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EFFICIENCY AND COMPETITION IN THE INVESTMENT BANKING INDUSTRY

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Abstract

This thesis consists of three substantive essays on investment bank efficiency and competition, each constituting a separate chapter. The first essay (Chapter 2) reviews the literature on investment banking and provides indication on the recent trends in the industry.

The second essay (Chapter 3) analyses cost and profit efficiency for a sample of investment banks for the G7 countries (Canada, France, Germany, Italy, Japan, UK and US) and Switzerland prior to the recent financial crisis. We follow Coelli et al. (1999)'s methodology to adjust the estimated cost and profit efficiency scores for environmental influences including key banks' risks, bank and industry specific factors and macroeconomic conditions. Our evidence suggests that failing to account for environmental factors can considerably bias the efficiency scores for investment banks. Specifically, bank-risk taking factors (including liquidity and capital risk exposures) are found particularly important to accurately assess profit efficiency: i.e. profit efficiency estimates are consistently underestimated without accounting for bank risk-taking. Interestingly, our evidence suggests that size matters for both cost and profit efficiency, however this does not imply that more concentrated markets are more efficient.

The final essay (Chapter 4) investigates the relationship between market power and efficiency, and explores characteristics of competitive conditions in worldwide investment banking. In order to conduct analysis of the countries competitive conditions and regional efficiency level, first we use stochastic frontier approach to model cost efficiency, and

second we investigates Lerner index of monopoly power to test the degree of the market power in the investment banking industry. To further comprehend competition pattern in the industry we use Panzar and Rosse model to assess the degree of competition in worldwide investment banking. Lastly, to investigate the relationship between market power and efficiency, we apply a causality test. Data used was obtained from balance sheet, income statement and annual reports data for the 15 countries over 2001-2008 periods. The analysis highlights the fact that the investment banking markets worldwide are becoming progressively more concentrated and less cost efficient. However this is not the case for all the countries. Further, investment banks seem to have reduced their marginal costs faster than price falls and this led to an increase in the Lerner index thus suggesting greater market power. Results from H: Statistics lead to similar conclusions, hence indicating existence of colluding oligopoly in the market. The findings on the relationship between market power and efficiency is not straightforward and that other factors (such as among others, risk incentives, regulatory framework and contestability) may influence both the magnitude and the direction of the relationship and therefore should be accounted for in future research in this area.

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List of symbols and acronyms

AD	Asset diversification
BAS	Bank asset size
BIB	Boutique investment banks
CAR	Capital risk exposure
CEO	Chief executive officer
CIB	Corporate and investment banks - based on the McKinsey global overview.
CONC	Herfindhal Index of concentration
DFA	Distribution free approach - parametric approach for measuring efficiency.
EU	European Union
FDI	Foreign direct investment, net inflows.
FSIB	Full service investment banks
G7	Group of seven industrialized nations (Canada, France, Germany, Italy, Japan, UK and US).
GDP	Gross domestic product
GMM	Generalized Methods of Moments
GNP	Gross national product
HTE	High-technology exports, calculated as % of manufactured exports.
H:Statistics	Panzar and Rosse model. A measure of the degree of competitiveness of the industry.
ID	Income diversification
INF	Rate of inflation, calculated by log difference of GDP deflator.
IT	Information technology
IR	Insolvency risk exposure
LB	Publicly listed bank
LER	Lerner Index. It is an indicator of the degree of market power.
LIQ	Liquidity risk exposure
M&A	Mergers and acquisitions

OBS	Off-Balance sheet items
OECD	Organization for Economic Co-operation and Development
PD	Population density
ROA	Return on Assets
ROE	Return on Equity
SFA	Stochastic Frontier Analysis - parametric approach for measuring efficiency.
SR	Securities risk exposure
UK	United Kingdom
US	United States
WRCE	Workers' remittances and compensation of employees, received.

