holdings. If the investor holds only one of the exactly similar assets, the upper bound of the probability of disaster would be $\frac{\alpha^2}{(p - \frac{d}{k})^2}$, while if all n assets are held in equal amounts this upper bound would become $\frac{\alpha^2}{n(p - \frac{d}{k})^2}$, which is lower than in the case of holding only one asset.

Roy (1952, p. 439) suggests that, if the absolute values of the standard errors are unknown but there are some estimates of their relative magnitude, Equation (5-51) can be used without modification. However, if there is no information to estimate the necessary standard error but the expected returns are equally reliable, the Safety First Principle can still be used to provide the optimal portfolio for minimising the probability of disaster. The optimal amount of the assets can be obtained from

$$x_i = \lambda(p_i - \frac{d}{k}) \tag{5-52}$$

In addition, if the estimates are thought to have equal proportionate reliability, which Roy advises as perhaps a more plausible assumption in the economic world, the amount of each asset can be decided by

$$x_i = \lambda \frac{p_i - \frac{d}{k}}{p_i^2} \tag{5-53}$$

5.3.2 The Principle of Safety First and a commercial bank's portfolio behaviour

In the previous section, we have explained a theoretical model of the Safety First. In this section, we will concentrate on ways of adapting the Safety First model to the commercial bank's portfolio selection behaviour. One of the reasons that the bank might adopt the Safety First Principle when it chooses its portfolio is from the nature of its liabilities, on which the survival of the bank depends for its ability to meet a disaster level of deposit withdrawals.

The bank is assumed to take care that its actual return at the end of a decision period from a given portfolio, Π, should not be lower than the predetermined critical level, R, which is supposed to exist for the bank. However, the bank is unable to determine its level of each and every asset or liability. As in the Expected Utility Maximisation model, it is assumed that the bank's balance sheet is divided into choice and non-choice items. By assuming that the bank's liabilities are treated as negative assets, the actual return from a given portfolio is

$$\Pi = A_1^{'} r_1 + A_2^{'} r_2 \tag{5-54}$$

where

A_1 is the (m x 1) vector of choice items.

r_1 is the (m x 1) vector of rates of return on the choice items.

A_2 is the ((n-m) x 1) vector of non-choice item where n>m.

r_2 is the ((n-m) x 1) vector of rates of return on the non-choice items.

Since the actual levels of assets and liabilities and their returns at the end of each decision period are not known when the decision is made, the actual return from a given portfolio is uncertain. However, the bank is assumed to be able to estimate the actual return from past data and have the expected value of Π as μ_π, and the variance of this expected value as σ_π^2. In addition, by assuming that the rates of return on assets or liabilities are not correlated with the levels of these assets or liabilities, and only the rates of return within the choice items are assumed to be correlated with each other, the expected return on a given portfolio and its variance can be written as

$$\mu_\pi = \hat{A}_1^{'} e_1 + \hat{A}_2^{'} e_2 \tag{5-55}$$

and

$$\sigma_\pi^2 = \hat{A}_1^{'} \Omega_{11} \hat{A}_1^{'} \tag{5-56}$$

where $\hat{A}_1^{'}, \hat{A}_2^{'}, e_1, e_2$ are the expected values of A_1, A_2, r_1, r_2 , respectively, and Ω_{11} is the variance-covariance matrix of the rates of return on the choice items.

To obtain the bank's asset demand equation, the bank is assumed to minimise the probability that the expected value of the gross return from a given portfolio, μ_π, is lower than the critical value, *R*, given a level of a total risk, σ_π^2 . According to Roy's Safety First Principle, this is equivalent to minimising the upper bound of the probability of disaster, which is the reciprocal of maximising

$$Q = \frac{(\mu_\pi - R)^2}{\sigma_\pi^2} \tag{5-57}$$

As with the basic Safety First model, Equation (5-57) involves two parameters of the probability distribution of Π, namely, mean and variance. This indicates that the bank's optimal portfolio derived from the Safety First Principle can be expressed in terms of the best combination of μ_π and σ_π^2. In particular, for given values of μ_π and σ_π^2 for all possible portfolios, there exists a functional relationship $f(\mu_\pi, \sigma_\pi^2) = 0$, as in Equation (5-40).

Thus, to solve for the optimal portfolio for the choice assets, the first step is to derive the efficient mean-variance frontier. To obtain the efficient mean-variance frontier, $\hat{A}_1$ has to be chosen to minimise the level of a total risk subject to a given portfolio and the bank's balance sheet constraint. This means minimising

$$\sigma_{\pi}^{2} = \hat{A}_{1}^{'}\Omega_{11}\hat{A}_{1}^{'} \tag{5-58}$$

subject to

$$\mu_{\pi} = \hat{A}_{1}^{'}e_{1} + \hat{A}_{2}^{'}e_{2} \tag{5-59}$$

$$\hat{A}_{1}^{'}i_{1} + \hat{A}_{2}^{'}i_{2} = 0 \tag{5-60}$$

where Equation (5-60) is the bank's balance sheet constraint, which presents that the sum of all assets is equal to the sum of all liabilities.

The Lagrangian model is

$$L = \hat{A}_{1}^{'}\Omega_{11}\hat{A}_{1} + 2\lambda_{1}(\mu_{\pi} - \hat{A}_{1}^{'}e_{1} - \hat{A}_{2}^{'}e_{2}) + 2\lambda_{2}(\hat{A}_{1}^{'}i_{1} + \hat{A}_{2}^{'}i_{2}) \tag{5-61}$$

where λ_1, λ_2 are the Lagrangian multipliers.

We differentiate Equation (5-61) with respect to $\hat{A}_1$, λ_1 and λ_2, to obtain the following first order conditions:

$$\frac{\partial L}{\partial \hat{A}_{1}} = 2\Omega_{11}\hat{A}_{1} - 2\lambda_{1}e_{1} + 2\lambda_{2}i_{1} = 0 \tag{5-62}$$

$$\frac{\partial L}{\partial \lambda_{1}} = 2\mu_{\pi} - 2\hat{A}_{1}^{'}e_{1} - 2\hat{A}_{2}^{'}e_{2} = 0 \tag{5-63}$$

$$\frac{\partial L}{\partial \lambda_{2}} = 2\hat{A}_{1}^{'}i_{1} + 2\hat{A}_{2}^{'}i_{2} = 0 \tag{5-64}$$

and rearrange (5-62) to get

$$\hat{A}_1 = \Omega_{11}^{-1}(\lambda_1 e_1 - \lambda_2 i_1) \tag{5-65}$$

Substitute the expression of $\hat{A}_1$ as in Equation (5-65) into Equations (5-58), (5-59) and (5-60) in order to eliminate the Lagrangian multipliers λ_1 and λ_2, so that

$$\sigma_\pi^2 = (\lambda_1 e_1 - \lambda_2 i_1)' \Omega_{11}^{-1}(\lambda_1 e_1 - \lambda_2 i_1) \tag{5-66}$$

$$\mu_\pi = (\lambda_1 e_1 - \lambda_2 i_1)' \Omega_{11}^{-1} e_1 + A_2' e_2 \tag{5-67}$$

$$\hat{A}_2' = -(\lambda_1 e_1 - \lambda_2 i_1)' \Omega_{11}^{-1} i_1 \tag{5-68}$$

Expanding Equation (5-66) and utilising Equations (5-67) and (5-68), to get

$$\sigma_\pi^2 - \lambda_1(\mu_\pi - \hat{A}_2' e_2) - \lambda_2 \hat{A}_2' i_2 = 0 \tag{5-69}$$

From Equation (5-67) and (5-68), λ_1 and λ_2 can be solved as

$$\lambda_1 = \frac{1}{d}\left[i_1' \Omega_{11}^{-1} i_1 (\mu_\pi - d_1) + i_1' \Omega_{11}^{-1} e_1 d_2 \right] \tag{5-70}$$

$$\lambda_2 = \frac{1}{d}\left[e_1' \Omega_{11}^{-1} e_1 d_2 + e_1' \Omega_{11}^{-1} i_1 (\mu_\pi - d_1) \right] \tag{5-71}$$

where

$$d = e_1^{'}\Omega_{11}^{-1}e_1 i_1^{'}\Omega_{11}^{-1}i_1 - e_1^{'}\Omega_{11}^{-1}i_1 i_1^{'}\Omega_{11}^{-1}e_1 \tag{5-72}$$

$$d_1 = \hat{A}_2^{'}e_2 \tag{5-73}$$

$$d_2 = \hat{A}_2^{'}i_2 \tag{5-74}$$

Substitute the expressions of λ_1 and λ_2 from Equations (5-70) and (5-71) into Equation (5-69) to get the efficient mean-variance frontier as

$$d\sigma_\pi^2 - i_1^{'}\Omega_{11}^{-1}i_1\mu_\pi^2 + 2(i_1^{'}\Omega_{11}^{-1}i_1 d_1 - i_1^{'}\Omega_{11}^{-1}e_1 d_2)\mu_\pi - i_1^{'}\Omega_{11}^{-1}i_1^{'}d_1^2 + 2i_1^{'}\Omega_{11}^{-1}e_1 d_1 d_2 - e_1^{'}\Omega_{11}^{-1}e_1 d_2^2 = 0 \tag{5-75}$$

All of the possible portfolios on this frontier, according to Equation (5-75), are efficient. In addition, we rewrite this efficient frontier, by dividing Equation (5-75) by $i_1^{'}\Omega_{11}^{-1}i_1$, to obtain a hyperbolic function in the μ_π - σ_π^2 space of

$$d\eta\sigma_\pi^2 + (\delta^2 - \gamma)d_2^2 = \left[\mu_\pi - (d_1 - \delta d_2)\right]^2 \tag{5-76}$$

where

$$\delta = \frac{i_1^{'}\Omega_{11}^{-1}e_1}{i_1^{'}\Omega_{11}^{-1}i_1} \tag{5-77}$$

$$\gamma = \frac{e_1^{'}\Omega_{11}^{-1}e_1}{i_1^{'}\Omega_{11}^{-1}i_1} \tag{5-78}$$

$$\eta = \frac{1}{i_1^{'}\Omega_{11}^{-1}i_1} \tag{5-79}$$

The optimal value of the mean return, μ_π, can be determined from the mean-variance frontier, Equation (5-76), and this optimal can then be used in Equations (5-65), (5-70) and (5-71) to obtain the optimal portfolio of the choice assets, $\hat{A}_1$. For example, if the bank chooses the portfolio as the point *P* in Figure 5-2, where the line *DP* touches the mean-variance curve *AB*, this tangent line can be expressed as

$$\mu_\pi = R + k\sigma_\pi \tag{5-80}$$

where *R* is the vertical intercept representing the critical value or disaster level, and *k* is the slope of the line *DP*.

At the optimal portfolio point *P,* the tangent line *DP* and the mean variance curve *AB* must be equal. Thus, substituting μ_π from Equation (5-80) into Equation (5-76) gives

$$(d\eta - k^2)\sigma_\pi^2 + 2k(d_1 - R - \delta d_2)\sigma_\pi - \left[R - (d_1 - \delta d_2)\right]^2 + (\delta^2 - \gamma)d^2 = 0 \tag{5-81}$$

Equation (5-81) can be written as a quadratic function of σ_π as

$$a\sigma_\pi^2 + b\sigma_\pi + c = 0 \tag{5-82}$$

where

$$a = d\eta - k^2 \tag{5-83}$$

$$b = 2k(d_1 - R - \delta d_2) \tag{5-84}$$

$$c = -\left[R - (d_1 - \delta d_2)\right]^2 + (\delta^2 - \gamma)d^2 \tag{5-85}$$

In general, there will be two solutions for σ_π, given by

$$\sigma_\pi = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{5-86}$$

Since, at point *P* where line *DP* is tangent to the curve *AB*, it must be the only one of these roots for Equation (5-82) which is required, that

$$b^2 - 4ac = 0 \tag{5-87}$$

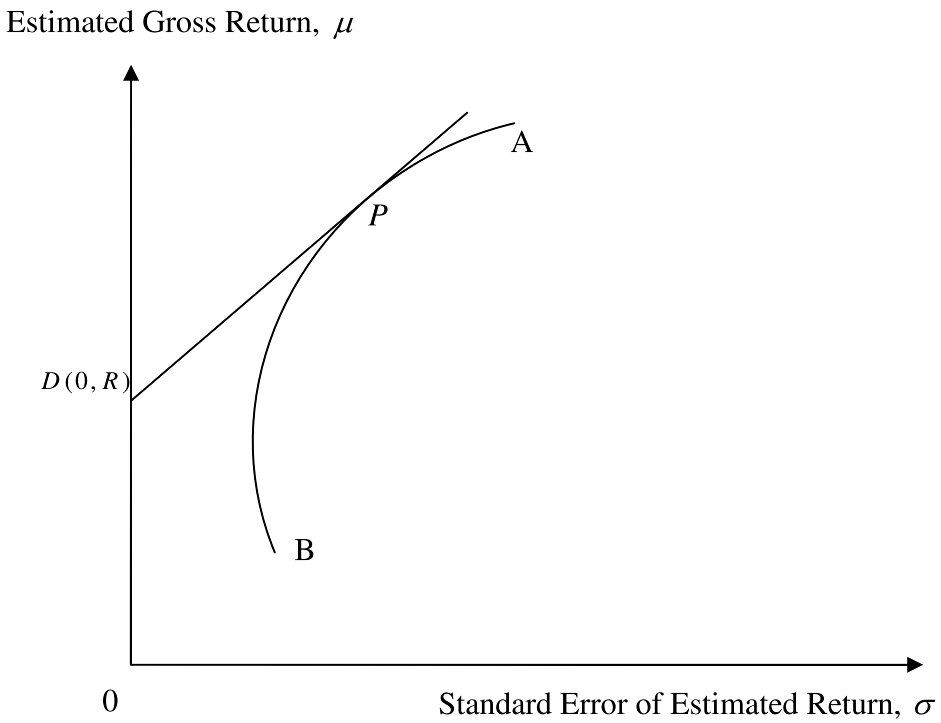
or

$$4k^2(d_1 - R - \delta d_2)^2 - 4(d\eta - k^2)\ \left[(\delta^2 - \gamma)d_2^2 - (R - d_1 + \delta d_2)^2\right] = 0 \tag{5-88}$$

Thus, the solution of k^2 is

$$k^2 = d\eta\left[1 - \frac{(R - d_1 + \delta d_2)^2}{(\delta^2 - \gamma)d_2^2}\right] \tag{5-89}$$

Figure 5-2: The graphical determination of the bank portfolio decision-making



Equation (5-89) shows that the slope of the tangent line *DP* is *k.* At this point of tangency, this slope has to be equal to the slope of the efficient mean-variance frontier *AB* which can be found by taking the differentiation of Equation (5-76) with respect to σ_π, which is

$$\frac{\partial \mu_\pi}{\partial \sigma_\pi} = \frac{d\eta}{\mu_\pi - d_1 + \delta d_2}\sigma_\pi \tag{5-90}$$

Substitute $\sigma_\pi = \dfrac{\mu_\pi - R}{k}$ from Equation (5-80) into Equation (5-90) to get

$$\frac{\partial \mu_\pi}{\partial \sigma_\pi} = \frac{d\eta}{\mu_\pi - d_1 + \delta d_2}(\frac{\mu_\pi - R}{k}) \tag{5-91}$$

These two slopes are equal as

$$k = \frac{d\eta}{\mu_\pi - d_1 + \delta d_2}(\frac{\mu_\pi - R}{k}) \tag{5-92}$$

Thus, the optimal value of μ_π can be obtained as

$$\mu_\pi = \frac{d\eta R - k^2(d_1 - \delta d_2)}{d\eta - k^2} \tag{5-93}$$

Substitute k^2 from Equation (5-89) into Equation (5-93), so that

$$\mu_\pi = \frac{(\delta^2 - \gamma)d_2^2}{(R - d_1 + \delta d_2)} + d_1 - \delta d_2 \tag{5-94}$$

Substitute the expression of μ_π from Equation (5-94) into Equations (5-70) and (5-71) and using the expression of δ from Equation (5-77) to get the solution of λ_1 and λ_2, which do not involve μ_π and σ_π, as

$$\lambda_1 = -\frac{d_2^2}{i_1^{'}\Omega_{11}^{1} i_1(\delta d_2 - d_1 + R)} = -\frac{d_2}{\left[e_1 - (d_1 - R)/d_2 i_1\right]^{'}\Omega_{11}^{-1} i_1} \tag{5-95}$$

$$\lambda_2 = \frac{(R - d_1)d_2}{i_1^{'}\Omega_{11}^{1} i_1(\delta d_2 - d_1 + R)} = \frac{R - d_1}{\left[e_1 - (d_1 - R)/d_2 i_1\right]^{'}\Omega_{11}^{-1} i_1} \tag{5-96}$$

Substitute the solution from Equations (5-95) and (5-96) into Equation (5-65) to yield the bank's optimal asset demand equation:

$$\hat{A}_1 = -\frac{\Omega_{11}^{-1}\left[e_1 - (d_1 - R)/d_2 i_1\right]}{\left[e_1 - (d_1 - R)/d_2 i_1\right]' \Omega_{11}^{-1} i_1} d_2 \tag{5-97}$$

where

$$\Omega_{11}^{-1} = \frac{1}{|\Omega_{11}|} M_{11} \tag{5-98}$$

with $|\Omega_{11}|$ as the determinant of Ω_{11} and M_{11} as the joint matrix of Ω_{11} and with m_{ij} being the cofactor of the $(i, j)^{th}$ element of Ω_{11}.

The optimal portfolio in Equation (5-97) requires that the inverse matrix Ω_{11}^{-1} should exist. From Equation (5-98), this inverse matrix exists if and only if $|\Omega_{11}|$ is positively definite. That is, that all the rates of return on the choice items are not linearly dependent in the mathematical sense.

In addition, assume

$$m_i = \sum_{j=1}^{m} m_{ij} \tag{5-99}$$

as the sum of the element of the i^{th} row of the adjoint matrix M_{11}. Since the covariance matrix Ω_{11} is symmetric, M_{11} is also symmetric, so that

$$m_i = \sum_{j=1}^{m} m_{ij} = \sum_{j=1}^{m} m_{ji} \tag{5-100}$$

In particular, in the case that Ω_{11} is assumed to be a diagonal matrix, M_{11} will be a diagonal matrix as well. That is,

$$m_i = m_{ii} \tag{5-101}$$

Thus, if the i^{th} element of $\hat{A}_1$ and its expected return, e_1, are defined as $\hat{a}_{1i}$ and e_{1i}, respectively, the bank's optimal holding of asset i can be expressed as

$$\hat{a}_{1i} = -\frac{m_{i1}\left[e_{11}-(d_1-R)/d_2\right]+m_{i2}\left[e_{12}-(d_1-R)/d_2\right]+...+m_{im}\left[e_{1m}-(d_1-R)/d_2\right]}{m_1\left[e_{11}-(d_1-R)/d_2\right]+m_2\left[e_{12}-(d_1-R)/d_2\right]+...+m_m\left[e_{1m}-(d_1-R)/d_2\right]}d_2 \tag{5-102}$$

The demand equations presented in Equation (5-102) are nonlinear with the denominators the same for all asset demand equations, since the denominator is independent of the subscript *i*. In addition, $d_1 = \hat{A}_2^{'}e_2$ and $d_2 = \hat{A}_2^{'}i_2$, where $\hat{A}_2, e_2$ are the expected levels and the expected rate of returns of non-choice items, respectively. Thus, Equation (5-102) shows that the bank's optimal choice assets depend not only on the expected rates of return on choice items and the riskiness of the returns (i.e., the covariance) but also on the expected return rates and the expected levels of non-choice items. That is, the Safety First model incorporates the effects of the exogenous variables into the decision-making and allows us to examine how the change in non-choice items can affect the optimal levels of the choice items.