Chapter 1

Introduction and motivations

1.1Background

During the last two decades the investment banking industry around the world has experienced continual transformations due to various environmental trends including new technologies, deregulation, the globalization of the economy and economic integration. These changes in banks' operating environment have altered the conditions in which banking firms compete. Increased competition has been considered as the driving force behind the acceleration in the recent consolidation process which is raising concerns about increased concentration in the banking sector and its potential implications for public policy. Furthermore, the recent financial crisis has intensified the public policy debates about banking regulatory environment and whether existing rules make financial sector more efficient and stable.

The recent financial turmoil has affected a relatively large number of investment banks. Under pressure for profits, the latter have contributed to the emergence of an unprecedented system of compensations, a highly leveraged industry and a pervasive risk culture. Post-crisis, surviving banks will have to comply with new constraints thus the evaluation of their operating efficiency will likely gain a new impetus, particularly on the cost side. In this context, the description of modern investment banks' production process should reflect the changes in their business focus, as well, as account for risk and other environmental and regulatory factors.

According to Berger and Humphrey (1997), Berger (2007), Hughes and Mester (2008), over the past decade, substantial research has been carried out with the aim of measuring the efficiency of financial institutions, mainly commercial banks. Surprisingly, the investment banking industry is inadequately explored due to the difficulties of modelling successfully the peculiar nature of their production process and partially to the lack of good quality data. Furthermore, the majority of the empirical studies in commercial banking have focused on the market structure and efficiency analysis, including the relationship with concentration. To the best of our knowledge there are no studies focusing on the causal links between market power and the efficiency of the banking sector in this area.

1.2 Aims of study

Given the background above, we believe that it is worth conducting further investigation on the investment banking phenomenon, in order to better understand how these banks operate and compete.

Specifically, this thesis intends to provide a focus on the efficiency, competition and concentration in the investment banking industry. Therefore, we intend to assess the factors that might impact investment banks' efficiency, and investigate the causality between market power and efficiency of the industry.

This objective can be disentangled in the following research questions:

1. Are environmental influences including banks' risks, industry specific factors and macroeconomic conditions important to accurately assess cost and profit efficiency of investment banks?

2. Which type of the investment banks is the most efficient one?
3. What kind of competitive conditions characterise the investment banking industry?
4. Is there a causality relationship between market power and efficiency for investment banks?

1.3 Methodology

In order to answer research questions we now concentrate on the methodology that we intend to use for empirical investigations.

Aim is to carry out a suitable comparison of investment banking efficiency across countries by using a global best-practice econometric frontier whereby the banks in each country can be compared against the same standard. From a methodological point of view we employ Coelli et al. (1999)'s approach to adjust the estimated cost and profit efficiency scores for environmental influences. Two methods are adopted: first, where we estimate common frontier with only structural variables; and second method which accounts for the influences of environmental factors on the industry, by including indicator of these factors in a definition of a common frontier. Cost and profit efficiency are measured using the Stochastic Frontier Analysis (originally independently proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977)). Same efficiency analysis is performed in 4 Chapter, with one small difference, where we only calculate regional common frontiers.

Furthermore, we investigate Lerner index of monopoly power to assess the degree of the market power in the investment banking industry, and Panzar and Rosse model to analyze the degree of competition in worldwide investment banking. These two methodologies are applied in order to examine competitive conditions that characterise the investment banking industry.

Lastly, to investigate the causality relationship between market power and efficiency, we consider panel data and obtain estimates using the Generalized Methods of Moments. Efficiency scores and market power estimates are obtained based on previously elaborated methodologies.

1.4 Structure of the study

The thesis can be divided into two main parts: The first part is dedicated to understanding the changes that have characterized the investment banking industry in recent years (chapter 1), and second part is devoted to the empirical analysis and contains two chapters (chapters 2 and 3). The remainder of the thesis is organised as follows.

Chapter 2 provides a general introduction outlining the importance of the investment banking sector and explaining its historical development worldwide. The chapter also describes and illustrates the different types of investment banks, the main players in the investment banking industry, and their operational areas. Then it analyzes the role of human resource management, current structure and processes in the industry and importance of compensation for top management. The issues of investment banks' strategies is specially analyzed and explained through risk management (which represents

the top priority in the industry due to major losses that have occurred in recent year), cost management (where maximization of the revenues is dealt by cost control) and special focus on unique mix of businesses and skills over capital in order to create strategic performance framework.