In addition, assume that all choice assets are contained in $\hat{A}_1$, and all liabilities which are treated as negative assets are included in $\hat{A}_2$. Thus, $d_2 = \hat{A}_2^{'} i_2$ is the total disposable fund that the bank can invest in the choice assets, or, in other words, it is the bank's total wealth, and $d_1 = \hat{A}_2^{'} e_2$ is the net cost of the bank's liabilities. That is, the unit cost of disposable funds, or, in other words, the unit cost of liabilities, can be expressed as

$$c_n = \frac{d_1}{d_2} = \frac{(A_2^{'} e_2)}{(A_2^{'} i_2)} \tag{5-103}$$

and the disaster rate of return required for each unit of liabilities can be written as

$$r_c = -\frac{R}{d_2} \tag{5-104}$$

Therefore, the bank's demand for asset i is

$$\hat{a}_{1i} = -\frac{m_{i1}\left[(e_{11} - c_n) - r_c\right] + m_{i2}\left[(e_{12} - c_n) - r_c\right] + \ldots + m_{im}\left[(e_{1m} - c_n) - r_c\right]}{m_1\left[(e_{11} - c_n) - r_c\right] + m_2\left[(e_{12} - c_n) - r_c\right] + \ldots + m_m\left[(e_{1m} - c_n) - r_c\right]} d_2 \tag{5-105}$$

Equation (5-105) can be used in order to consider which assets the bank should hold in its portfolio. In particular, the bank will decide to hold some of its total disposal funds in the asset whose net expected rates of return, measured by the difference between the gross expected rate of return and the net unit cost of disposable funds, $\left(e_{1i} - c_n\right)$ for $i=1,2,\ldots,m$, is greater than the disaster rate of return, r_c , while the rates of return of all other assets fall to the disaster rate of return. In contrast, regarding any asset whose net expected rate of return is less than the disaster rate of return, the bank would then eliminate this asset from its portfolio. The proportion of each asset in the bank's portfolio depends on the size of the difference between the net expected rate of return on this particular asset and the disaster rate of return, and the variance and covariance of the expected returns.

The interesting point is that the bank's optimal asset holding presented in Equation (5-105) is nonlinear. That is, if, for example, all the asset returns are not correlated with each other, i.e. if Ω_{11} is diagonal, then, given the definition of $m_i = \sum_{j=1}^{m} m_{ij} = \sum_{j=1}^{m} m_{ji}$ as in Equation (5-100), Equation (5-105) can be rewritten as

$$\hat{a}_{1i} = -\frac{m_{ii}\left[(e_{1i} - c_n) - r_c\right]}{m_{11}\left[(e_{11} - c_n) - r_c\right] + m_{22}\left[(e_{12} - c_n) - r_c\right] + \ldots + m_{mm}\left[(e_{1m} - c_n) - r_c\right]} d_2 \qquad \text{(5-106)}$$

That is, even when the returns on the choice items are not correlated with each other, the demand for the particular asset depends not only on its own expected rate of return but also on the expected rates of return on all other assets in the choice set.

5.3.3 The empirical application of the Safety First model and bank lending behaviour

In order to apply the Safety First Principle to the bank's portfolio decision, the same assumptions used for the empirical estimation for the Expected Utility Maximisation model still hold. That is, the bank is assumed to hold two types of asset: loans and other earning assets, which both are assumed to be choice assets. The bank's liability side includes two liabilities: deposits and equities, the former of which is assumed to be a choice item while the latter is assumed to be a non-choice item and exogenous, in the sense that it will be chosen at the beginning of the decision period and does not change during over the period. All of the assets and liabilities are assumed to have the same returns structures as when the bank maximised its expected utility.

By assuming that the rates of returns on assets (liabilities) are not correlated with the level of the assets (liabilities) and only the rates of return within the choice items are correlated with each other, we can ascertain the empirical expression for the demands for loans, other earning assets, and deposits as

$$\tilde{a}_{L,t} = -\frac{m_{LL}\left[\tilde{e}_{L,t} - (d_{1,t} - R_t)/d_{2,t}\right] + m_{LO}\left[\tilde{e}_{O,t} - (d_{1,t} - R_t)/d_{2,t}\right] + m_{LD}\left[\tilde{e}_{D,t} - (d_{1,t} - R_t)/d_{2,t}\right]}{\begin{array}{l}\left[m_{LL} + m_{LO} + m_{LD}\right]\left[\tilde{e}_{L,t} - (d_{1,t} - R_t)/d_{2,t}\right] + \left[m_{LO} + m_{OO} + m_{OD}\right]\left[\tilde{e}_{O,t} - (d_{1,t} - R_t)/d_{2,t}\right] \\ + \left[m_{LD} + m_{OD} + m_{DD}\right]\left[\tilde{e}_{D,t} - (d_{1,t} - R_t)/d_{2,t}\right]\end{array}} d_{2,t} \tag{5-107}$$

$$\tilde{a}_{O,t} = -\frac{m_{LO}\left[\tilde{e}_{L,t}-(d_{1,t}-R_t)/d_{2,t}\right]+m_{OO}\left[\tilde{e}_{O,t}-(d_{1,t}-R_t)/d_{2,t}\right]+m_{OD}\left[\tilde{e}_{D,t}-(d_{1,t}-R_t)/d_{2,t}\right]}{\begin{array}{l}\left[m_{LL}+m_{LO}+m_{LD}\right]\left[\tilde{e}_{L,t}-(d_{1,t}-R_t)/d_{2,t}\right]+\left[m_{LO}+m_{OO}+m_{OD}\right]\left[\tilde{e}_{O,t}-(d_{1,t}-R_t)/d_{2,t}\right]\\ +\left[m_{LD}+m_{OD}+m_{DD}\right]\left[\tilde{e}_{D,t}-(d_{1,t}-R_t)/d_{2,t}\right]\end{array}} d_{2,t}$$

(5-108)

$$\tilde{a}_{D,t} = -\frac{m_{LD}\left[\tilde{e}_{L,t}-(d_{1,t}-R_t)/d_{2,t}\right]+m_{OD}\left[\tilde{e}_{O,t}-(d_{1,t}-R_t)/d_{2,t}\right]+m_{DD}\left[\tilde{e}_{D,t}-(d_{1,t}-R_t)/d_{2,t}\right]}{\begin{array}{l}\left[m_{LL}+m_{LO}+m_{LD}\right]\left[\tilde{e}_{L,t}-(d_{1,t}-R_t)/d_{2,t}\right]+\left[m_{LO}+m_{OO}+m_{OD}\right]\left[\tilde{e}_{O,t}-(d_{1,t}-R_t)/d_{2,t}\right]\\ +\left[m_{LD}+m_{OD}+m_{DD}\right]\left[\tilde{e}_{D,t}-(d_{1,t}-R_t)/d_{2,t}\right]\end{array}} d_{2,t}$$

(5-109)

where

$\tilde{a}_{L,t}$, $\tilde{a}_{O,t}$ and $\tilde{a}_{D,t}$ are the observed levels of loan, other earning assets and deposits, at period *t*.

$\tilde{e}_{L,t}$ $\tilde{e}_{O,t}$ and $\tilde{e}_{D,t}$ are the observed rates of the banks' choice items at period *t*.

R_t is the critical value or disaster level at period *t*.

$\varepsilon_{L,t}$, $\varepsilon_{O,t}$ and $\varepsilon_{D,t}$ are the error terms for the corresponding choice items.

$$d_{1,t} = A'_{2,t}e_{2,t} = \tilde{a}_{E,t}\tilde{e}_{E,t} \qquad (5\text{-}110)$$

$$d_{2,t} = A'_2 i_2 = \tilde{a}_{E,t} + \tilde{a}_{B,t} \qquad (5\text{-}111)$$

Equation (5-110) presents the total cost of non-choice items and Equation (5-111) shows that the total amount of non-choice items, with $\tilde{a}_{E,t}$ and $\tilde{a}_{B,t}$ are the observed levels of equity and the balancing item at period *t*.

In order to eliminate the size effects, the decisions of each choice item can be expressed in terms of shares by dividing both sides of Equations (5-107) – (5-109) by the sum of the non-choice items, $d_{2,t} = \hat{a}_{E,t} + \hat{a}_{B,t}$. These can be expressed in matrix form as

$$\begin{bmatrix} \tilde{s}_{L,t} \\ \tilde{s}_{O,t} \\ \tilde{s}_{D,t} \end{bmatrix} = \frac{\begin{pmatrix} m_{LL} & m_{LO} & m_{LD} \\ m_{LO} & m_{OO} & m_{OD} \\ m_{LD} & m_{OD} & m_{DD} \end{pmatrix} \begin{bmatrix} \tilde{e}_{L,t} - (d_{1,t} - R_t)/d_{2,t} \\ \tilde{e}_{O,t} - (d_{1,t} - R_t)/d_{2,t} \\ \tilde{e}_{D,t} - (d_{1,t} - R_t)/d_{2,t} \end{bmatrix}}{\begin{bmatrix} \tilde{e}_{L,t} - (d_{1,t} - R_t)/d_{2,t} \\ \tilde{e}_{O,t} - (d_{1,t} - R_t)/d_{2,t} \\ \tilde{e}_{D,t} - (d_{1,t} - R_t)/d_{2,t} \end{bmatrix} \begin{bmatrix} m_{LL} + m_{LO} + m_{LD} \\ m_{LO} + m_{OO} + m_{OD} \\ m_{LD} + m_{OD} + m_{DD} \end{bmatrix}} + \begin{bmatrix} \varepsilon_{L,t} \\ \varepsilon_{O,t} \\ \varepsilon_{D,t} \end{bmatrix} \qquad (5\text{-}112)$$

where

$\tilde{s}_{L,t}, \tilde{s}_{O,t}$ and $s_{D,t}$ are the observed shares of loans, other earning assets and deposits of bank *i* operating in country *j* in period *t*, respectively.

$\begin{pmatrix} m_{LL} & m_{LO} & m_{LD} \\ m_{LO} & m_{OO} & m_{OD} \\ m_{LD} & m_{OD} & m_{DD} \end{pmatrix}$ is the variance-covariance matrix of the rates of return on the choice items.

We can see that all the denominators of these three optimal equations are the same, which include the expected rates of returns of all the choice and non-choice items. This demonstrates that the Safety First criteria depends on the overall portfolio risk, σ_π , which is determined by all the assets and liabilities.

5.4 Non-nested hypothesis testing

5.4.1 Literature Review

In the previous sections, two different models for bank portfolio selection behaviour were developed. Under the Expected Utility Maximisation model, commercial banks will select the combinations of assets in order to maximise their expected utility, which is a function of the expected rate of return and associated risk. In the Safety First Principle, however, banks are concerned only that the expected rate of return will not fall below a predetermined disaster level.

The major objective of this chapter is to answer the question whether the Expected Utility Maximisation of the Safety First model is better at explaining the lending behaviour of banks involved in merger activities, and whether it is different from the model which describes the lending behaviour of non-merging banks. In order to compare these two models, the non-nested hypothesis test, which is used to compare the models whose details are inaccessible from one another by the imposition of appropriate parametric restriction, will be applied.

The first procedure of the non-nested tests was originally introduced by Cox (1961, 1962). This technique is to test the validity of models as a generalisation of the likelihood ratio test. The idea is that the validity of a null hypothesis is tested by comparing the value of the log likelihood ratio between the null hypothesis and some alternative hypotheses, with an estimate of the expected value of this quantity if the null hypothesis is a true model. Pesaran and Deaton (1978) extend Cox's technique in order to compare the non-linear and multivariate regression models. This procedure aims to test whether the truth of one model can be maintained, given the performance of the same data on an alternative model. These two models can be reversed and it is entirely possible that both (or neither) may be rejected. Davidson and Mackinnon (1982) propose two non-nested testing techniques, called the *J*-test and the *P*-test. These two tests are based on the same procedure, in that both models will be generalised into one artificial compound model and the validity of the model will be evaluated by Maximum Likelihood estimates of this model.

5.4.2 The *J*-test and the *P*-test

Because we have to compare the Expected Utility Maximisation model, which is a linear model, and the Safety First model, which is a strongly non-linear one, the *J*-test and the *P*-test of Davidson and Mackinnon (1982), which can provide the test statistics for both linear and non-linear regressions, will be applied.

For the *J*-test, the null hypothesis and the alternative hypothesis may be in such forms as

$$H_0 : A_i = f_i(X_i, \beta) + \varepsilon_{0i} \tag{5-113}$$

and

$$H_1 : A_i = g_i(Z_i, \gamma) + \varepsilon_{1i} \tag{5-114}$$

where

A_i ($i= 1,\ldots,n$) are the observations on dependent variables.

f_i and g_i are the continuous and second-order differentiable functions.

X_i and Z_i are the vectors of observation on exogenous independent variables.

β and γ are the vectors of unknown parameters to be estimated.

ε_{0i} and ε_{1i} are the error terms which are assumed to be serially independent and multivariate normal with means zero and an unknown nonsingular covariance matrix, and independent of X_i and Z_i.

To get the *J*-test, H_0 and H_1 are nested in an artificial compound model as

$$A_i = (1-\alpha) f_i(X_{i,}\beta) + \alpha g_i(Z_{i,}\gamma) + \varepsilon_i \tag{5-115}$$

To ensure that α in Equation (5-115) can be identified, γ is replaced by its Maximum Likelihood parameter $\hat{\gamma}$. Thus, to test the validity of H_0, the following regression is estimated:

$$A_i = (1-\alpha) f_i(X_{i,}\beta) + \alpha \hat{g}_i + \varepsilon_i \tag{5-116}$$

where $\hat{g}_i$ denoted $g_i(Z_i, \hat{\gamma})$ is the estimated function of the exogenous variables Z_i and the Maximum Likelihood estimate parameter vector $\hat{\gamma}$. The *J*-test is the conventional asymptotic t-statistic for the test that α in Equation (5-116) equals 0, which is asymptotically normally distributed with mean zero and variance 1 if H_0 is a true model.

For the *P*-test, Davidson and Mackinnon linearise the *J*-test regression (5-116) around the point $(\alpha = 0, \beta = \hat{\beta})$ where $\hat{\beta}$ is the Maximum Likelihood estimate of β. The estimated regression is in the form

$$A_i - \hat{f}_i = \hat{F}_I b + \alpha(\hat{g}_i - \hat{f}_i) + \varepsilon_i \tag{5-117}$$

where $\hat{f}_i = f(\hat{\beta})$, $b = \beta - \hat{\beta}$ and $\hat{F}_i = F(\hat{\beta})$ is a row vector of the derivatives of f with respect to the parameters β for the i^{th} observation evaluated at $\hat{\beta}$. The *P*-test is simply the t-statistic of $\alpha = 0$ in Equation (5-117).

In a general case, if the estimated parameter α is not significantly different from 0, H_0 is accepted. If H_1 is true, the estimate of α will asymptotically converge to 1. Thus, when α is statistically significant and close to unity, H_0 can be rejected in a direction towards H_1; but, if α is statistically significantly different from unity, H_0 can be rejected in a direction away from H_1. However, the rejection of H_0 does not mean the truth of H_1. Or, in other words, although we might assume that the alternative hypothesis H_1 is true if α converges to 1, it is not necessarily true. It is because the t-statistics of the *J*-test and the *P*-test are conditional on the truth of H_0 and not on the truth of H_1. Thus, H_0 and H_1 must be reversed to test for the alternative models.

In addition, Davidson and Mackinnon (1981, p. 782-783) recommend that if H_0 is linear the *J*-test is easier, while it is extremely easy to use the *P*-test if H_0 is nonlinear. Moreover, if H_0 is linear these two procedures will obtain identical results. In addition, for a non-linear regression, the results will be different but they will obtain the same results asymptotically when H_0 is true.

That is, if the Expected Utility Maximisation model is considered as a null hypothesis against the Safety First model, the *J*-test will be used. If H_0 is true, the results will be exactly the same as when we use the *P*-test. In contrast, if the Safety First model is tested as a null hypothesis against the Expected Utility Maximisation model, the *P*-test will be applied. If H_0 is true, the results from the *P*-test will be asymptotically the same as when the J-test is employed. Therefore, we can use only the *J*-test, which is simpler and easier for both cases, and receive asymptotically identical results.

5.5. Data and variables

The data used in this chapter are the data of large European commercial banks gathered from the BankScope database. These commercial banks include both banks which engaged in merger activities and non-merging banks, both operating in EU15 countries during the period 1997-2005. Since no bank in Finland or Denmark merged during this period, we exclude the data of all banks from these two countries from our analysis. Therefore, in total, there are 106 banks composed of 39 merged banks and 67 non-merging banks for our consideration.

According to the models developed in the previous sections, the bank is assumed to hold two types of asset: loans and other earning assets and two types of liability:

deposits and equity, which are both considered negative assets. As in the general balance sheet constraint, the bank's asset and liability sides have to be equal with the balancing items as the netting of the portfolio, or, in other words, as the net total value of all other banking balance sheet items including non-interest assets/liabilities and reserves. That is, the balancing item can be expressed as

$$Balancing_{i,j,t} = Loan_{i,j,t} + OEA_{i,j,t} - Deposit_{i,j,t} - Equity_{i,j,t} \tag{5-118}$$

where i refers to banks, j refers to countries and t refers to years.

With both the Expected Utility Maximisation approach and the Safety First Principle, loans, other earning assets and deposits are assumed to be choice items, while equity and balancing items are non-choice items. Therefore, the dependent variables in our analysis, for both models, include loans, other earning assets and deposits. Regarding the Expected Utility Maximisation approach, as presented in Equation (5-38), the optimal size of the choice items in the bank's portfolio depend on the return on every choice item and the levels of every non-choice item. However, with the Safety First Principle, the optimal conditions depend on the rates of return of every asset and liability in the bank's portfolio, as shown in Equation (5-106).