Chapter 3 analyses cost and profit efficiency for a sample of investment banks for the G7 countries (Canada, France, Germany, Italy, Japan, UK and US) and Switzerland prior to the recent financial crisis. Coelli et al. (1999)'s methodology is adopted in order to adjust the estimated cost and profit efficiency scores for environmental influences including key banks' risks, bank and industry specific factors and macroeconomic conditions. Evidence suggests that failing to account for environmental factors can considerably bias the efficiency scores for investment banks.

Chapter 4 investigates the evolution of market structure as well as the dynamics of both competition and efficiency worldwide. Focusing on the investment banking sector worldwide, we calculate concentration measures for individual countries using the Herfindahl-Hirshman Index and estimate cost efficiency by employing parametric approach (Stochastic Frontier Analysis). We also test the degree of competition by using the Lerner index of monopoly power. Furthermore, we follow the empirical literature on competition in banking markets and employ Panzar and Rosse model, in order to deepen our comprehension of competitive conditions in the investment banking. Finally, we consider panel data and obtain estimates using the Generalized Methods of Moments to test the direction of causality between market power and efficiency.

Chapter 5 provides main findings, considerations about the limits of this study and possible further developments are finally presented in Concluding Remarks.

Chapter 2

Investment banking overview

2.1 Introduction

The aim of this chapter is to shed some light on the development of the investment banking industry, and to address the management issues and business strategies.

In order to better comprehend efficiency and level of competition in the investment banking, it is necessary to understand different factors that contribute to continuous growth of the industry, operating environment, and strategies employed. Moreover, current financial crisis only underline importance of these institutions for banking and financial markets. Therefore, to understand factors that impact investment banks efficiency levels and efficiency of financial markets, will lead us to consider risk management of these institutions. Going back to current financial crisis, we can realize how important change in these factors can be, which can alter the strategies and business environment in the market, and therefore inevitably change how investment banks execute their operations.

The remainder has the following structure:

- Section 2.2 summarises and explains the factors behind the development and evolution of investment banking system discuss economic forces and deregulation that led to high industry growth.
- Section 2.3 explains and reviews the main players in investment banking industry, types of investment banks, and their operational areas.

- Section 2.4 addresses the management issue in the investment banking by analyzing the role of human resource management, current structure and processes in the industry, and the issue of compensation for top management.
- Section 2.5 investigates investment bank strategies through risk management (which represents the top priority in the industry due to disasters and losses that have occurred or might occur), cost management (where maximization of the revenues is dealt by cost control) and special focus on unique mix of businesses and skills over capital in order to create strategic performance framework.
- Section 2.6 concludes motivating the objective of the thesis and its innovative contribution to the existing literature.

2.2 Factors behind the development of the investment banking industry

The development of investment banking is linked to the development of capital and financial markets on which its activities are exercised.

According to Gardener and Molyneux (1995) fundamental economic forces affect and influence the evolution of investment banking in two ways:

1. First by increasing real per capita income and wealth they alter the nature of demand for financial services, causing ultimate savers and financial intermediaries to seek the most attractive mix of financial assets. In terms of risk, reword and liquidity attributes in relation to their preferences and constantly changing evaluation of individual financial assets. Furthermore those wishing to obtain additional external fund

for investment and/or consumption are able to select more easily the most suitable methods and financial instruments for their needs.

2. Secondly, economic forces directly affect investment banking services, by lowering relative costs and enhancing the attraction of investment banking through widening the mix of attributes associated with the products they offer. Both these influences are propelled by technological advances.

The regulatory framework may also affect the development investment banking through its impact on financial innovation.

Gardener and Molyneux (1995) assume that apart from these factors, the development of industry is also affected by the distribution of property rights and the way that they are exercised (issue of corporate governance).

A number of environmental trends as well as the creativity and dynamism of their professional teams have shaped today's investment banks. Morrison and Wilhelm Jr (2007), Liaw (2006), Davis (2003), and Gardener and Molyneux (1995) agree that the key drivers of the phenomenal secular growth of the business have been:

- ***GDP growth and stock market prices*** - the unprecedented global stock market boom which ended in the early 2000 sustained a remarkable decade of double digit annual earnings growth for investment bankers.