In order to control for the difference in bank sizes, the shares of assets and liabilities are included in the estimation and not the levels. As suggested by the Safety First approach, since the sum of non-choice items is the total of disposable funds, or, in other words the total wealth which the bank can invest in the choice items, we can therefore define the share of each asset (liability) as this choice asset (liability) per unit of the total non-choice items. This means that these shares are computed by dividing the volumes of assets (liabilities) by the sum of the equity and balancing item. In addition, by doing this, we find the absolute value of the sum of the equity share and balancing item share equalling 1, i.e. $\left| s_{E,i,t} + s_{B,i,t} \right| = 1$. As a consequence, including both shares in the analysis of the Expected Utility Maximisation model will also lead to the singularity problem. Thus, to eliminate the singularity problem, we only include the equity share as the independent variable in the equations. The shares of assets and liabilities used in this analysis can be defined in the forms

$$\tilde{s}_{L,i,j,t} = \frac{Loan_{i.,j,t}}{Equity_{i,j,t} + BalancingItem_{i,j,t}} \tag{5-119}$$

$$\tilde{s}_{O,i,j,t} = \frac{OEA_{i.,j,t}}{Equity_{i,j,t} + BalancingItem_{i,j,t}} \tag{5-120}$$

$$\tilde{s}_{D,i,j,t} = \frac{Deposit_{i.,j,t}}{Equity_{i,j,t} + BalancingItem_{i,j,t}} \tag{5-121}$$

$$\tilde{s}_{E,i,j,t} = \frac{Equity_{i.,j,t}}{Equity_{i,j,t} + BalancingItem_{i,j,t}} \tag{5-122}$$

where

$i=1,\ldots,n$

$t=1,\ldots,T$

$j=1,\ldots,J$

$\tilde{s}_{L,i,t}, \tilde{s}_{O,i,t}, \tilde{s}_{D,i,t}$ and $\tilde{s}_{E,i,t}$ and are the shares of loans, other earning assets, deposits and the equity of bank *i* operating in country *j* in period *t* respectively.

$Loan_{i,j,t}, OEA_{i,j,t}, Deposit_{i,j,t}, Equity_{i,j,t}$ and $BalancingItem_{i,j,t}$ are the amounts of loans, other earning assets, deposits, equity and the balancing item of bank *i* operating in country *j* in period *t*. The values of every item, excepting only the bank's balancing item, which is calculated from Equation (5-118), were obtained from the BankScope database. According to the definitions of this database, loans are measured as all types of loan from the bank. Other earning assets (OEA) consist of deposits with banks, due from other banks, short-term investments, investment securities, bills and bonds. Deposits include domestic non-interest bearing deposits, domestic interest bearing deposits and short-term funding. Equity includes perpetual preferred stock, common stock and retained earnings.

As in the previous chapters, for the rate of returns on assets and liability, due to the limitations of the data, we use artificial average rates for loans, deposits and equity as the measurements for their return rates. We follow the study of Kahn, Pennacchi and Sopranzetti (2001), who use the average loan interest rate instead of the precise rate charged to customers by the banks. This is because the income statements of banks in the BankScope database do not separate interest revenue earned on loans and interest earned from other earning assets; therefore, we use instead the average loan rate calculated from dividing a bank's interest revenue by the total amount of its issued loans plus the total amount of other earning assets. Similarly, for the return on deposits, the same problem applies. The income statements of the banks do not distinguish between interest paid on deposits and interest paid on other sources of funds. Therefore, we use the same method here also and receive the proxy for the deposit interest rate from dividing the bank's interest expenses by the total amount of its deposits plus the total amount of other funding. In addition, the rate of return on equity is also proxied by the average rate of dividend on equity. These return rates can be expressed as Equation (5-123) to Equation (5-125). The data of interest income, interest expense and dividend are from the bank's income statement, while the levels of loan, deposit, other earning asset, other funding and equity are from the bank's balance sheet date, both obtained from the BankScope database. Moreover, consistent with the previous chapters, following Nys (2003), Panaetta, Schivardi and Shum (2004) and Banal-Estonal and Ottaviani (2007), the 3-month interbank interest rate is used as a proxy for the return on other earning assets in our study. This rate is an annual average amount quoted as a percentage, obtained from the Eurostat database.

$$\tilde{e}_{L,i,j,t} = \frac{InterestIncome_{i,j,t}}{Loan_{i,j,t} + OEA_{i,j,t}} \tag{5-123}$$

$$\tilde{e}_{D,i,j,t} = \frac{InterestExpense_{i.,j,t}}{Deposit_{i,j,t} + OtherFunding_{i,j,t}} \tag{5-124}$$

$$\tilde{e}_{E,i,j,t} = \frac{Dividen_{i.j,t}}{Equity_{i,j,t}} \tag{5-125}$$

where $\tilde{e}_{L,i,t}$, $\tilde{e}_{D,i,t}$ and $\tilde{e}_{E,i,t}$ are the observed returns on loans, deposits and equity of bank *i* operating in country *j* at time *t*.

The descriptions of the variables are presented in Table 5-1. The characteristics of the data of merged banks and non-merging banks are presented in Table 5-2 and Table 5-3 respectively.

Table 5-1: Description of the variables

Variables	Symbols	Descriptions	Sources
Dependent variables	$\tilde{s}_{L,i,t}$	The share of loans in portfolio, as a percentage amount, calculated by dividing a bank's loan volume by the amount of equity plus the amount of balancing item	Author's own calculation. Loan and equity volumes are obtained from the BankScope database. Balancing item is calculated by Equation (5-118)
	$\tilde{s}_{O,i,t}$	The share of OEA in portfolio, as a percentage amount, calculated by dividing a bank's OEA volume by the amount of equity plus the amount of balancing item	Author's own calculation. OEA and equity volumes are obtained from the BankScope database. Balancing item is calculated by Equation (5-118)
	$\tilde{s}_{D,i,t}$	The share of deposit in portfolio, as a percentage amount , calculated by dividing a bank's deposit volume by the amount of equity plus the amount of balancing item	Author's own calculation. Deposit and equity volumes are obtained from the BankScope database. Balancing item is calculated by Equation (5-118)
Explanatory variables	$\tilde{s}_{E,i,t}$	The share of equity in portfolio, as a percentage amount, calculated by dividing a bank's equity volume by the amount of equity plus the amount of balancing item	Author's own calculation. Equity volumes are obtained from the BankScope database. Balancing item is calculated by Equation (5-118)

Table 5-1: Description of the variables *(continued).*

Variables	Symbols	Descriptions	Sources
Explanatory variables	$\tilde{e}_{L,i,t}$	The average loan interest rate, as a percentage value, calculated by dividing a bank's interest revenue by the total amount of loans plus the total amount of other earning assets	Author's own calculation. Values of interest revenue, loans and other earning assets are obtained from the BankScope database
	$\tilde{e}_{O,i,t}$	Annual average 3-month interbank rate in percentage amount	Eurostat database
	$\tilde{e}_{D,i,t}$	The average deposit interest rate, as a percentage value, calculated by dividing a bank's interest expense by the total amount of deposits plus the total amount of other funding	Author's own calculation. Values of interest expense, deposit and other funding are obtained from the BankScope database
	$\tilde{e}_{E,i,t}$	The average return on equity, as a percentage value, calculated by dividing a bank's dividend by the total amount of equity	Author's own calculation. Values of dividend and equity are obtained from the BankScope database

Table 5-2: Summary statistics of data: Merged banks

Variable	Mean	Standard Deviation	Minimum	Maximum
Loans (%)	53.82053	15.10789	2.21132	91.11459
Other earning assets (%)	36.77519	14.97346	3.92004	93.05668
Deposits (%)	71.39535	10.90404	21.91390	92.71909
Equity (%)	19.20036	10.46329	0.33172	68.69577
Loan rate (%)	5.89440	2.07435	1.20971	13.27683
Other earning assets rate (%)	1.88357	3.10430	0.00000	13.97000
Deposit rate (%)	3.91890	1.72832	0.77855	11.37939
Dividend rate (%)	4.404	4.543579	0.00000	35.27597

Table 5-3: Summary statistics of data: Non-merging banks

Variable	Mean	Standard Deviation	Minimum	Maximum
Loans (%)	57.56294	23.26632	.20535	99.13007
Other earning assets (%)	35.12311	22.99636	0.088409	98.55389
Deposits (%)	70.53868	18.48338	1.61444	96.51385
Equity (%)	22.14737	17.60685	0.54954	95.11262
Loan rate (%)	6.68726	4.98118	0.00000	27.94003
Other earning assets rate (%)	1.840051	6.774523	0.00000	13.97000
Deposit rate (%)	4.93773	5.05269	0.13303	16.08089
Dividend rate (%)	4.284641	6.774523	0.00000	64.59471

From Table 5-2 and Table 5-3, we can see that the two data groups are insignificantly different.

5.6 Methodology and empirical models

5.6.1 Assumptions in the estimations

In our estimations we assume, first, that all banks face the same decision period and maximise the same objective functions. Second, we assume that all banks have the same expectations about the future rate of return on assets so that the expected rates of return and the subjective variance-covariance matrix are the same for all banks. Third, we assume that all banks face the same transaction costs.

In addition, for the Safety First model, we make an additional assumption that the disaster return, R, equals zero for all banks. This means that every bank regards break-even or zero profit point as the critical value and will try to minimise the probability that the actual return from their portfolios will fall below this cost of funding. Moreover, we can see that the disaster level does not actually have any influence on the relative attractiveness of the assets in the portfolio since from the asset demand equations the same quantity of R is subtracted from each and every expected rate of return on the choice items.

In addition, from the existence of the balance sheet constraint, *Deposit = Loan + OEA – Equity – Balancing Item*, estimating the whole system of equations will lead to the singularity problem of the residual covariance matrix, making it impossible to identify some of the parameters. This problem can be solved by dropping one of the equations in the system; then the remaining system equations can be estimated simultaneously without losing any information and remain the statistical properties of the model. Therefore, we estimate our system equations without the deposit equation.

As mentioned, because the absolute value of the sum of equity share and balancing item share equal 1, in order to eliminate the singularity problem, only the equity share is considered as the independent variable in the equations.

Finally, we have to test the restrictions for demand equations. According to Courakis (1988, p.622), if the disposable fund is constant during the decision period, the change in a choice or non-choice items must be compensated by a change in one or more of the assets in the choice set. Therefore, the Cournot aggregation and Engel aggregation conditions[17] are already a direct solution of the budget constraint. However, the symmetry condition has to be tested, and here we found that the symmetry condition can be accepted for both models for the merged banks' data. However, it can be accepted at a 1% level of significance but not at a 5% for the non-merging bank data which we test for the Safety First model.

5.6.2 Empirical models

The empirical models of the optimal portfolio for approaches with both time and country dummy variables, when the deposits equations are deleted and only the equity share is included for the effect of non-choice items, can be expressed as

[17] The Cournot aggregation condition is the condition under which the variance covariance matrix has a zero row and column sum. In other words, the change in all items following a change in return must satisfy the budget constraint. The Engel aggregation condition is the condition under which the sum of the change in an asset according to the change in the level of non-choice items must add up to the initial change, i.e. which equals 1.

$$\tilde{s}_{L,i,j,t,EUM} = \lambda_{0L} + \lambda_{1L}\tilde{e}_{L,i,j,t} + \lambda_{2L}\tilde{e}_{O,i,j,t} + \lambda_{3L}\tilde{e}_{D,i,j,t} + \lambda_{4L}\tilde{s}_{E,i,j,t,EMU} + D_{Lt} + C_{Lj} + \varepsilon_{L,i,j,t,EUM}$$

(5-126)

and

$$\tilde{s}_{O,i,j,t,EUM} = \lambda_{0O} + \lambda_{1O}\tilde{e}_{L,i,j,t} + \lambda_{2O}\tilde{e}_{O,i,j,t} + \lambda_{3O}\tilde{e}_{D,i,j,t} + \lambda_{4O}\tilde{s}_{E,i,j,t,EMU} + D_{Ot} + C_{Oj} + \varepsilon_{O,i,j,t,EUM}$$

(5-127)

where

i = 1,…,n is the number of banks.

D_t are the year dummies for t = 1997-2005.

C_j are the country dummies.

$\tilde{s}_{L,i,j,t,EUM}$ and $\tilde{s}_{O,i,j,t,EUM}$ are the shares of loans and other earning assets of bank i operating in country j at time t.

$\varepsilon_{L,i,j,t,EUM}$ and $\varepsilon_{O,i,j,t,EUM}$ are the error terms, according to the Expected Utility Maximisation model.

$$\tilde{s}_{L,i,j,t,SFP} = \left\{ \frac{\begin{array}{l} m_{LL}\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + m_{LO}\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] \\ + m_{LD}\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] - m_{0L} \end{array}}{\begin{array}{c} \left[m_{LL} + m_{LO} + m_{LD}\right]\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + \\ \left[m_{LO} + m_{OO} + m_{OD}\right]\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + \\ \left[m_{LD} + m_{OD} + m_{DD}\right]\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] \\ -m_0\left[1 + m_{LO} + m_{OO} + m_{OD} + m_{LD} + m_{OD} + m_{DD}\right] \end{array}} \right\}$$
$$+ D_{Lt} + C_{Lj} + \varepsilon_{L,i,t,j,SFP}$$

(5-128)

$$\tilde{s}_{O,i,t,j,SFP} = \left\{ \frac{\begin{array}{l} m_{LO}\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + m_{OO}\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] \\ +m_{OD}\left[e_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] - m_{0O} \end{array}}{\begin{array}{l} \left[m_{LL} + m_{LO} + m_{LD}\right]\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + \\ \left[m_{LO} + m_{OO} + m_{OD}\right]\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + \\ \left[m_{LD} + m_{OD} + m_{DD}\right]\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] \\ -m_0\left[1 + m_{LO} + m_{OO} + m_{OD} + m_{LD} + m_{OD} + m_{DD}\right] \end{array}} \right\}$$

$$+D_{Ot} + C_{Oj} + \varepsilon_{O,i,j,t,SFP}$$

(5-129)

where

$i = 1,,,n$ is the number of banks.

$\tilde{s}_{L,i,,jt,SFP}$, $\tilde{s}_{O,i,j,t,SFP}$, and $\tilde{s}_{E,i,j,t,SFP}$ are the shares of loans, other earning assets and equity.

m_{0L} and m_{0O} are constants.

$\varepsilon_{L,i.t.SFP}$ and $\varepsilon_{O,i.t.SFP}$ are the error terms according to the Safety First principle model.

Note that the optimal asset demand equations according to the Safety First model are the non-linear system equations in which every equation has to be estimated simultaneously, since, for example, the demand for loans is actually affected by every element of the variance-covariance matrix. Therefore, we cannot estimate the equation separately but must estimate the whole system simultaneously. This needs the TSP program which simulates the denominators of every equation and obtains the results of each coefficient.

In addition, since the whole system of equations has to be estimated simultaneously for each period, the errors associated with each demand equation can be correlated. Furthermore, there is an association between these two equations in the existence of the balance sheet constraint and thus a shock to one error can be transmitted to another. According to Prucha (1985, p.491), we can use the Full Information Maximum Likelihood (FIML) to estimate the simultaneous model, in particular, when the model is non-linear with errors which are jointly normally distributed. In addition, as mentioned by Amemiya (1977, p.967), the FIML is the only known efficient estimator for models which are nonlinear in their parameters.

In brief, the FIML estimator is based on the entire system of equations, or, in other words, it treats all *M* equations and all parameters jointly. The object is to maximise the likelihood function of reduced form errors subject to a zero restriction on all structure form parameters in the system to get estimates of all the reduced form parameters. For example, if we have the structural equation

$$Y = X\Pi + V \tag{5-130}$$

where each row of *V* is assumed to be multivariate and normally distributed with zero mean and covariance matrix $E[v_t v_t^{'}] = \Omega$.

The log likelihood function for a sample of *T* jointly observed is

$$\ln L = -\frac{T}{2}[M \ln(2\Pi) + \ln|\Omega| + tr(\Omega^{-1}W)] \tag{5-131}$$

where

$$W = \frac{1}{T}(y - X\Pi_i^c)^{'}(y - X\Pi_j)^0$$

and Π_j^0 is the j column of Π

We can get the estimator by maximizing Equation (5-131) subject to all restrictions. In addition, we can substitute $\Pi = -B\Gamma^{-1}$ and $\Omega = (\Gamma^{-1})^{'}\Sigma\Gamma^{-1}$. We can have a simplified equation for (5-131), thus,

$$\ln L = -\frac{MT}{2}\ln(2\Pi) + T\ln|\Gamma| - \frac{T}{2}tr(\Sigma^{-1}S) - \frac{T}{2}\ln|\Sigma| \qquad (5\text{-}132)$$

where $S_{ij} = \frac{1}{T}(Y\Gamma_i + XB_i)^{'}(Y\Gamma_j + XB_j)$

In this way we can maximise Equation (5-132) to get the FIML estimators.

5.6.3 Empirical models for the Non-nested hypothesis testing

As mentioned earlier, the *J*-test and the *P*-test have identical results with a large number of observations. Thus, we can apply the *J*-test, which is much easier than the *P*-test in which we have to include the derivative as the explanation variable.

According to Davidson and Mackinnon, if we wish to test the null hypothesis that the true model is as the H_0 against the alternative hypothesis, H_1, the first step is nesting the two models into a general artificial model which includes the fitted value of the alternative model as an explanation variable. The second step is to regress this nested model and obtain the FIML estimates for this parameter of interest and test whether the coefficient is different from zero by using the conventional t-statistic. If the coefficient is not statistically different from zero, the null hypothesis cannot be rejected. However, as noted by Davidson and Mackinnon, the t-statistics are conditional on the truth of H_0 but not on the truth of H_1, which means that rejecting H_0 does not make H_1 a true model. Hence, we need to reverse H_0 and H_1 to test for the alternative model and repeat the whole procedure.

Therefore, if the Expected Utility Maximisation is assumed to be a true model, the testing hypothesis can be constructed as follows:

H_0 : Utility Maximisation

H_1 : Safety First

Thus, the *J*-test can be formulated from the following equations where the FIML estimates from the Safety First model are included as the explanation variables.

$$\tilde{s}^{'}_{L,i,j,t,EUM} = \lambda'_{0L} + \lambda'_{1L}\tilde{e}_{L,i,j,t} + \lambda'_{2L}\tilde{e}_{O,i,j,t} + \lambda'_{3L}\tilde{e}_{D,i,j,t} + \lambda'_{4L}\tilde{s}_{E,i,j,t} + \lambda'_{LNN}\tilde{s}^{'}_{L,i,j,t,SFP} + D^{'}_{Lt} + C^{'}_{Lj} + \varepsilon'_{L,i,j,t,EUM} \tag{5-133}$$

and

$$\tilde{s}^{'}_{O,i,j,t,EUM} = \lambda'_{0O} + \lambda'_{1O}\tilde{e}_{L,i,j,t} + \lambda'_{2O}\tilde{e}_{O,i,j,t} + \lambda'_{3O}\tilde{e}_{D,i,j,t} + \lambda'_{4O}\tilde{s}_{E,i,j,t} + \lambda'_{ONN}\tilde{s}^{'}_{E,i,j,t,SFP} + D^{'}_{Ot} + C^{'}_{Oj} + \varepsilon'_{O,i,j,t,EUM} \tag{5-134}$$

where λ'_{LNN} and λ'_{ONN} are the parameters for the non-nested test.