- ***Globalization through cross border investment flows*** - cross border mergers and acquisitions in the developed world as well as direct and portfolio investment in emerging markets have fuelled the profitability of these sector, primarily US based banks, which have had the relationship and networks to capture these flows.

- ***The accumulation of assets managed by institutions*** - growing share of GNP wealth managed by institutions such as pension funds has created a well structured market for investment banks.

- ***Securitization*** - fuelled by investors demand for rated paper, the need of many banks to release regulatory capital, and the investment banker's creativity in creating new securitization concept, securitization has represented a direct economical transfer from commercial to investment banks.

- ***Deregulation*** - started with US brokerage commissions 1975 and the 1996 Big Bang in the UK (where banks were allowed to own brokers), have triggered consolidation on a massive scale not only in the sector but also the eventual fusion of commercial and investment banks. As far as the current crisis regulatory changes are concerned, we still have to wait and see new regulatory rules impact on the investment banking industry.

Since investment banking enables the financial system to perform some of its basic function better and more efficiently, therefore its evolution is driving force behind the development of the financial system. Consequently, progress in investment banking is beneficial as it: improves quality, enhances the ability of the economy to carry out more risk, to respond more rapidly to changes and to make rapid actions in relation to the performance of units using externally raised funds.

2.3 Investment banking industry

Investment banking represents highly specialized segment of financial industry. Its main function is to bring together ultimate savers and saving collection institutions with those wishing to raise additional funds for investments or consumption. Also it helps holders of accumulated wealth to re-allocate their assets using financial markets. In performing these two functions, those involved in investment banking act as market intermediaries.

According to Gardener and Molyneux (1995) there is important distinction between investment banking activity and the institutions that perform it. Investment banking activity can be undertaken by banks who are financial intermediaries, and an individual bank – universal bank. Type of institution engaged in investment banking is determined by the regulatory framework within which financial institutions and are free to operate at any particular time and by the choice by individual investors. There are two types of regulatory framework: First, which allows investment banking to be carried out by all types of commercial banks, resulting in emergence of universal banks; Second, which separates classic investment banking (underwriting) from commercial banking and sometimes also from other types of investment banking activities.

2.3.1 Types of investment banks

Gardener and Molyneux (1995) consider that United States and United Kingdom are in most developed phase of investment banking, while Germany and Japan are in less developed phase. Important indicators of the importance of investment banking are equity markets, mergers and amalgamations, pension funds and insurance claims (in form of the

securities), bilateral debt (in form of bank deposits), and common stocks control. The differences between position of investment banking in major and other countries, can be attributed to the different impact of interaction between economic, regulatory and social factors responsible for the evolution of investment banking and the financial system.

The impact of investment banking profitability has been most marked for the largest US investment banks, also known as bulge bracket firms. Table 2.1 illustrates top 10 global corporate and investment banks worldwide, from which we can realize the importance of these institutions for financial markets overall.

Table 2.1: The top 10 global corporate and investment banks (CIB)

Rank		**Financial institution**	**CIB revenues reported**		**CIB profit**
2006	2005		2006 $ million	2005 $ million	2006 $ million
1	3	Goldman Sachs	33,371	22,282	12,167
2	2	JP Morgan Chase	28,186	23,640	9,287
3	1	Citigroup	27,187	23,863	9,709
4	4	GE Commercial Finance	23,792	20,646	5,028
5	6	Deutsche Bank	23,506	19,830	7,262
6	5	Bank of America	22,691	20,600	10,752
7	7	UBS	21,607	18,143	6,627
8	10	Morgan Stanley	21,562	15,673	8,160
9	9	Royal Bank of Scotland	18,944	15,949	10,232
10	12	Merrill Lynch	18,917	13,844	5,751

Source: The McKinsey Global CIB 10 overview

The capital resources, distribution network and global capacity of these banks, is the reason why they have dominated and forecast to dominate global investment banking.