For the case when the Safety First model is a true model, the testing hypothesis is

H_0 : Safety First

H_1 : Utility Maximisation

The estimated models which have the FIML estimates of the Expected Utility Maximisation model included as independent variables can be expressed as

$$\tilde{s}'_{L,i,j,t,SFP} = \left\{ \frac{\begin{array}{l} m'_{LL}\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + m'_{LO}\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,t})/d_{2,i,j,t}\right] \\ +m'_{LD}\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] - m'_{0L} \end{array}}{\begin{array}{l} \left[m'_{LL} + m'_{LO} + m'_{LD}\right]\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + \\ \left[m'_{LO} + m'_{OO} + m'_{OD}\right]\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + \\ \left[m'_{LD} + m'_{OD} + m'_{DD}\right]\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] \\ -m'_0\left[1 + m'_{LO} + m'_{OO} + m'_{OD} + m'_{LD} + m'_{OD} + m'_{DD}\right] \end{array}} \right\}$$
$$+m'_{LNN}\tilde{s}'_{L,i,j,t,EUM} + D'_{L,t} + C'_{Lj} + \varepsilon'_{L,i,j,t,SFP} \tag{5-135}$$

and

$$\tilde{s}'_{O,i,j,t,SFP} = \left\{ \frac{\begin{array}{l} m'_{LO}\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] + m'_{OO}\left[\tilde{e}_{O,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] \\ +m'_{OD}\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,j,t})/d_{2,i,j,t}\right] - m'_{0O} \end{array}}{\begin{array}{l} [m'_{LL} + m'_{LO} + m'_{LD}]\left[\tilde{e}_{L,i,j,t} - (d_{1,i,j,t} - R_{i,t})/d_{2,i,t}\right] + \\ \left[m'_{LO} + m'_{OO} + m'_{OD}\right]\left[\tilde{e}_{O,i,j,t} - (d_{1,i,t} - R_{i,t})/d_{2,i,j,t}\right] + \\ \left[m'_{LD} + m'_{OD} + m'_{DD}\right]\left[\tilde{e}_{D,i,j,t} - (d_{1,i,j,t} - R_{i,t})/d_{2,i,j,t}\right] \\ -m'_0\left[1 + m'_{LO} + m'_{OO} + m'_{OD} + m'_{LD} + m'_{OD} + m'_{DD}\right] \end{array}} \right\}$$
$$+m'_{ONN}\tilde{s}'_{O,i,j,t,EUM} + D'_{Ot} + C'_{Oj} + \varepsilon'_{O,i,j,t,SFP} \tag{5-136}$$

where m'_{LNN} and m'_{ONN} are the parameters for the non-nested test.

5.7. Results

Tables 5-4 to 5-7 report the FIML estimates of merged and non-merging banks which are estimated by the Expected Utility Maximisation model and the Safety First model. In each cell we give the estimated coefficient values and in the brackets their associated t-statistics . The signs ***, ** and * indicate 1%, 5% and 10% significance respectively.

For the merged banks, the results of both the Expected Utility Maximisation and the Safety First models show that most of the coefficients are statistically significant excepting only the effects of the change in the level of non-choice item on demands for loans and on demands for other earning assets in the Expected Utility Maximisation model. As expected, the loan interest rate has a positive and statistically significant coefficient. This result is consistent with the risk-averse assumption which states that the ARA, presented by the coefficient of the choice asset's return, of the risk-averse bank will be positive. Thus, the higher return on a loan the higher the loan demand in a bank's portfolio. In addition, for the non-merging banks, most of the coefficients of the Expected Utility Maximisation are insignificant while most of the coefficients of the Safety First model are statistically significant.

Table 5-4: Estimation of the Expected Utility Maximisation model: Merged banks

	Constant	Loan rate	OEA rate	Deposit rate	Equity share
Loans share	-1.11324	.988743***	-.588144***	.770649***	.153885
	(-.733034)	(14.2933)	(-7.94865)	(8.33674)	(.227965)
Other earning assets share	4.98570***		.504697***	-.816297***	.280925
	(2.92756)		(4.98150)	(-3.09256)	(.360772)

Table 5-5: Estimation of the Safety First model: Merged banks

	Constant	Loan rate	OEA rate	Deposit rate
Loans share	3.42416***	.947811***	-1.03523***	-.343055***
	(3.83327)	(15.8331)	(-22.1755)	(-6.20215)
Other earning assets share	-2.00463		-.798014***	2.95103***
	(-1.22890)		(-3.25064)	(13.2957)

Table 5-6: Estimation of the Expected Utility Maximisation model: Non-merging banks

	Constant	Loan rate	OEA rate	Deposit rate	Equity share
Loans share	3.46220	-.260953	.310564***	.372318***	.826657
	(.370644)	(-1.55645)	(2.89480)	(3.01362)	(.179612)
Other earning assets share	9.65562		.098516	.212519	-8.28528
	(.261394)		(-1.45756)	(.251713)	(-.454355)

Table 5-7: Estimation of the Safety First model: Non-merging banks

	Constant	Loan rate	OEA rate	Deposit rate
Loans share	6.54685	.389357**	-.201107**	-.183050**
	(.764436)	(2.50623)	(-2.21287)	(-2.49091)
Other earning assets share	-4.37980**		1.07455***	-.261224
	(-2.37980)		(3.63531)	(-.815471)

The non-nested test results are reported in Tables 5-8 and 5-9. For the merged banks, as we can see from Table 5-8, when the Expected Utility Maximisation is assumed as a true model, the test testing parameters, λ'_{LNN} and λ'_{ONN} are not statistically significant. The P-values present the probability of whether λ'_{LNN} or λ'_{ONN} equals zero by the conventional asymptotic t test. As the p-value for the Wald test is higher than 0.100, they suggest that the null hypothesis cannot be rejected. That is, it indicates that the Expected Utility Maximisation is the true model. In addition, when we reverse the analysis, the results indicate that if the Safety First model is a true model, m'_{LNN} and m'_{ONN} are statistically significant and thus the null hypothesis can be rejected. This confirms that the Expected Utility Maximisation is a true model for the banks involved in M&As.

For the non-merging participants, Table 5-9 shows that when the Expected Utility Maximisation model is a true model, λ'_{LNN} is not statistically significant while λ'_{ONN} is statistically significant. The joint test suggests that the parameters are jointly significant at a 10% significance level, which implies that we can reject the null hypothesis that the Expected Utility Maximisation is a true model. In addition, when the Safety First model is assumed to be a true model, only the estimate m'_{LNN} is not statistically significant, the Wald test confirming that the parameters are jointly insignificant and therefore we cannot reject the null hypothesis that the Safety First model is the true model for the non-merging banks.

Table 5-8: Non-nested test estimation: Merged banks

The Expected Utility Maximisation is a true model

H_0 : Expected Utility Maximisation

H_1 : Safety First

Parameter	Estimate	Standard error	t-statistic	p-value
λ'_{LNN}	.292465	.151181	1.93454	.053
λ'_{ONN}	.175855	.221235	.794878	.427

Wald Test for the hypothesis that a given set of Parameters are jointly zero:

CHISQ(1) = 2.7038516 ; P-value = 0.10111

The Safety First model is a true model

H_0 : Safety First

H_1 : Expected Utility Maximisation

Parameter	Estimate	Standard error	t-statistic	p-value
m'_{LNN}	-2.86375	.410685	-6.97310	.000
m'_{ONN}	1.79110	.131692	13.6007	.000

Table 5-9: Non-nested test estimation: Non-merging banks

The Expected Utility Maximisation model is a true model

H_0 : Expected Utility Maximisation

H_1 : Safety First

Parameter	Estimate	Standard error	t-statistic	p-value
λ'_{LNN}	2.29629	1.51244	1.51827	.129
λ'_{ONN}	.599433	.192715	3.11046	.002

Wald Test for the hypothesis that the given set of Parameters are jointly zero:

CHISQ(1) = 3.5365046 ; P-value = 0.06003

The Safety First model is a true model

H_0 : Safety First

H_1 : Expected Utility Maximisation

Parameter	Estimate	Standard error	t-statistic	p-value
m'_{LNN}	.196595	.726723	.270522	.787
m'_{ONN}	.594311	.285067	1.08481	.031

Wald Test for the hypothesis that the given set of Parameters are jointly zero:

CHISQ(1) = 0.97597319 ; P-value = 0.32319

From the above results, the Expected Utility Maximisation is a better model for the merged banks' lending behaviour, while the Safety First is more appropriate to explain the non-merging banks' decision-making on loans. This implies that merged and non-merging banks have different objectives in managing their portfolios. Specifically, banks engaged in M&As may be able to exploit the benefits of being involved in merger activities and to diversify their risk. Therefore, M&A participants can have less concern in risking in their objectives. Their objectives then emphasise maximising their expected returns and thus we find that the Expected Utility Maximisation model definitively explains their lending behaviours. In contrast, banks which have not engaged in M&As consider more carefully the prevention of risks and try to minimise the probability that the expected returns will fall below the disaster level. In other words, they are more risk-averse and the Safety First model reasonably well represents their portfolio selection behaviours.

5.8. Conclusion

The aim of this chapter has been to examine whether banks involved in mergers and non-merging banks have different lending objectives. To determine this difference, two alternative portfolio selection approaches derived from different assumptions about banks' objectives were adopted. First came the Expected Utility Maximisation model, of Parkin, Gray and Barret (1970), which assumes that a commercial bank's objective is to maximise its expected returns, and second was Roy's Safety First Principle under which the bank is assumed to minimise risk by ensuring that the disaster level will not go below a predetermined disaster point.

Having applied the non-nested hypothesis testing technique of Davidson and Mackinnon (1982), the results indicate that the Safety First model performs well in describing non-merging banks while the behaviour of banks engaged in M&As is better explained by the Expected Utility Maximisation model. These results confirm that bank mergers have a significant impact on banks' lending behaviour. In particular, mergers can alter banks' attitude to risk. That is, non-merging banks are more risk averse and more concerned about risk, while merged banks focus on maximising their expected utility or expected return.

The difference in attitude to risk can be explained by two hypotheses regarding the motives behind bank mergers. The first hypothesis suggests that merged banks are less risk averse as a result of the benefits deriving from risk diversification as a consequence of merging. Geographic expansion through mergers can also increase loan diversification and thus reduce the cost of financial distress (Park and Pennachi, 2007, p.4). As risk diminishes, merged banks can have afford to give less consideration to risk and therefore choose the objective of maximising their utility as their priority. This positive relationship between bank mergers and risk diversification is supported by evidence of Boyd and Graham (1988), Craig and Santos (1997), Hugehes *et al.* (1999), Lown *et al.* (2000) and Mishra *et al.* (2005). At the same time, lower risk aversion can result in more risky portfolio choices by merged banks. As explained by the results of O'Hara and Shaw (1990), Boyd and Graham (1996), Kane (2000), Penas and Unal (2004), Rime (2005) and Brewer III and Jagtiani (2009), larger merged banks are more exposed to moral hazard as a consequence of being 'Too-Big-To-Fail'. As a result, merged banks could misuse the diversification gains to engage in risky activities with no concern for additional capital or charging a higher interest rate on uninsured debts. However, because this study aims to examine only whether merged banks have different lending objectives, asking which merger motive should be supported is outside its scope and offers a subject for study in the future.

Chapter 6

Conclusion and remarks

Mergers and Acquisitions (M&As) are among the corporate strategies dealing with the buying, selling and combining of different companies so as to finance and help a growing company without having to generate another business entity. The main rationale in explaining bank M&A activities is that merging firms seek to improve their financial performance. Consolidations can improve the efficiency gains of the banks which emerge through combining assets in new ways, increasing market share and market power, safeguarding access to important inputs, assessing new technologies, new customer groups or new geographical markets and diversifying.

Besides their impact on firms' performance, mergers also have a significant effect on consumers. Consumers may or may not obtain benefits from M&As. The pooling of assets through consolidation can create efficiency gains to entrepreneurs, and consumers can benefit if the gains are passed on to them in the form of lower prices, higher quality products or new products and services. At the same time, if M&As are not controlled by an effective competition policy, the market will be concentrated and controlled by high market power competitors so that consumers find themselves paying higher prices or faced with poorer quality products and services.

In the banking sector, M&As increased during the late 1990s. Three main factors encouraged the waves of M&As. First, M&As were used as a management strategy in order to increase shareholder gains through the increase in market power and/or efficiency improvements. Second, bank managers used M&As to enhance or defend their personal power and status. Finally, environmental factors such as government regulations encouraged the integration between financial institutions, in particular, between healthy banks and troubled ones.

Commercial bank M&As can have a significant impact on bank behaviour. In addition, since commercial banks are the main financial intermediary for collecting funds from depositors and supplying loans to borrowers, changes in their behaviour can affect banking market structure and the benefits of bank clients and even the development of the entire economy. Therefore, it is necessary for policy makers to understand the changes in bank lending behaviour consequent on the M&A process so that they can decide whether M&As in banking sectors should be encouraged and which policies relating to bank M&As should be designed and implemented in order to help increase prosperity and gradually raise living standards.

6.1 The summary of the results of the thesis

This thesis aims to investigate the impacts of M&As on commercial bank lending behaviour. We use the data of large commercial banks operating in the EU15 countries during the period 1997 to 2005 to investigate whether merged banks have different lending behaviour from non-merging ones. The results obtained from every empirical analysis provide evidence to show that bank mergers can have substantial influence on the difference in bank lending behaviour. In Chapter 3, the Monti-Klein model of the banking firm is applied to examine the impact of bank mergers on loan pricing behaviour. Based on this model, the estimated regression equation of the optimal loan interest rates depends on macroeconomic situations, in particular, the elasticity of demand for loans, financial market competition and bank characteristics, including the cost of managing loans, liquidity risk and default risk. In addition, the merge effect is included by the use of a binary merger dummy variable.

Estimating the regression model using the random effect estimation technique, the results of Chapter 3 confirm the importance of bank M&As for the decision-making on banks' loan interest rates. That is, banks involved in M&A activities tend to set lower loan interest rates than non-merging banks. This situation suggests that, as other variables are constant, efficiency gains can be obtained from consolidations and banks can pass these benefits on to their borrowers by charging less for borrowing. However, merged banks have different loan pricing behaviour in different market situations. That is, if mergers have a substantial impact on financial structure, banks involved in M&As can use their market power and set higher loan prices than can non-merging banks.

The significant role of bank mergers on loan pricing behaviour is also supported by the empirical results in Chapter 4. The main contribution of this chapter is the use of the Difference-in-Differences (DID) estimation technique to analyse the impacts of bank mergers on bank lending behaviour. To the best of our knowledge, this is the first and only study which has applied this technique in the context of the effects of bank mergers.

In Chapter 4, the DID estimation method is applied to examine the impact of bank mergers on lending behaviour in three areas: loan interest rates, interest rate margins, and credit availability. Using this method, we can investigate the differences in the pre- and post-merger lending behaviour of merged banks and also the differences in the post-merger lending behaviour of merged banks and that of banks which have not merged. Consistent with the findings from Chapter 3, the DID estimators indicate that bank mergers can create value gains to consumers. That is, bank mergers tend to lower the loan interest rates of merged banks. In addition, merged banks tend to have lower interest margins post-merger; these are also lower than those of non-merging banks. For credit supply, the results indicate that, although the amount of available credit from merged banks' tends to decline, this adverse effect is significant only in the short term. In the long run, bank mergers have no significant influence on the changes in banks' decision-making on the supply of credit.

In Chapter 5, we examine whether consolidations affect banks' lending objectives. Two extremely opposed portfolio selection models for commercial banks are applied in this context. First is the Expected Utility Maximisation model developed by Parkin, Gray and Barrett (1970), in which the bank's objective is to maximise its expected profit. Second is the Safety First Principle developed by Roy (1952), where the lending objective is to minimise the probability that the disaster level will not descend below a predetermined disaster point. In order to ascertain which model is better at explaining merged banks' lending objectives, the non-nested testing technique of Davidson and Mackinnon (1981) is applied.

The non-nested test results make it clear that the Expected Utility Maximisation model performs well in describing the portfolio selection behaviour of merged banks, while the Safety First model is more suitable for explaining the behaviour of non-merging banks. This result implies that commercial banks which are not engaged in merger activities are more risk averse and put more effort into preventing risk, while merged banks tend to be less risk averse. Their being less risk averse may be due to risk diversification through consolidation and this result may suggest the importance of risk diversification as a motive for commercial bank to engage in M&As, as suggested by Boyd and Graham (1988), Craig and Santos (1997) and Mishra *et al.* (2005), who find that consolidations could reduce the total bank risk and diversification may thus be an incentive for banks to merge.

The results of Chapters 3, 4 and 5 are consistent. As presented in Chapter 5, bank mergers tend to reduce the risk aversion of merged banks. This lower concern over risk implies that bank mergers could lower risk itself. In other words, merged banks could obtain diversification gains through consolidation. As supported by the results of Banal-Estanol and Ottaviani (2007), better diversified banks could also offer better financial services and prices to their customers. This explanation is consistent with the results in Chapters 3 and 4, which show that merged banks have lower lending prices and lower interest margins. In addition, the different objectives of merged banks which have lower risk concern, as revealed in Chapter 5, is also consistent with the results shown in Chapter 4 that merged banks tend to provide a lower supply of credit and have lower interest margins. The lower loan portfolio could be explained by the change in the pattern of business undertaken by large merged banks, which focus more on other activities than lending. As mentioned by De Young and Rice (2003, p.3-8), the main reason for this change is the deregulation of the banking industry. In particular, the deregulation eliminating barriers-to-expansion across state boundaries encourages banking companies to embrace this new freedom by acquiring banks in other states or nations. As banks grow larger as a result of mergers, they can make a profit by employing advance technologies, such as loan securitisations and credit scoring, which generate large amounts of non-interest income. In addition, these new technologies have put more emphasis on non-interest income and less on interest income to banks. For instance, banks could obtain loan securitisation to offset the interest income which they lost with the disintermediation of consumer lending. Furthermore, there is a regulation which allows banks to extend their businesses into financial services unrelated to traditional intermediary activities. Since large banks tend to take quick advantage of this legislation to expand into non-traditional activities which generate non-interest income, it can be seen that large banks have a tendency to rely more heavily on non-interest income than do small banks with traditional business strategies. In addition, as suggested by Molyneux (2003, p. 14), the growth of other operations leads to the potential of non-interest income to generating profit and this is an important motivation for the revenue-based merger strategies. That is, merged banks tend to focus on growing their earnings from other non-interest income, while reducing their intermediary activities. Since interest margins can reflect net interest income from intermediary activities, the reduction in traditional business by merged banks can lead to a decrease in their interest margins, as presented in Chapter 4. Moreover, as suggested by Soper (2001, p.40), the most significant source of earnings diversification is the increase in fee income compared with traditional interest income. That is, adding non-interest income allows merged banks to diversify their activities and can reduce their noninterest expenses, in particular, by the elimination of the redundant operations of fixed investment costs. Therefore, the higher fee and other non-interest income, vis-à-vis interest margins, could lower risk for merged banks. In turn, lower risk due to portfolio diversification could promote the other activities as they become more attractive than investing in risky loans. These explanations support our results in Chapter 5 that merged banks are less risk averse as a result of the diversification obtained from mergers.

6.2 Remarks

Our results reveal that bank M&As have a significant impact on commercial bank behaviour. The changes in bank behaviour seem to benefit their borrowers in terms of lower lending rates and interest margins. However, before we decide whether bank mergers are good and should be promoted, there is an interesting question still to ask: whether bank mergers really create value gains for the entire economy. There are some points to be made here.

The first concerns the issue of market competition. As shown by the results in Chapters 3 and 4, although much merged banks tend to reduce their loan interest rate, the effect of bank mergers on loan prices can differ in different competitive situations. In other words, if mergers among large banks increase market concentration, banks involved in such M&As have a tendency to use their market power by charging a higher lending rate. This can adversely affect not only the welfare but also the efficiency of managers. Therefore, in order to obtain benefits from mergers, policy makers should propose certain policies to facilitate cross-border M&As which will not affect the domestic market structure. These policies include the liberalisation of foreign investment and ownership and also tax incentives which can amplify the mobility of resources. In addition, to avoid the disadvantages of cross-border bank consolidations, such as the immediate unemployment effects, the policies which would promote a flexible labour market should be implemented. Furthermore, because efficient banks tend to set more favourable loan prices to their borrowers, governments also should propose policies which enhance efficiency. For instance, the operating of secondary markets, which facilitate the flow of funds and reduce variability in the cost of funds to banks, together with a programme of making information more widely available and lowering the cost of information- this information improvement would reduce total costs and reduce the level of unpaid debt.

The second policy issue concerning bank mergers is the impact of M&As on the lower availability of credit. This decrease in the supply of loans could affect real economic activity. Because bank loans are the most important source of finance, disruptions to the loan supply might cause significant changes in economic development. In addition, besides economic consequences, this change in credit conditions could also have social impacts. As suggested by Garmaise and Moskowitz (2006), who study the relationship between bank consolidation and crime, the increase in bank mergers has a marked influence on the reduction in market competition between local banks. Merged banks can exploit their market power by offering worse credit terms and this can lower construction activity and raise the rate of burglary. In addition, in the context of social impacts, employment could also be affected by bank mergers. This is because merged banks require employees to be more qualified and flexible for their diversified jobs. However, training costs are high.

In consequence, banks might choose to replace staff instead of training present staff, which leads to an employment problem.

The third question is whether merged banks are less risk averse because of the risk diversification obtained from consolidations. Other factors may be reducing the risk aversion of merged banks. One possible factor is the 'Too-Big-To-Fail' (TBTF)[18] policy. This policy aims to prevent bank runs and avoid the systemic failure of the banking system. However, there is an argument about the consequences of the TBTF as a policy. This is because TBTF can create a moral hazard problem as bank managers have an incentive to engage in mergers in order to increase the size of their bank to the point where public authorities will find it too costly to allow it to close. Since a larger merged bank is protected by its systemic importance, it might choose to take on more risk according to this TBTF behaviour and then concentrate on only maximising its utility. This suggestion is supported by O'Hara and Shaw (1990), Kane (2000), Penas and Unal (2004) and Brewer III and Jagtiani (2009), who argue that, as a result of being TBTF, larger banks are more exposed to moral hazard and higher risk. In addition, consolidations between large banks could misuse the diversification gains to engage in risky strategies for example offering higher interest rates on uninsured debt. That is, TBTF might lead to merged banks indulging in high risk behaviour. Moreover, as large banks are important to the entire financial system, the higher the risk taken by large merged banks, the more the inefficiency of the whole financial market. As a consequence, this inefficiency could cause the failure of the banking market. Therefore, in order to avoid the problems from TBTF, policy-makers have to monitor the systemic risk posed by large banks. In addition, the size of

---

18 According to Heffernan (2006, p.395), all countries apply a TBTF policy, to some degree. For example, France has a 100% safety net, which means that only small banks are allowed to fail.

banks should be prevented from becoming too systemically important. However, this should be more carefully thought through, because some banks get large through growth based on superior efficiency and not through opportunistic and imprudent mergers. A size restriction could limit the growth of banks and thus the growth of the entire economy.

The final issue is whether commercial bank mergers are desirable for helping an economy in crisis. Although our results suggest that merged banks are less risk averse and risks may be diversified after mergers, we should be cautious about concluding that bank mergers could be used to counteract the threat of bank failure. This is because we examine data in a normal situation, not data from a crisis period. Therefore, using the results to answer this question might be misleading and an analysis which focuses on bank M&As in crisis events will provide a better explanation.

From the above remarks, we can see that bank M&As can have the potential to either benefit or harm the economy. Therefore, before promoting bank M&As, policy-makers should weigh the probable gains against the possible losses. In addition, in order to investigate the welfare implications to take into account in the effects of bank M&As, a full theoretical analysis relevant to every aspect should be undertaken and should be backed up by detailed micro-evidence on the characteristics of borrowers and loan contracts. These subjects are beyond the aims of this thesis and could well be tackled in future research.

Bibliography

Abadie, Alberto. "Semiparametric Difference-in-Differences estimators." *Review of Economic Studies*. 2005:1-19.

Abbasoglu, Osman F., Ahmet F. Aysan, and Ali Gunes. "Concentration, competition, efficiency and profitability of the Turkish banking sector in the post-crises period." *MPRA Paper.* No. 5494. 2007.

Acock, Alan C. *A gentle introduction to STATA*. Texas: A STATA Press Publication, 2006.

Adam, Robert M., and Dean F. Amel. "The effects of local banking market structure on the bank-lending channel of monetary." *FEDS Working Papers.* No.2005-16. 2005.

Afanasieff, T. Segalla, Priscilla Maria Villa Lhacer, and Marcio Issao Nakane. "The determinants of bank interest spread in Brazil." *Anais do XXIX Encontro Nacional de Economia*. Proceedings of the 29th Brazilian Economics Meeting. Brazilian Association of Graduate Programs in Economics. No. 051. 2001.

Ahmed, Anwer S., Carolyn Takeda, and Shawn Thomas. "Bank loan loss provision: A reexamination of capital management, earnings management and signaling effects." *Journal of Accounting and Economics.* 1999: 1-25.

Ahrendsen, Bruce L., Bruce L. Dixon, and Bing Luo. "The effects of bank mergers on commercial bank agricultural lending." *American Agricultural Economics Association, 2003 Annual meeting*, July 27-30, 2003. Montreal, Canada.

Ahtiala, Pekka. "The new theory of commercial banking and bank lending behaviour." *Scottish Journal of Political Economy*. 2005: 769-792.

Akhavein, Jalal D., Allen N. Beger, and Daviv B. Humphery. “The effects of megamergers on efficiency and prices: Evidence from a bank profit function.” *Finance and Economics Discussion Series.* Board of Governors of Federal Reserve System. No. 1997-9. 1997.

Akhigbe, Aigbe, Jeff Madura, and Ann Marie Whyte. “Partial Anticipation and the gains to bank merger targets.” *Journal of Financial Services Research.* 2004:55-71.

Alhadeff, Charlotte P., and David A. Alhadeff. “Recent bank mergers.” *The Quarterly Journal of Economics.* 1955: 503-532.

Allen, Linda. “The determinants of bank interest margins: A note.” *Journal of Financial and Quantitative Analysis.* 1988:231-235.

Allen, Linda, and Julapa Jagtiani. “The risk effects of combining banking, securities, and insurance activities.” *Journal of Economics and Business.* 2000:485-497.

Allen, Linda, Julapa Jagtiani, Stavros Peristiani, and Anthony Saunders. “The role of bank advisors in Mergers and Acquisitions.” *Journal of Money, Credit and Banking*. 2004: 197-224.

Allen, Jason. “Non-interest income and U.S. bank stock returns.” *Job Market Paper.* 2005.

Altunbas, Yener, and David M. Ibanez. “Mergers and acquisitions and bank performance in Europe: The role of strategic similarities.” *Journal of Economics and Business*.2008: 204-222.

Alvarez, Roberto, and Ricardo A. Lopez. “Trade liberalization and industry dynamics: A Difference in Difference approach.” Working Papers. Central Bank of Chile. No,470. 2008.

Amel, Dean, Colleen Barnes, Fabio Panetta, and Carmelo Salleo. "Consolidation and efficiency in the financial sector: A review of the international evidence." *Journal of Banking and Finance.* 2004: 2493-2519.

Amemiya, Takeshi. "The maximum likelihood and the nonlinear three-stage least squares estimator in the general nonlinear simultaneous equations model." *Econometrica.* 1977: 955-968.

Amihud, Yakov, Gayle L. DeLong, and Anthony Saunders. "The effects of cross-border bank mergers on bank risk and value." *Journal of International Money and Finance.* 2002: 857-877.

Anderson, Patricia, and Bruce Meyer. "The effects of the unemployment insurance payroll tax on wages, employment, claims, and denials." *Journal of Public Economics.* 2000: 81-106.

Anderson, Christopher W., David A. Becher, and Therry L. Campbell II. "Bank mergers, the market for bank CEOs, and managerial incentives." *Journal of Financial Intermediation.* 2004: 6-27.

Angbanzo, Lazarus. "Commercial bank net interest margins, default risk, interest-rate risk and off-balance sheet banking." *Journal of Banking and Finance*. 1997: 55-87.

Angklomkliew, Sarawan, Jason George, and Frank Packer. "Issues and developments in loan loss provisioning: The case of Asia." *BIS Quarterly Review.* 2009: 69-83.

Angrist, Joshua D., and Jorn-Steffen Pischke. *Mostly harmless econometrics: An empiricist's companion.* Oxford: Princeton University Press, 2009.

Ariss, Rima T. "On the implications of market power in banking: Evidence from developing countries." Presented in ERF 16th Annual Conference. Cairo. 2009.

Arrow, Kenneth. *Essays in the theory of risk-bearing*. Chicago: Markham Publishing Company, 1971.

Ashenfelter, Orley, and David Card. "Using the longitudinal structure of earnings to estimate the effect of training programs." *Working Papers.* Industrial Relation Section. Princeton University. No. 174. 1984.

Ashton, John, and Khac Pham. "Efficiency and price effects on horizontal bank mergers." *Centre for Competition Policy Working Paper*. University of East Anglia. No. 07-9. 2007.

Aspinwall, Richard C. "Market structure and commercial bank mortgage interest rates." *Southern Economic Journal.* 1970:376-384.

Avery, Robert B., and Katherine Samolyk. "Bank consolidation and the provision of banking services: The case of small commercial loans." *Journal of Financial Services Research.* 2004: 291-325.

Ayadi, Rym, and Georges Pujals. "Banking mergers and acquisitions in the EU: Overview, assessment and prospects." *SUERF Studies.* The European Money and Finance Forum. No. 2005/3. 2005.

Baert, Lieven, and Rudi Vander Vennet. "Bank market structure and firm capital structure in Europe." Ghent University. 2009 < July 10, 2009 from http://ssrn.com/abstract=1342395>

Baltensperger, Ernst. "Alternative approaches to the theory of the banking firm." *Journal of Monetary Economics.* 1980: 1-37.

Baltagi, Badi H. *Econometric analysis of panel data.* 3rd ed. West Sussex: John Wiley & Sons, Ltd., 2005.

Banal-Estabol, Albert, and Marco Ottaviani. "Bank mergers and diversification: Implications for competition policy." *European Financial Management*. 2007: 578-590.

Bank for International Settlements. "Findings on the interaction of market and credit risk." *Working Papers.* Basel Committee on Banking Supervision. No. 16. 2009.

Baum, Christopher F., Mustafa Caglayan, and Neslihan Ozkan. "The second moments matter: The impact of macroeconomic uncertainty on the allocation of loanable funds." *Economics Letters.* 2009: 87-89.

Baum, Christopher F. *An introduction to modern econometrics using STATA*. Texas: A STATA Press Publication, 2006.

Beatty, Anne, and Scott Liao. "Regulatory capital ratios, loan loss provisioning and pro-cyclicality." *Working Papers.* The Ohio State University. 2009.

Beccalli, Elena, and Pascal Frantz. "M&A Operations and performance in Banking." *Journal of Financial Service Research*. 2009: 203-226.

Becher, David A. "The valuation effects of bank mergers." *Journal of Corporate Finance*. 2000: 189-214.

Beitel, Patrick, Dirk Schiereck, and Mark Wahrenburg. "Explain M&A success in European banks." *European Financial Management.* 2004: 109-139.

Behr, Andreas, and Frank Heid. "The success of bank mergers revisited-an assessment based on a matching strategy." *Discussion Paper series2: Banking and Financial Studies.* Deutsche Bundesbank. NO. 06/2008. 2008.

Benston, George J.., William C. Hunter, and Larry D. Wall. "Motivations for bank mergers and acquisitions: enhancing the deposit insurance put option versus earnings diversification." *Journal of Money, Credit and Banking.* 1995: 777-788.

Berg, Sigbjorn A., and Moshe Kim. “Banks as multioutput oligopolies: An empirical evaluation of the retail and corporate banking markets.” *Journal of Money, Credit and Banking.* 1998: 135-53.

Berger, Allen N., and Timothy H. Hannan. “The price-concentration relationship in banking.” *Review of Economics and Statistics*. 1989: 291-299.

Berger, Allen N. “The profit-structure relationship in banking: Tests of market-power and efficient-structure hypotheses.” *Journal of Money, Credit and Banking.* 1995:404-431.

Berger, Allen N., and Gregory F. Udell. “Universal banking and the future of small business lending.” *Finance and Economics Discussion Series.* Board of Governors of the Federal Reserve System. No. 95-21. 1995.

Berger, Allen N., and Timothy H. Hannan. “Using efficiency measures to distinguish among alternative explanations of the structure-performance relationship in banking.” *Managerial Finance.* 1997:6-31.

Berger, Allen N., and David B. Humphrey. “Efficiency of financial institutions: International survey and directions for further research.” *European Journal of Operation Research.* 1997: 175-212.

Berger, Allen N. “The efficiency effects of bank mergers and acquisition: A preliminary look at the 1990s data.” *In Bank Mergers & Acquisitions, eds.* Y. Amihud and G. Miller. Amsterdam: Kluwer Academic Publishers, 1998.

Berger, Allen N., Anthony Saunders, Joseph M. Scalise, and Gregory F. Udell. “The effects of bank mergers and acquisitions on small business lending.” *Journal of Financial Economics.* 1998: 187-229.

Berger, Allen N., Rebecca S. Demsetz, and Phillip E. Strahan. "The consolidation of the financial services industry: causes, consequences, and implications for the future." *Journal of Banking and Finance*. 1999: 135-194.

Berger, Allen N., Robert DeYoung, Hesna Genay, and Gregory F. Udell. Globalisation of financial institutions: Evidence from cross-border banking performance. *Finance and Economics Discussion Series.* Board of Governors of the Federal Reserve System. No. 2000-04. 2000.

Berger, Allen N., Asli Demirguc-Kunt, Ross Levine, and Joseph G. Haubrich. "Bank concentration and competition: An evolution in the making." *Journal of Money, Credit and Banking*. 2004: 433-451.

Berger, Allen N., Seth D. Bonime, Lawrence G.Goldberg, and Lawrence J. White. "The dynamics of market entry: The effects of mergers and acquisitions on entry in the banking industry." *Journal of Business.* 2004:797-834.

Berger, Allen N., Nathen H. Miller, Mitchell A. Petersen, Raghuram G. Rajan, and Jeremy C. Stein. "Does functional follow organisational form? Evidence from the lending practices of large and small banks." *Journal of Financial Economics.* 2005: 237-269.

Berger, Allen N. "Obstacles to a global banking system: 'Old Europe' versus 'New Europe'." *Journal of Banking and Finance.* 2007: 1955-1973.

Berger, Allen N., Richard J Rosen, and Gregory F Udell. "Does market size structure affect competition? The case of small business lending." *Journal of Banking and Finance.* 2007: 11-33.

Berger, Allen N., and Lamont K. Black. "Bank size, lending technologies, and small business finance." *Working Papers.* University of South Carolina. 2008.

Bergstresser, Daniel. "Market concentration and commercial bank loan portfolios." Harvard Business School. 2004.

Berndt, Ernst R., Thomas H. McCurdy, and Davis E. Rose. "On testing theories of financial intermediary portfolio selection." *The Review of Economic Studies.* 1980: 861-873.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. "How much should we trust differences-in-differences estimates?." *NBER Working Paper.* No. 8841. 2002.

Betancourt, Rocio, Hernando Vargas, and Norberto Rodriguez. "Interest rate pass-through in Colombia: A micro banking perspective." *Cuadernos De Economia.* 2008: 29-58.

Bhattacharya, Kaushik. "How good is the BankScope database? A cross-validation exercise with correction factors for market concentration measures." *BIS Working Paper*. No 133. 2003.

Bikker, Jacob A., and Katharina Haaf. "Measures of competition and concentration in the banking industry: a review of the literature." *Research Series Supervision*. De Nederlandsche Bank. No, 27. 2000.

Bikker, Jacob A., and Katharina Haaf. "Competition, concentration and their relationship: An empirical analysis of the banking industry." *Journal of Banking & Finance.* 2002: 2191-2214

Bikker, Jacob A., Laura Spierdijk, and Paul Finnie. "Misspecification of the Panzar-Rosse model: Assessing competition in the banking industry." *DNB Working Papers.* No. 114. 2007.

Bikker, Jacob A., Sherrill Shaffer, and Laura Spierdijk. "Assessing competition with the Panzar-Rosse model: The role of scale, costs, and equilibrium." *Discussion Paper Series.* Tjalling C. Koopmans Research Institute. No. 09-27. 2009

Bils, Mark. "Cyclical pricing of durable goods." *NBER Working Paper*. No. 3050. 1989.

Black, Sandra E. and Philip E. Strahan. "Entrepreneurship and bank credit availability." *Journal of Finance*. 2002:2807-2934.

Blanchard, Olivier J., and Lawrence F. Katz. "Regional evolutions." *Brookings Papers on Economic Activity.* The Brookings Institution. 1992: 1-76.

Bliss, Richard T., and Richard J. Rosen. "CEO compensation and bank mergers." *Journal of Financial Economics.* 2001: 107-138.

Bliss, Robert. "Discuss of 'Bank mergers and the dynamics of deposit rates'". *Journal of Finance Service Research.* 2009: 135-136.

Bodenhorn, Howard. "Usury ceiling, relationships and bank lending behaviour: Evidence from nineteenth century New York." *NBER Working Papers.* No. 11734. 2005.

Bonaccorsi di Patti, Emilia, and Giorgio Gobbi. "The effects of bank mergers and acquisitions on credit availability: Evidence from corporate data." *Economic Working Papers.* Bank of Italy. Economic research department. No. 479. 2003.

Bonaccorsi di Patti, Emilia, and Giovanni Dell'Ariccia. "Bank competition and firm creation." *Journal of Money, Credit and Banking*. 2004: 225-251.

Bonaccorsi di Patti, Emilia, and Giorgio Gobbi. "Winners of Losers? The effects of banking consolidation on corporate borrowers." *The Journal of Finance*. 2007: 669-695.

Borio, Claudio E.V., and Wilhelm Fritz. "The response of short-term bank lending rates to policy rates: a cross-country perspective." *in BIS, Financial Structure and the Monetary Transmission Policy Transmission Mechanism*. 1995: 106-153.

Boyd, John H. and Stanley L. Graham. "The profitability and risk effects of allowing bank holding companies to merge with other financial firms: a simulation study." *Quarterly Reviews*. Federal Reserve Bank of Minneapolis. 1988: 3-20.

Boyd, John H. and Stanley L. Graham. "Investigating the banking consolidation trend." *Quarterly Review*. Federal Reserve Bank of Minneapolis. 1991:1-15.

Boyd, John H. and Stanley L. Graham. "Consolidation in US banking: implications for efficiency and risk." *Working Papers*. Federal Reserve Bank of Minneapolis. No. 572. 1996.

Boyd, John H. and Gianni De Nicola. "The theory of bank risk taking and competition revisited." *Journal of Finance*. 2005:1329-1343

Brady, Thomas F. "Change in loan pricing and business lending at commercial banks." *Federal Reserve Bulletin*. 1985:1-13.

Bresnahan, Timothy F. "Competition and collussion in the American automobile industry: The 1955 price war." *Journal of Industrial Economics*. 1987: 457-482.

Breuer, Thomas, Martin Jandacka, Klaus Rheinberger, and Martin Summer. Regulatory capital for market and credit risk interaction: Is current regulation always conservative?" *Discussion Paper Series*. Deutsche Bundesbank. No.14/2008. 2008.

Brewer III, Elijah, and Julapa Jagtiani. "How much did banks pay to become Too-Big-To-Fail and to become systemically important?" *Working Papers*. Federal Reserve Bank of Philadelphia. No. 09-34. 2009.

Brock, Philip L., and Liliana Rojas-Suarez. “Understanding the behaviour of bank spreads in Latin America.” *Journal of Development Economics.* 2000: 113-134.

Bryson, Alex, Richard Dorsett, and Susan Purdon. “The use of propensity score matching in the evaluation of active labour market policies.” *Working Papers.* Policy Studies Institute and National Centre for Social Research. No.4. 2002.

Buch, Claudia M., John C. Driscoll, and Charlotte Ostergaard. “Cross-border diversification in bank asset portfolios.” *International Finance.* 2009. Forthcoming.

Buch, Claudia M., and Gayle L. Delong. “Under-regulated and over-guaranteed? International bank mergers and bank risk-taking.” *Working Papers.* University of Tuebinger and City University of New York. 2004.

Buch, Claudia M., Gayle L. Delong, and Katja Neugebauer. “International banking and the allocation of risk.” *IAW Discussion Papers.* No. 32. 2007.

Buch, Claudia M., and Gayle L. Delong. “Banking globalisation: International consolidation and mergers in banking.” *IAW Discussion Papers.* No.38. 2008.

Buckley, Jack, and Yi Shang. “Estimating policy and program effects with observational data: the “differences-in-differences” estimator.” *Practical Assessment, Research & Evaluation.* 2003. <March 7, 2009 from http://PAREonline.net/getvn.asp?v=8&n=24>.

Burgstaller, Johann, and Johann Scharler. “How do bank lending rates and the supply of loans react to shifts in loan demand in the U.K.?” *Working Papers.* Johannes Kepler University of Linz. No. 0902. 2009.

Caglayan, Mustafa, Neslihan Ozkan, and Christopher F. Baum. “The impact of macroeconomic uncertainty on bank lending behaviour.” *Research Papers*. University of Liverpool Management School. No. 2002_02. 2002.

Calmes, Christian, and Raymond Theoret. “The impact of off-balance-sheet activities on banks returns: An application of the ARCH-M to Canadian data.” *Working Papers.* Cahier de recherché. No. 07-2009. 2009.

Calomiris , Charles W., and Jason Karceski. “Is the bank merger wave of the 1990s efficient? Lessons from the Nine case studies.” *NBER Working Papers*. No 8650. 2000.

Calomiris , Charles W., and Thanavut Pornrojnangkool. “Monopoly creating bank consolidation? The merger of Fleet and Bankbonston.” *NBER Working Papers.* No.11351. 2005.

Cameron, Adrian C., and Pravin. K. Trivedi. *Microeconometrics: methods and applications*. New York: Cambridge University Press, 2005.

Campa, Jose Manuel, and Ignacio Hernando. “M&A performance in the European finance industry.” *CIIF Working Papers*. IESE Business School. University of Navarra. No. 588. 2005.

Canals, Jordi. *Universal banking: The international comparisons and theoretical perspectives.* New York: Oxford University Press Inc., 1997.

Card, David. “The impact of the Mariel Boatlift on the Miami labour market.” *Industrial and Labour Relations Review*. 1990:245-257.

Card, David., and Alan B. Krueger. “Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania.” *American Economic Review.* 1994: 772-793.

Carletti, Elena, Philipp Hartmann, and Giancarlo Spagnolo. “Implications of the bank merger wave for competition and stability.” *CGFS Conference Papers.* Risk Measurement and Systemic Risk, Proceedings of the Third Joint Central Bank Research Conference. 2002.

Carletti, Elena, Philipp Hartmann, and Giancarlo Spagnolo. “Bank mergers, competition, and liquidity.” *Journal of Money, Credit and Banking*. 2007: 1067- 1105.

Carow, Kenneth A., Edward J. Kane, and Rajesh P. Narauanan. “How have borrowers fared in banking megamergers?” *Journal of Money, Credit and Banking.* 2006: 821- 836.

Casu, Barbara, and Claudia Girardone. “Bank competition, concentration and efficiency in the single European market.” *Essex Finance Centre Discussion Paper.* University of Essex. No. 05/02. 2005.

Casu, Barbara, and Claudia Girardone. “Competition issues in European banking.” *Journal of Financial Regulation and Compliance.* 2009: 119-133.

Cecchetti, Stephen G. “Legal structure, financial structure, and the monetary policy transmission mechanism.” *Economic Policy Review*. Federal Reserve Bank of New York .1999: 9-28

Cerqueiro, Geraldo, Hans Degryse, and Stevem Ongena. “Distance, bank organisational structure, and credit.” *Discussion Papers*. Tilburg Law and Economic Center. No 2007-018. 2007.

Cerqueiro, Geraldo. “Bank concentration, credit quality and loan rates.” *Working Papers.* CentER Tilburg University. 2009.

Chiang, Alpha C. *Fundamental methods of mathematical economics*. 3rd ed. Singapore: McGraw-Hill, 1984.

Chiang, Raymond, and John M, Finkelstein. “An incentive framework for evaluating the impact of loan provisions on default risk.” *Southern Economic Journal.* 1982: 962-969.

Chionsini, Gaetano., Antonella Foglia, and Paolo M .Reedtz. “Bank mergers, diversification and risk.” Bank of Italy. 2003.

Chong, B. Soon. “The effects of interstate banking on commercial banks’ risk and profitability.” *Review of Economics and Statistics*. 1991:78-84.

Claessens, Sijn, and Luc Laeven. “What drives bank competition? Some international evidence.” *Proceedings.* Federal Reserve Bank of Cleveland. 2004: 563-592.

Conley, Timothy G., and Christopher R. Taber. “A note on inference with ‘Difference-in-Differences’ with a small number of policy changes.” *NBER Technical Working Papers.* No.0312. 2005.

Cornett, Millon, and Hassan Tehranian. “Changes in corporate performance associated with bank acquisitions.” *Journal of Financial Economics*. 1992: 211-234.

Cornett, Marcia M., Evren Ors, and Hassan Tehranian. “Bank performance around the introduction of a section 20 subsidiary.” *Journal of Finance*. 2002: 501-521.

Cornett, Marcia M., Jamie J. McNutt, and Hassan Tehranian. “Performance changes around bank mergers: Revenue enhancements versus cost reductions.” *Journal of Money, Credit and Banking*. 2006: 1013-1050.

Corvoisier, Sandrine, and Reint Gropp. “Bank concentration and retail interest rates.” *Working Paper Series.* European Central Bank. No. 072. 2001.

Cottarelli, Carlo, and Angeliki Kourelis. “Financial structure, bank lending rates, and the transmission mechanism of monetary policy.” *IMF Staff Papers.* 1994:587-623.

Courakis, Anthony S. “In search of an explanation of commercial bank short-run portfolio selection.” *Oxford Bulletin of Economics and Statistics.* 1980: 305-335.

Courakis, Anthony S. “Modelling portfolio selection.” *The Economic Journal*. 1988: 619-642.

Cox, David R. *The test of Separate Families of Hypotheses.* Proceedings of the Forth Berkeley Symposium on Mathematical Statistics and Probability. Vol.1. Berkeley: University of California Press, 1961.

Cox, David R. "Further Results on Tests of Separate Families of Hypotheses" *Journal of the Royal Statistical Society*. 1962: 406-424.

Craig, Ben R., and Cabral dos Santos. "The risk effects of bank acquisitions." *Economic Review*. 1997: 25-35.

Craig, Ben R., and Valeriya Dinger. "Bank mergers and the dynamics of deposit interest rates." *Working Papers*. Federal Reserve Bank of Cleveland. No 08-06. 2008.

Craig, Steven G., and Pauline Hardee. "The impact of bank consolidation on small business credit availability." *Journal of Banking and Finance*. 2007: 1237-1263.

Cramer, Harald. "Collective risk theory: A survey of the theory from the point of view of the theory of stochastic processes." *In the Jubilee Volume of Skandia Insurance Company,* Stockholm. 1955:1-92.

Cybo-Otton, A., and M. Murgia. "Mergers and shareholder wealth in European banking." *Journal of Banking and Finance.* 2000: 831-859.

Davidson, Russel, and James G. Mackinnon. "Several tests for model specification in the presence of alternative hypotheses." *Econometrica*. 1981: 781-793.

Davidson, Russel, and James G. Mackinnon. "Some Non-nested hypothesis tests and the relations among them" *The review of Economic Studies*.1982: 551-565.

Davidson, Russel, and James G. Mckinnon. "The interpretation of test statistics." *The Canadian Journal of Economics Econometric Special.* 1985: 38-57.

De Bandt, Olivier, and Philip E. Davis. “A cross-country comparison of market structures in European banking.” *European Central Bank Working Papers*. No. 7. 1999

De Bandt, Olivier, and Philip E. Davis. “Competition, contestability and market structure in European banking sectors on the eve of EMU.” *Journal of Banking and Finance*. 2000:1045-1066.

De Bondt, Gabe. “Retail bank interest rate pass-through: New evidence at the euro area level.” *Working Paper Series.* European Central Bank. No. 136. 2002.

De Bondt, Gabe, Benoit Mojon, and Natacha Valla. “Interest rate setting by universal banks and the monetary policy transmission mechanism in the euro area.” *Unpublished Working Paper.* European Central Bank. 2002.

De Graeve, Ferre, Olivier De Jonghe, and Rudi Vander Vennet. “Competition, transmission and bank pricing policies: Evidence from Belgian loan and deposit markets.” *Journal of Banking and Finance.* 2007: 259-278.

Degryse, Hans A., Nancy Masschelein, and Janet Mitchell. “SME and Bank lending relationships: the impact of mergers.” *National Bank of Belgium Working Papers Research Series*. No 46. 2004.

Degryse, Hans A., Nancy Masschelein, and Janet Mitchell. “Staying, dropping, or switching: The impacts of bank mergers on SMEs.” *TILEC Discussion Papers.* Tilburg University. No. 2006-034. 2006.

Degryse, Hans A., and Steven Ongena. “The impact of competition on bank orientation.” *Research Discussion Paper*s. Tilburg University. Centre for Economic. No 68. 2006.

Degryse, Hans A., and Steven Ongena. “Competition and regulation in the banking sector: A review of the empirical evidence on the sources of bank rents.” *In Handbook of Corporate Finance: Financial Intermediation and Banking. eds. A. Boot and A. Thakor. Elsevier/ North Holland.* 2008:483-554.

Delis, Manthos D. “Competitive conditions in the Central and Eastern European banking systems.” *The International Journal of Management Science.* 2009: 1-7.

Demirguc-Kunt, Asli, and Harry Huizinga. “Determinants of commercial bank interest margins and profitability: Some international evidence.” *World Bank Policy Research Working Papers*. No. WPS 1900. 1998.

De Nicolo, Giaani. “Size, charter value and risk in banking: An international perspective.” *International Finance Discussion Papers.* Board of Governors of the Federal Reserve System. No 689. 2000.

De Nicolo, Giaani, and Myron L. Kwast. “Systemic risk and financial consolidation: Are they relater?” *IMF Working Papers.* IMF. No. 02/55. 2002.

De Nicolo, Giaani, Philip Bartholomew, Jahanara Zaman, and Mary Zaphirin. “Bank consolidation, internationalisation, and conglomeration: Trends and implications for financial risk.” *IMF Working Papers.* IMF. No. 03/158. 2003

Dermine, Jean. “Deposit rates, credit rates and bank capital: the Monti-Klein model revisited.” *Journal of Banking and Finance*. 1986: 100-114.

Deutsche Bundesbank. *Activity Report for 2000*. 2000.

DeYoung, Robert, and Karin P. Roland. “Product mix and earnings volatility at commercial banks: Evidence from a degree of total leverage model.” *Journal of Financial Intermediation.* 2001: 54-84.

DeYoung, Robert, and Tara Rice. “Noninterest income and financial performance at U.S. commercial banks.” *Policy studies.* Federal Reserve Bank of Chicago. 2003.

DeYoung, Robert, Douglas D. Evanoff, and Philip Molyneux. “Mergers and acquisitions of financial institutions: A review of the post-2000 literature.” *Journal of Financial Service and Research.* 2009: 87-110.

Diamond, Douglas W., and Phillip H. Dybvig. “Banking theory, deposit insurance and bank regulation.” *The Journal of Business*. 1986: 55-68.

Dickinson, David G., Michael J. Driscoll, and Jim L. Ford. “Revenue raising trade restriction policies under uncertainty: The sub-optimality of the expected welfare criterion and some safety-first results.” *Journal of Economics*. 1984: 387-403.

Doliente, Jude S. “Determinants of bank net interest margins of Southeast Asia.” *Applied Financial Economics Letters.* 2005: 53-57.

Donnay, Maria and Hans Degryse. “Bank lending rate pass-through and difference in the transmission of a single EMU monetary policy.” *Discussion Papers*. Centre for Economic Studies. No. 01.17. 2001.

Doornik, Jurgen A., and David F. Hendry. *GiveWin: An interface to empirical modelling*. 3rd ed. London: Timberlake Consultants Ltd., 2001.

Drucker, Steven. “Information asymmetries, cross-product banking mergers, and the effects on corporate borrowers.” *FDIC Centre for Financial Research Papers.* 2005.

Dvorak, Pavel. “Rethinking the Monti-Klein model of banking industry: new insights about the separability of loans and deposits decisions”. *Discussion paper series*. Centre for Economic Research and Graduate Education. Charles University. No. 2005-138. 2005.

Edgeworth, Francis Y. “The mathematical theory of banking.” *Journal of the Royal Statistical Society*. 1888: 113-127.

Edwards, Franklin R. “Concentration in banking and its effect on business loan rates.” *The review of economics and statistics.* 1964: 294-300.

Edwards, Franklin R. and Mustafa O. Caglayan. “Hedge fund and commodity fund investment styles in bull and bear markets.” *Journal of Portfolio Management.* 2001: 97-108.

Edwards, Seaniaa., Albert J. Allen, and Saleem Shaik. “Market Structure-Conduct-Performance (SCP) hypothesis revisited using stochastic frontier efficiency analysis”. selected paper prepared for presentation at the American Agricultural Economics Association Annual Meeting. Long Beach. California. July 2006. 2005.

Elsas, Ralf. “Empirical determinants of relationship lending.” *Journal of Financial Intermediation*.2005:.32-57.

Elsas, Ralf, Andreas Hackethal, and Markus Holzhauser. “The anatomy of bank diversification.” *Discussion Papers.* Munich School of Management. University of Munich. No. 2006-1. 2006.

Ely, David P., and Kenneth J. Robinson. “Consolidation, technology, and the changing structure of banks’ small business lending.” *Economic and financial review*. Federal bank of Dallas. 2001: 23-32.

Ely, David P., and Kenneth J. Robinson. “The impact of banks’ expanded securities powers on small-business lending.” *Review of Financial Economics.* 2004: 79-102.

Erel, Isil. “The effect of bank mergers on loan prices: evidence from the U.S.” *Market Paper*. MIT Sloan School of Management. 2005.

Estrella, Arturo. “Mixing and matching: Prospective financial sector mergers and market valuation.” *Journal of Banking and Finance.* 2001: 2367-2392.

European Central Bank. *Mergers and acquisitions involving in the EU banking industry- Facts and implications*. European Central Bank Publication. 2000.

European Central Bank. *Structural analysis of the EU banking sector year 2001*. European Central Bank Publication. 2002.

European Central Bank. *EU banking structures*. European Central Bank Publication. 2006.

European Central Bank. *EU banking structure*s. European Central Bank Publication. 2008.

Eurostat. *Europe in figures: Eurostat yearbook 2009.* 2009.

Evernett, Simon J. "The cross borders and acquisitions wave of the late 1009s." *NBER Working Papers*. No. 9655. 2003.

Farrar, Donald E. "The investment decision under uncertainty: Portfolio selection." *The Journal of Finance.* 1962: 671-672.

Farrell, Joseph, and Carl Shapiro. "Dynamic competition with switching costs." *RAND Journal of Economics*. 1988: 123-137.

Fase, M.M.G. "The demand for commercial bank loans and the lending rate." *The European Economic Review*. 1995: 99-115.

Featherstone, Allen M. "Post-acquisition performance of rural banks." *American Journal of Agricultural Economics.* 1996: 728-733.

Fecht, Falko and Hans P. Gruner. "Limits to international banking consolidation." *Discussion Paper Series 2: Banking and Financial Studies.* Deutsche Bundesbank. No. 11/2006. 2006.

Feldman, Ron, and Jason Schmidt. "Noninterest income: A potential for profits, risk reduction and some exaggerated claims**."** *Federal Reserve Bank of Minneapolis Journal.* 1999: 20-21

Fernández de Guevara, Juan, Joaquín Maudos, and Francisco Pérez. "Market Power in European Banking Sectors." *Journal of Financial Services Research*. 2005:109-137.

Fisher, Klaus P., Jean-Pierre Gueyle, and Edgar Ortz. “Risk-taking and charter value of commercial banks’ from the NAFTA countries.” paper presented at the 1st International Banking and Finance Conference. Kuala Lumpur. Malaysia. 2000.

Focarelli, Dario, and Fabio Panetta. “Are mergers beneficial to consumers” Evidence from the market for bank deposits.” *The American Economic Review*. 2003: 1152-1172.

Focarelli, Dario, Fabio Panetta, and Carmelo Salleo. “Why do banks merge?” *Journal of Money, Credit and Banking.* 2002:1047-1066.

Frankel, Michael E.S. *Mergers and acquisitions basics: The key steps of acquisitions, divestitures and investments*. New Jersey: John Wiley & Sons Ltd., 2005.

Francis, Bill, Iftekhar Hasan, and Haizhi Wang. “Bank consolidation and new business formation.” *Journal of Banking and Finance*. 2008: 1598-1612.

Freixas, Xavier, and Jean-Charles Rochet. *Microeconomics of Banking*. Massachusetts: The MIT Press, 1998.

Friedrich, Robert. "In defence of multiplicative terms in multiple regression equations." *American Journal of Political Science*. 1982:797–833.

Fu Alex. Z., Dow W.H., and Liu G.G. “Propensity score and difference-in-difference methods: A study of second-generation antidepressant use in patients with bipolar disorder.” *Health Services and Outcomes Research Methodology*. 2007: 23-38.

Fuentes, Ignacio, and Teresa Sastre. “Mergers and acquisitions in the Spanish banking industry: some empirical evidence” *Working Paper.* Madrid: Bank of Spain. No. 9924. 1998.

Fungacova, Zuzana, and Tigran Poghosyan. "Determinants of bank interest margins in Russia: Does bank ownership matter?" *BOFIT Discussion Papers.* Institute for Economies in Transition. Bank of Finland. No. 22/2009. 2009.

Furlong, Frederisk, T. "Capital regulation and bank lending." *Economic Review.* Federal Reserve Bank f San Francisco. 1992: 23-33.

Gambacorta, Leonardo, and Paolo Emilio Mistrulli. "Bank capital and lending behaviour: Empirical evidence for Italy." *Economic Working Papers*. Bank of Italy. Economic Research Department. No. 486. 2003.

Gambacorta, Leonardo. "How do banks set interest rates?." *NBER Working Papers.* No. 10295. 2004.

Gambacorta, Leonardo, and Simonetta Iannotti. "Are these asymmetries in the response of bank interest rates to monetary shocks?" *Economic Working Papers.* Bank of Italy. No. 566. 2005.

Garcia, Angel B. "The post Keynesian theory of banking and the endogenous money supply." *Revista Venezolana de Analisis de Coyuntura.* 2006: 1-55.

Garmaise, Mark J., and Tobias J. Moskowitz. "Bank mergers and crime: The real and social effects of credit market competition." *The Journal of Finance*. 2006: 495-538.

Garrett, Thomas A., Gary A. Wagner, and David C. Wheelock. "A Spatial analysis of State banking regulation." Regional Science. 2005:575-595.

Garvey, Gerald T., and Gordon Hanka. "Capital structure and corporate control: The effect of antitakeover statutes on firm leverage." *Journal of Finance*. 1999: 519-546.

Getting started with STATA for windows. Texas: A STATA Press Publication, 2006.

Giannetti, Mariassunta, and Steven Ongena. "Financial integration and entrepreneurial activity: Evidence from foreign bank entry in emerging markets." *CEPRR Discussion papers*. European Central Bank. No. 498. 2005.

Gilbert, R. Alton. "Bank market structure and competition: A survey." *Journal of Money, Credit and Banking.* 1984: 617-645.

Gilbert, R. Alton, and Michael T. Belongia. "The effects of affiliation with large bank holding companies on commercial bank lending to agriculture." *American Journal of Agricultural Economics.* 1988: 69-78.

Gischer, Horst, and Mike Stiele. "Competition tests with a non-structural model: The Panzar-Ross method applied to Germany's savings banks." German Economic Review. 2009: 50-70.

Gischer, Horst, and Mike Stiele. "Testing for banking competition in Germany: Evidence from savings banks." *Money Macro and Finance Research Group Conference 2004.* No. 35. 2004.

Golosnoy, Vasyl, and Yarema Okhrin. "General uncertainty in portfolio selection: A case-based decision approach." *Journal of Economic Behaviour and Organisation.* 2008: 718-734.

Gomez, Javier. "The banking spread and the resource cost of capital." *Borradores de Economia.* Banco de la Republica de Colombia. No.092. 1998.

Gorton, Gary, and Andrew Winton. "Financial intermediation." *NBER Working Papers.* No. 8928. 2002.

Greene, William H. *Econometric analysis*. 5th ed. New Jersey: Prentice Hall, 2003.

Gressis, Nicolas, and William A. Remaley. "Comments on 'Safety First: An expected utility principle." *The Journal of Financial and Quantitative Analysis.* 1974:1057-1061.

Groeneveld, Johannes M., and Wim W. Boonstra. “Competition in a highly concentrated banking sector: Theoretical, empirical and practical considerations for the Netherlands.” Rabobank, 2005.

Gropp, Reint, Christoffer K. Sorensen, and Jung-Duk Lichtenberger. “The dynamics of bank spreads and financial structure.” *Working Paper Series.* European Central Bank. No. 714. 2007.

Group of 10. *Report on consolidation in the financial sector*. Basel: Bank for International Settlements, 2001.

Guest, Paul M. “The impact of mergers and acquisitions on executive pay in the United Kingdom.” *Economica.* 2009: 149-175.

Gujarati, Damodar N. *Basic econometrics*. 4th ed. Singapore: McGraw-Hill, 2003.

Haley, Ryan.M, and M. Kevin McGee. “Tilting safety first and the Sharpe portfolio.” *Finance Research Letters.* 2006: 173-180.

Haley, Ryan.M., Harry J. Paarsch, and Charles.H. Whiteman. “Smoothed Safety First and the Holding of assets.” Typescript. Oshkosh, Wisconsin: Department of Economics. University of Wisconsin. 2009.

Hall, Bronwyn H., and Clint Cummins. *TSP 5.1 user’s guide*. TSP International, 2009.

Hall, Bronwyn H., and Clint Cummins. *TSP 5.1 reference manual*. TSP International, 2005.

Hancock, Diana, Joe Peel, and James A. Wilcox. “The effects of mergers and acquisitions on small business lending by large banks.” *Research Summary*. SBA Office of Advocacy. No. 254. 2005.

Hannan, Timothy H. “Bank commercial loan markets and the role of market structure: Evidence from surveys of commercial lending.” *Journal of Banking and Finance*. 1991a: 133-149.

Hannan, Timothy H. "Foundation of the structure-performance paradigm in banking." *Journal of Money, Credit, and Banking*. 1991b: 68-84.

Hannan, Timothy H., and Robin A. Prager. "Multimarket bank pricing: An empirical investigation of deposit interest rates." *Finance and Economics Discussion Series.* Board of Governors of the Federal Reserve System. No. 2004-38. 2004.

Hao, Li. "Bank effects and the determinations of loan yield spreads." *Working Papers.* York University. Schulich School of Business. 2004.

Hardin, William G. III, and Zhonghua Wu. "Bank mergers, REIT loan pricing and takeover likelihood." *Journal of Real Estate Finance and Economics.* 2009

Harwood, Joy, Richard Heifner, Keith Coble, Janet Perry, and Agapi Somwara. "Managing risk in farming: Concepts, research, and analysis." *Agricultural Economic Report.* No. 774. 1999.

Hausman, Jerry, and Guido Kuersteiner. "Difference in difference meets generalised least squares: Higher order properties of hypotheses tests." *Journal of Econometrics.* 2008: 371-391.

Hauswald, Robert B.H., and Robert Marquez. "Competition and strategic information acquisition in credit markets." *The Review of Financial Studies.* 2006: 967-1000.

Hayden, Evelyn, Daniel Porath, and Natalja V. Westernhagen. "Does diversification improve the performance of German banks? Evidence from individual bank loan portfolios." *Working Papers.* Austrian Central Bank. No. 110. 2006.

Heffernan, Shelagh A. *Modern banking in theory and practice*. West Sussex: John Wiley & Sons Ltd., 1996.

Heffernan, Shelagh A. *Modern banking*. West Sussex: John Wiley & Sons Ltd., 2005.

Heffernan, Shelagh A., and Peter Sinclair. *Modern international economics*. West Sussex: John Wiley & Sons Ltd.,1990.

Heggestad, Arnold A. "Market structure, risk, and profitability in commercial banking." *Journal of Finance.* 1997: 1207-1216.

Heinemann, Feiedrich, and Martin Schuller. "Integration benefits on EU retail credit markets: Evidence from interest rate pass-through." *Zentrum fur Wirtschaftsforschung Papers.* 2002.

Hernando, Ignacio, Maria J. Nieto, and Larry D. Wall. "Determinants of domestic and cross-border bank acquisitions in the European Union." *Working Papers.* Bank of Spain. No. 0823. 2008.

Hill, Jennifer. "Comments on 'A critical appraisal of propensity-score matching in the medical literature between 1996 and 2003' by Peter Austin." *Statistics in Medicine.* 2008: 2055-2061.

Ho, Thomas S.Y., and Anthony Saunders. "The determinants of banks interest margins: Theory and empirical evidence." *Journal of Financial and Quantitative Analysis*. 1981: 581-600.

Hotz, V. Joseph, Charles H. Mullin, and Seth G. Sanders. "Bounding causal effects using data from a contaminated natural experiment: Analysing the effect of teenage childbearing." *Review of Economic Studies*. 1997:576-603.

Huang, Ming-Hsiang. "Banking reforms, productivity, and risk management in Taiwan's banking industry." *Academia Economic Papers.* 2004: 413-439.

Hughes, Joseph P., William W. Lang, Loretta J. Mester, and Choon-Geol Moon. "Efficient banking under interstate branching." *Journal of Money, Credit and Banking*. 1996:1045-1071.

Hughes, Joseph P., William W. Lang, Loretta J. Mester, and Choon-Geol Moon. "The dollars and sense of bank consolidation." *Journal of Banking and Finance*. 1999: 291-324.

Hugehes, Joseph P., Loretta J. Mester, and Choon-Geol Moon. "Are scale economies in banking elusive or illusive? Evidence obtained by incorporating capital structure and risk-taking into models of bank production." *Journal of Banking and Finance.* 2001: 2169-2208.

Huizinga, Harry P., J.H.M. Neilissen, and Rudi Vander Vennet. "Efficiency effects of bank mergers and acquisition in Europe." *Tinbergen Institute Discussion Papers*. Ti-2001 088/3. 2001.

Ioannidou, Vasso, and Steven Ongena. "Time for a change: Loan conditions and bank behaviour when firms switch banks." *Journal of Finance*. 2010, Forthcoming.

Ismail, A. Ghafar, and Adelina Tan Be Lay. "Bank Loan Portfolio Composition and the Disclosure of Loan Loss Provisions: Empirical Evidence from Malaysian Banks." *Asian Review of Accounting*. 2002: 147-162.

Iwata, Gyoichi. "Measurement of conjectural variations in oligopoly." *Econometrice.* 1974: 949-966.

Jacques, Kevin T. "Capital shocks, bank asset allocation, and the revised Basel Accord." *Review of Financial Economics.* 2008: 79-91.

Jackson, William E. III. "The price-concentration relationship in banking: A comments" *The Review of Economics and Statistics*. 1992: 373-376.

Jagtiani, Julapa, and William R. Keeton. "Geographic diversification as motive for bank mergers: New evidence from takeover premiums." *2008 FMA Conference.* 2008.

Jahera, John S. Jr., and Joseph F. Sinkey Jr. "A note on the intracyclical balance-sheet behavior of large commercial banks 1072-1978." *Journal of Banking and Finance.* 1984: 109-117.

James, Frederick. *Statistical methods in experimental physics*. 2nd edition. Singapore: World Scientific Publishing Co.Pte. Ltd., 2007.

Jayaratne, Jith. and Philip E. Strahan. "The finance-growth nexus: Evidence from bank branch deregulation." *Quarterly Journal of Economics*.1996:639-670.

Kahn, Charles., George Pennacchi, and Ben Sopranzetti. "Bank consolidation and consumer loan interest rates." *Wharton School Centre for Financial Working Papers.* No. 01-14. 2001

Kane, Edward J., and Burton G. Malkiel. "Bank portfolio allocation, deposit variability, and the availability doctrine." *Quarterly Journal of Economics.* 1965: 113-134.

Kane, Edward J. "Incentives for baking megamergers: What motives might regulators infer from event-study evidence?" *Journol of Money, Credit and Banking*. 2000: 671-701.

Kang, Jun-Koo, and Wei-Lin Liu. "Is universal banking justified? Evidence from bank underwriting of corporate bonds in Japan." *Journal of Financial Economics.* 2007: 142-186.

Kamagaretnam, Kiridaran, Geral J. Lobo, and Dong-Hoon Yang. "Determinants of signaling by banks through loan loss provisions." *Journal of Business Research.* 2005: 312-320.

Kaplan, Paul D. "Asset allocation models using the Markowitz approach." 1998. <3 October, 2008 from http://corporate.morningstar.com/ib/html/pdf.htm?../documents/MethodologyDocuments/IBBAssociates/MarkowitzApproach.pdf>

Karceski, Jason, Steven Ongena, and David C. Smith. “The impact of bank consolidation on commercial borrower welfare.” *Journal of Finance.* 2005: 2043-2082.

Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox. “Monetary policy and credit conditions: Evidence from the composition of external finance.” *American Economic Review.* 1993: 78-98.

Kashyap, Anil K. and Jeremy C. Stein. “The role of banks in monetary policy: A survey with implications for the European Monetary Union.” *Economic Perspectives*. Federal Reserve Bank of Chicago. 1997: 2-18.

Katib, M. Nasser. “Market structure and performance in the Malaysian banking industry: A robust estimation.” *Indian Institute of Capital Markets Papers.* 2004.

Keeton, William R. *Equilibrium credit rationing*. New York: Garland Press, 1979.

Keeton, William R. “Do bank mergers reduce lending to businesses and farmers? New evidence from tenth district states.” *Working Papers.* Federal Reserve Bank of Kansas City 1996: 63-75.

Khawaja, Idrees, and Musleh-ud Din. “Determinants of interest spread in Pakistan.” *PIDE Working Papers.* Pakistan Institute of Development Economics Islamabad. No.2007:22. 2007.

King, Gary, Robert O. Keohane, and Sidney Verba. Designing social inquiry: Scientific inference in qualitative research. New Jersey: Princeton University Press, 1994.

Klein, Michael A. “A theory of the banking firm, Journal of Money.” *Banking and Finance.* 1971: 205-218.

Konno, Hiroshi. “Piecewise linear risk functions and portfolio optimisation.” *Journal of the Operations Research Society of Japan*. 1989:139-156.

Kroll, Yoran, Haim Levy, and Harry M. Markowitz. “Mean-variance versus direct utility maximisation.” *Journal of Finance*. 1984: 47-62.

Kroszner, Randall S., and Philip E. Strahan. “What drives deregulation? Economics and politics of the relaxation of bank branching restrictions.” *Quarterly Journal of Economics*.1999:1437-1467.

Kunreuther, Howard, and Robin Hogarth. “How does ambiguity affect insurance decisions?” *Working Papers.* Graduate School of Business. University of Chicago. No. 92-08-01. 1992.

Lago-Gonzalez, Raquel, and Vicente Salas-Fumas. “Market power and bank interest rate adjustments.” *Working Papers.* Bank of Spain. No. 0539. 2005.

Lee, Chyi L. “The strengths and limitations of risk measures in real estate: A review.” *Malaysian Journal of Real Estate.* 2006: 68-74.

Lepetit, Laetitia, Emmanuelle Nyw, Philippe Rous, and Amine Tarazi. “Product diversification in the European banking industry: Risk and loan pricing implications.” 2005. <10 November, 2008 from http://ssrn.com/abstract=873490>.

LeRoy, Stephen F., Jan Werner, and Stephen A. Ross. *Principles of financial Economics.* New York: Cambridge University Press, 2001.

Leslie, R. Scott, and Hassan Ghomrawi. “The use of propensity scores and instrumental variable methods to adjust for treatment selection bias.” *Working Papers.* SAS Global Forum. No. 366-2008. 2008.

Levy, Haim, and Marshall Sarnat. “Safety first: An expected utility principle.” *The Journal of Financial and Quantitative Analysis.* 1972: 1829-1834.

Levy, Haim, and Harry M. Markowitz. “Approximating Expected Utility by a function of mean and variance.” *American Economic Review*. 1979: 308-317.

Levy, Haim, and Moshe Levy. "The safety first expected utility model: Experimental evidence and economic implications." *Journal of Banking and Finance.* 2009: 1494-1506.

Llewellyn, David T. "Competition and profitability in European banking: Why are British banks so profitable?" *Economic Notes*. 2005: 279-311.

Longitudinal/ Panel data: Reference manual release 9. Texas: A STATA Press Publication, 2006.

Lown, Cara S., Carol L.Osler, Philip E. Strahan, and Amir Sufi. "The changing landscape of the financial services industry: What lies ahead?" *Economic Policy Review*. Federal Reserve Bank New York. 2000:39-55.

Majid, Abdul, Muhamed Zulkhibri, and Sifian Fadzlan. "Market structure and competition in emerging market: Evidence from Malaysian Islamic Banking industry." *MPRA Paper*s. No. 12126. 2007.

Majid, Abdul, Fadzlan Sufian, and Mohd N. Alifiah. " Consolidation, market structure and competition in the Malaysian banking industry: Empirical evidence from Malaysia." Unpublished paper presented in the 15th Annual Conference PBFEAM, Vietnam. 2007.

Markowitz, Harry. "Portfolio selection." *The Journal of Finance.* 1952: 77-91.

Marotta, Giuseppe. "Lending interest rate pass-through in the euro area. A data-driven tale. *CEFIN Working Papers.* Centro Studi Banca E Finanza. No.12. 2008.

Marsch, Katharina, Christian Schmieder, and Katrin Forster-van Aerssen. "Banking consolidation and small business finance: Empirical evidence for Germany." *Discussion Papers.* Deutsche Bundesbank. No09-2007. 2007.

Martin, Alfredo, Jesus Saurina, and Vicente Salas. “Interest rate dispersion in deposit and loan markets.” *Working Papers.* Bank of Spain. No. 0506. 2005.

Matsumura, Toshihiro, and Makoto Okamura. “Equilibrium number of firms and economic welfare in a spatial price discrimination model.” *Economics Letters.* 2006: 396-401.

Matthews, Kent, Victor Murinde, and Tianshu Zhao. “Competitive conditions among the major British banks.” *Journal of Banking and Finance.* 2007: 2025-2042.

Matz, Leonard M. *Liquidity risk measurement and management*. Singapore: John Wiley & Sons (Asia) Pte. Ltd., 2007.

Maudos, Joaquin, and Juam Fernandez de Guevara. “Factors explaining the interest margin in the banking sectors of the European Union.” *The Journal of Banking and Finance*. 2004: 2259-2281.

McIntosh, James. “A welfare analysis of Canadian chartered bank mergers.” *The Canadian Journal of Economics.* 2002: 457-475.

Meon, Pierre-Guillaume, and Laurent Weill. “Can mergers in Europe help banks hedge against macroeconomic risk.”*Applied Financial Economics*. 2005: 315-326.

Mercieca, Steve, Klaus Schaeck, and Simon Wolfe. “Bank market structure, competition, and SME financing relationships in European Regions.” *Journal of Financial Service Research.* 2009: 137-155.

Meyer, Bruce D., W. Kip Viscusi, and David L. Durbin. “Worker’s compensation and injury duration: Evidence from a natural experiment.” *American Economic Review*. 1995:322-340.

Micco, Alejandro, and Ugo Panizza. “Bank ownership and lending behaviour.” *Economics Letters.* 2006:248-254.

Milbourn, Todd. T., Arnoud W.A. Boot, and Anjan V. Thakor. "Megamergers and expanded scope: Theories of bank size and activity diversity." *Journal of Banking and Finance.* 1999:195-214.

Miranda, Alfonso. "FIML estimation of an endogenous switching model for count data." *The Stata Journal.* 2004: 40-49.

Mishra, Suchismita, Arun J. Prakash, Gordon V. Karels, and Manferd Peterson. "Bank mergers and components of risk: An evaluation." *Journal of Economics and Finance.* 2005: 85-96.

Molyneux, Philip, Michael Lloyd-Williams, and John Thornton. "Competitive conditions in European banking." *Journal of Banking and Finance.* 1994: 445-459.

Molyneux, Philip. "Does size matter? Financial restructuring under EMU." *Working Papers.* The European Commission. DG Research. No. 03-30. 2003.

Monti, Mario. "Deposit, credit, and interest rate determination under alternative bank objectives." In *Mathematical Methods in Investment and Finance*. Edited by G.P. Szego and K. Shell. Amsterdam: North-Holland, 1972.

Montoriol-Garriga, Judit. "Bank mergers and lending relationships." *Working Paper Series.* European Central Bank. No. 934. 2008.

Morris, Theresa. "Bank mergers under a changing regulatory environment." *Sociological Forum.* 2004: 435-463.

Moschandreas, Maria. *Business Economics*. 2nd ed. Singapore: Thomson Learning, 2000.

Nachane, Dilip, Saibal Ghosh, and Partha Ray. "Basel II and bank lending behaviour: Some likely implications for monetary policy." *Economic and Political Weekly*. 2006:1053-1058.

Nathan, Alli. and Edwin H. Neave. “Competition and contestability in Canada’s financial system: Empirical results.” *Canadian Journal of Economics.* 1989:576-594.

Nawrocki, David. “A brief history of downside risk measures.” *The Investment Think Tank.* 2004: 235-250.

Neuberger, Doris. “Industrial organisation of banking: A review.” *International Journal of the Economics of Business.* 1998:97-118.

Northcott, Carol A. “Competition in banking: A review of the literature.” *Working Papers.* Bank of Canada. No. 2004-24. 2004.

Nys, Emmanuelle. “A European study of bank interest margins: Is net fees revenue a determinant?” 2003. Forthcoming.

Ogura, Yoshiaki, and Hirofumi Uchida. “Bank consolidation and soft information acquisition in small business lending.” *Discussion Papers.* RIETI. No. 07037. 2007.

O’Hara, Maureem. “A dynamic theory of the banking firm.” *The Journal of Finance*. 1983: 127-140.

O’Hara, Maureem, and Wayne Shaw, W. “Deposit insurance and wealth effects: The value of being ‘Too Big To Fail’.” *Journal of Finance*. 1990:1587 – 1600.

Ortobelli, Sergio, and Franco Pellerey. “Applications to portfolio theory of market stochastic bounds.” *Investment Management and Financial Innovations.* 2007: 25- 36.

Panetta, Fabio, Fabiano Schivardi, and Matthew Shum. “Do mergers improve information? Evidence from the loan market.” *Banco d’Italia Economic Research Paper.* Bank of Italy. No 521. 2004.

Panzar, John and James Rosse. “Structure, conduct and comparative statistics.” *Bell Laboratories Economic Discussion Papers.* NO. 248. 1982.

Panzar, John, and James Rosse. “Testing for monopoly equilibrium.” *Journal of Industrial Economic*. 1987:443-456.

Paris, Francesco M. “Selecting an optimal portfolio of consumer loans by applying the state preference approach.” *European Journal of Operational Research.* 2005: 230-241.

Park, Kwangwoo, and George Pennacchi. “Harming depositors and helping borrowers: The disparate Impact of Bank consolidation.” *Working Papers.* Federal Reserve Bank of Cleveland. No. 07-04. 2007.

Park, Kang H. “Has bank consolidation in Korea lessened competition?” *The Quarterly Review of Economics and Finance.* 2009: 651-667.

Parkin, Michael J. “Discount house portfolio and debt selection.” *Review of Economic Studies.* 1970: 469-497.

Parkin, Michael J., M.R. Gray, and R.J. Barrett. “The Portfolio Behaviour of Commercial Banks.” in K. Hilton and D.F. Heathfield. eds. *The Econometric Study of the UK*. Macmillan. 1970.

Peek, Joe, and Eric S. Rosengren. “Bank consolidation and small business lending: It’s not just bank size that matters.” *Working Papers.* Federal Reserve Bank of Boston. No. 97-1. 1997.

Peek, Joe, and Eric S. Rosengren. “Bank consolidation and small business lending: It’s not just bank size that matters.” *Journal of Banking and Finance*. 1998: 799-819.

Penas, Maria F., and Haluk Unal. “Gains in bank mergers: Evidence from the bond markets.” *Journal of Financial Economic.* 2004: 149-179.

Perara, Shrimal, Michael Skully, and J. Wickramanayake. “Bank market concentration and interest spreads: South Asian evidence.” *International Journal of Emerging Markets.* 2010: 23-37.

Peria, Maria S.M., and Ashoka Mody. “ How foreign participation and market concentration impact bank spreads: Evidence from Latin America.” Journal *of Money, Credi, and Banking*. 2004: 511-537.

Peristiani, Stavros. “The effect of mergers on bank performance.” *Working Research Papers.* Federal Reserve Bank of New York. No. 9313.1993.

Perrakis, Stylianos. “Assessing competition in Canada’s financial system: A note.” *Canadian Journal of Economics*. 1991: 727-732.

Pesaran, M. H., and Angus S. Deaton “Testing Non-nested Nonlinear Regression Models.” *Econometrica.* 1978: 677-694.

Petersen, Mitchell A., and Raghuram G. Rajan. “The effect of credit market competition on lending relationships.” *Quarterly Journal of Economics.* 1995: 406-443.

Petersen, Mitchell A., and Raghuram G. Rajan. “Does distance still matter? The information revolution in small business lending.” *Journal of Finance*. 2002: 2533-70.

Pilloff, Steven J. “Performance changes and shareholder wealth creation associated with mergers of publicly traded banking institutions.” *Journal of Money, Credit and Banki*ng. 1996: 294-310.

Ply, David H., and Stephen J. Turnovsky. “Safety-first and expected utility maximisation in mean-standard deviation portfolio analysis.” *The Review of Economics and Statistics.* 1970: 75-81.

Prager, Robin A., and Timothy H. Hannan. "Do substantial horizontal mergers generate significant price effects? Evidence from the banking industry." *The Journal of Industrial Economics*. edited by Kennenth Hilton and Daviv F. Heathefield. 1998: 433-452.

Pratt, John W. "Risk aversion in the small and in the large." Economietrica. 1964: 122-136.

PricewaterhouseCooper. "European banking consolidation." *PwC analysis*. 2006.

Prisman, Eliezer, Myron Slovin, and Marie Sushka. "A general model of the banking firm under conditions of monopoly, uncertainty and recourse." *Journal of Monetary Economics.* 1986: 293-304.

Prucha, Ingmar R., "Maximum likelihood and instrumental variable estimation in stimultaneous equation systems with error components." *International Economic Review.* 1985: 491-506.

Pulley, Lawrence B., Allen N. Berger, David B. Humphrey, and Anthony M. Santomero. "Do consumers pay for one-stop banking? Evidence from a non-standard revenue function." *Finance and Economics Discussion Series*. Board of Governors of Federal Reserve System. No. 93-30. 1993.

Pyle, David H. "On the theory of financial intermediation." *Journal of Finance*.1971: 737-747.

Pyle, David H. "Bank risk management: Theory." *Research Program in Finance Working Papers.* University of California. No. 272. 1997.

Repullo, Rafael, and Javier Suarez. "Loan pricing under Basel capital requirements." *Journal of Financial Intermediation.* 2004: 496.521.

Resti, Andrea. "Regulation can foster mergers, can mergers foster efficiency? The Italian case." *Journal of Economics and Business*. 1998: 157-169.

Rhoades, Stephen A. "The efficiency effects of bank mergers: an overview of case studies of nine mergers." *Journal of Banking and Finance.* 1998: 273-291.

Rhoades, Stephen A. "Bank mergers and banking structure in the U.S., 1980-1998." *Board of Governors Staff Study.* Federal Reserve System. No. 174. 2000.

Rime, Bertrand, and Kevin J. Stiroh. "The performance of universal banks: Evidence from Switzerland." *Journal of Banking and Finance.* 2003: 2121-2150.

Rime, Bertrand. "Do Too-Big-To-Fail expectations boost large banks issuer ratings?" *Working Papers*. Swiss National Banks. Systemic Stability Section. 2005.

Roman, Diana, and Gautam Mitra. "Portfolio selection models: A review and new directions." *Wilmott Journal.* 2009: 69-85.

Roy, Andrew D. "Safety First and the Holding of Assets." *Economictrica.* 1952: 431-449.

Rose, Peter S. *Commercial bank management.* USA: McGraw Hill Cos, Inc, 1996.

Rosen, Richard J. "Banking market conditions and deposit interest rates." *Working Papers.* Federal Reserve Bank of Chicago. No. 2003-19. 2003.

Rosse, James and John Panzar. "Chamberlin vs. Robinson: An empirical test for monopoly rents." Bell Laboratories Economic Discussion Paper. No. 90. 1977.

Ruth, George E. *Commercial lending*. 4th ed. Washington D.C. : American Bankers Association, 1999.

Ryan, Peter J., and Jean Lefoll. "A comment on mean-variance portfolio with either a singular or a non-singular variance-covariance matrix." *The Journal of Financial and Quantitative Analysis.* 1981: 389-395.

Salami, Fatimah O. "CEO compensation and bank risk: Empirical evidence from the Canadian banking system." *Seminar Papers.* KENMS. No. FIN6264. 2009.

Salop, Steven C. "Monopolistic competition with outside goods." *The Bell Journal of Economics.* 1979: 141-156.

Samanta, Subarna K., and Ali H. Mohamad-Zadeh. “Bank’s portfolio management under uncertainty.” *The American Economist.* 1992: 30-38.

Samson, Danny A. “Expected utility strategic decision models for general insurers.” *ASTIN Bulletin.* 1986: 46-58.

Santomero, Anthony M. “Modelling the banking firm: A survey.” *Journal of Money, Credit and Banking*. 1984: 576-602.

Sapienza, Paola. “The effects of banking mergers on loan contracts.” *The Journal of Finance.* 2002: 329-366.

Sapienza, Paola. “The effects of government ownership on bank lending.” *Journal of Financial Economics.* 2004: 357-384.

Saunders, Anthony, and Liliana Schumacher. “The determinants of bank interest rate margins: An international study.” *Journal of International Money and Finance.* 2000: 813-832.

Schmid, Markus M., and Ingo Walter. “Do financial conglomerates create or destroy economic value?” *Journal of Financial Intermediate*. 2009:193-216.

Scott, Jonathan A., and William C. Dunkelberg. “Bank mergers and small firm financing.” *Journal of Money, Credit and Banking*. 2003: 999-1017.

Shaffer, Sherrill. “Competition, conduct and demand elasticity.” *Economics Letter*. 1982: 167-171.

Shaffer, Sherrill. “Non-structural measures of competition: Toward a synthesis of alternatives.” *Economics Letters.* 1983: 349-353.

Shaffer, Sherrill. “Can megamergers improve bank efficiency?.” *Journal of Banking and Finance.* 1993: 423-436.

Shaffer, Sherrill. “Comment on ‘What drives bank competition? Some international evidence’ by Stijin Claessens and Luc Laeven.” *Journal of Money, Credit, and Banking*. 2004:585-592.

Shaffer, Sherrill, and Lorein Thomas. “A reassessment of market power among credit card banks.” *Applied Financial Economic.* 2007: 755-767.

Shaik, Saleem, Albert J. Allen, Seanicaa Edwards, and James Harris. “Market Structure Conduct Performance hypothesis revisited using stochastic frontier efficiency analysis.” *Agribusiness and Applied Economics.* North Dakota State University. No. 649. 2009.

Shahimi, Shahida, Abd. Ghafar B. Ismail, and Sanep B. Ahmad. “A panel data analysis of fee income activities in Islamic banks.” *Islamic Economics.* 2006: 23-35.

Shull, Nernard, and Gerald A. Hanweck. *Bank mergers in deregulated environment: promise and peril*. Westport: Quorum Books, 2001.

Skoufias, Emmanuel. “Applying impact evaluation tools: Hypothetical fertilizer project.” *The World Bank PREM Learning Week.* April 21-22, 2008. < January 2008 from http://siteresources.worldbank.org/INTISPMA/Resources/ Training-Events-and Materials/4493651241130611853/ Day2_Session1_Fertilizer_ESkoufias.ppt#420,1,Applying Impact Evaluation Tools: Hypothetical Fertilizer Project>

Skoufias, Emmanuel, Mishel Unar, and Teresa Gonzalez-Cossio. “The impacts of cash and in-kind transfers on consumption and labor supply: Experimental evidence from rural Mexico.” *The World Bank Policy Research Working Papers.* No, 4778. 2008

Slijkerman, Jan F., Dirk Schoenmaker, and Casper G. de Vries. “Risk diversification by European Financial conglomerates.” *Tinbergen Institute Discussion Papers.* Tinbergen Institute. No. TI 2005-110/2. 2005.

Slovin, Myron B., and Marie E. Sushka. “A model of the commercial loan rate.” *The journal of Finance*. 1984: 1583-1596.

Smith, Robert, and David Trip. “Competition and contestability in New Zealand’s banking system.” Paper presented at the 14th Australian Finance and Banking Conference. Sydney. 2001.

Snow, John. “On the mode of communication of cholera.” *The Challenge of Epidemiology: Issues and Selected Readings.* 1855: 42-45.

Soper, John C. “What’s next for consolidation in banking?” *Business Economics.* 2001: 39-43.

Stanhouse, Bryan, and Duane Stock. “The impact of loan prepayment risk and deposit withdrawal risk on the optimal intermediation margin.” *Journal of Banking and Finance.* 2004: 1825-1843.

Stiroh, Kevin J. “Diversification in banking: Is noninterest income the answer?” *Staff Reports.* Federal Reserve Bank of New York. No.154. 2002.

Stiroh, Kevin J. “Bank risk and revenue diversification: An assessment of using equity returns.” Federal Reserve Bank of New York. 2005.

Strahan, Philip E., and James P. Weston. “Small business lending and bank consolidation: Is there cause for concern?.” *Current Issues In Economics and Finance*. Federal Reserve Bank of New York. 1996:1-6.

Strahan, Philip E., and James P. Weston. “Small business lending and the changing structure of the banking industry.” *Journal of Banking and Finance.* 1998:821-845.

Stutzer, Michael. J. “A portfolio performance index.” *Financial Analysts Journal*. 2000:52-61.

Stutzer, Michael. J. “'Portfolio choice with endogenous utility: A large deviations approach.” *Journal of Econometrics*. 2003: 365-386.

Thalheimer, Richard, and Mukhtar M. Ali. “Time series analysis and portfolio selection: An application to mutual savings banks.” *Southern Economic Journal.* 1979: 821-837.

Todd, Petra E. Matching estimators. Palgrave Dictionary of Economics. 2006. < 20 December, 2009 from athena.sas.upenn.edu/~petra/papers/mpalgrave2.pdf>

Todd, Petra E., and Kenneth I. Wolpin. “Structural estimation and policy evaluation in developing countries.” *Working Papers.* Penn Institute for Economic Research. No. 09-028. 2009.

Tra, Pham Thi Thu, and Robert Lensink, “The determinants of loan contracts to business firms.” *UNN-WIDER Research Papers*. No 2006/86. 2006.

Twigger, Robert. “GDP per capita in OECD countries: the UK’s relative position.” *Research Papers.* House of Commons Library. No.98/64. 1998.

Tyrowicz, Joanna. “Bank and credit? Impact of market structure on investment credit policies of Polish banks.” *Working Papers.* Warsaw University. 2006.

Uchida, Hirofumi, and Yoshiro Tsutsui. “Has competition in the Japanese banking sector improved?” *Journal of Banking and Finance* 2004: 419-439.

Unicredit Group Bank Austria Creditanstalt. “Banking in CEE and the role of international players.” 2006.

Valverde, Santiago C., and David B. Humphrey. “Predicted and actual costs from individual bank mergers.” *Journal of Economics and Business.* 2004: 137-157.

Valverde, Santiago C., and Francisco R. Fernandez. "The determinants of bank margins in European banking." *Journal of Banking and Finance.* 2007: 2043-2063.

Van Lelyveld. Iman, and Klaas Knot. "Do financial conglomerates create or destroy value? Evidence for the EU." *Working Papers.* De Nederlandsche Bank NV. No. 174/2008. 2008.

Van Leuvensteijn, Michiel, Christoffer Kok-Sorensen, Jacob A. Bikker, and Adrian A.R.J.M.Van Rixtel. "Impact of bank competition on the interest rate pass-through in the euro area." *Working Papers.* European Central Bank. No. 885. 2008.

Van Loo, Perter D. "On the microeconomic foundations of bank behaviour in macroeconomic models." *De Economist*. 1980:474-495.

Vojtek, Martin. "The alternative model of portfolio management." *Discussion Paper Series.* CERGE-EI. No. 2005-141. 2005.

Walkner, Christoph, and Jean-Pierre Raes. "Integration and consolidation on EU banking and unfinished business." *European Commission Economic Papers*. The European Economy. No. 226. 2005.

Wall, Larry D., Alan K. Reichert, and Hsin-Yu Liang. "The final frontier: The integration of banking and commerce Part1: The likely outcome of eliminating the barrier." *Economic Review*. Federal Reserve Bank of Atlanta. 2008.

Walraven, Nicholas A. "Small business lending by banks involved in mergers." *Draft Working Papers.* Board of Governors of the Federal Reserve System. September 1996.

Walter, Ingo. *Mergers and Acquisitions in banking and finance: What works, what fails and why.* New York: Oxford University Press Inc., 2004.

Werner, Hurlimann. "A mean-variance portfolio optimal under utility pricing." *Journal of Mathematics and Statistics.* 2006: 445-452.

Williams, Barry. "Factors determining net interest margins in Australia: Domestic and foreign banks." *Financial Markets, Institutions & Instruments*. 2007: 145-165.

Wooldridge, Jeffrey M. *Econometric analysis of cross section and panel data*. London: The MIT Press, 2001.

Wooldridge, Jeffrey M. *Difference-in-difference estimation* NBER. Summer 2007.

Yassour, Joseph, David D. Zilberman, and Gordon C. Rausser. "Option choices among alternative technologies with stochastic yield." *CUDARE Working Papers.* No. 155. 1980.

Yildrim, H. Semith, and George C. Philappatos. "Competition and contestability in Central and Eastern European banking markets." FMA International Annual Meeting, Dublin:Ireland. 2002.

Yildrim, H. Semith, and George C. Philappatos. "Restructuring, consolidation and competition in Latin American banking markets." *Journal of Banking and Finance.* 2007: 629-639.

Zarruck, Emilio R. "Bank margin with uncertain deposit level and risk aversion." *Journal of Banking and Finance.* 1989: 797-810.