Many of the small to medium sized European investment banks belong to large universal banking conglomerates.

According to Liaw (2006) there are two basic types of investment banks: full-service and boutique, and lately due to regulatory changes and development in the sector we have also financial holding companies that engages in investment banking business.

Financial holding companies

Liaw (2006) defines financial holding companies as banks which operate full-service investment banking, and can besides that offer clients large sums of credit (for example Citigroup, HSBC, Credit Suisse, JP Morgan Chase and Bank of America). Universal banks, from Europe and Japan have operated in commercial and investment banking, while in the United States after the Gramm-Leach-Bliley Act investment banking has become part of their business.

Global financial holding companies have all banking service to offer and perform their operations in most financial centers and continents. Advancement in technology has enabled them to offer complete menu of service around the world.

Table 2.2 in the page bellow gives overview of the business segments from major financial holding companies.

Table 2.2: Business Segments of Financial Holding Companies							
Banks:	***Barclays and ABN Amro***	***BNP Paribas***	***Citi Group***	***HSBC Group***	***Intesa Sanpaolo***	***JPMorgan Chase***	***Nomura***
Business segments:	Commercial banking Retail banking Card services Investment banking Transaction banking Asset management Wealth management	Retail banking Corporate and Investment banking Asset management and services	Global consumer group Corporate and Investment banking Global wealth management Alternative investments Global community	Personal Financial Services Commercial banking Corporate, Investment banking and Markets Private banking	Public finance Corporate and Investment banking Banca dei territori (domestic commercial banking) Eurizon Financial Group International Subsidiary Banks	Investment bank Retail financial services Card services Commercial banking Treasury and securities service Asset management Corporate citizenship	Domestic retail Global markets Global Investment banking Global merchant banking Asset management
Sources: Companies annual reports for 2008							

Full service investment banks

Liaw (2006) defines full service investment banks (also known as the Wall Street bulge bracket) as banks that offer clients a range of service including underwriting, merger and acquisition advice, trading, merchant banking and prime brokerage. Goldman Sachs, Morgan Stanley and Merrill Lynch traditionally called the Big Three, have their own unique strengths, which they have been using to stay on leading positions in this business. Today, some of these banks are nonexistent due to bankruptcy after recent financial crisis. Table 2.3 in the page bellow gives overview of business segments from full service investment banks.

Table 2.3: Business Segments of Full Service Investment Banks						
Banks:	***Bear Stearns***	***Deutche Bank***	***Goldman Sachs***	***Lehman Brothers***	***Merrill Lynch***	***Morgan Stanley***
Business segments:	Capital markets Global clearing services Wealth management	Global markets Global banking Asset management Private wealth management Private and business clients	Investment banking Trading and principal investments Asset management and securities service	Capital markets Investment banking Investment management	Capital markets Investment banking and advisory Wealth management Investment management Insurance Banking	Institutional Securities Individual Investor Group Investment management Credit Services
Sources: Banks annual reports for 2007						

Boutique investment banks

Liaw (2006) defines boutique investment banks as banks which are smaller in general, but are creative in specializing in particular type of clients or services. They do not offer a range of service and are not part of larger financial institution.

Table 2.4 gives overview of business segments from boutique investment banks.

Table 2.4: Boutique Investment Banks Specializations			
Banks:	***Greenhill***	***Lazard***	***Sandler O'Neil***
Specializations	Advisory services in M&A Financial restructuring Merchant banking	Financial advisory Asset management	Investment banking Fixed income/balance sheet management Equity research, trading and sales Capital markets Mortgage finance Consulting services
Sources: Banks annual reports for 2008			

2.3.2 Investment bank operational areas

Demand for investment banking services is influenced by interaction between economic, social and regulatory factors, while supply depends entirely on the regulatory framework and the capacity and willingness of individual financial units to supply services and products. In order to have more efficient investment banking it is necessary to have legal separation of investment banking (some or all of its three main components - underwriting, restructuring and management of funds) from commercial banking and other financial activities (for example life insurance). It can also be said that investment banking tends to be offered by universal banks as a service to their clients or by specialized securities firms operating on global, regional or domestic stage.

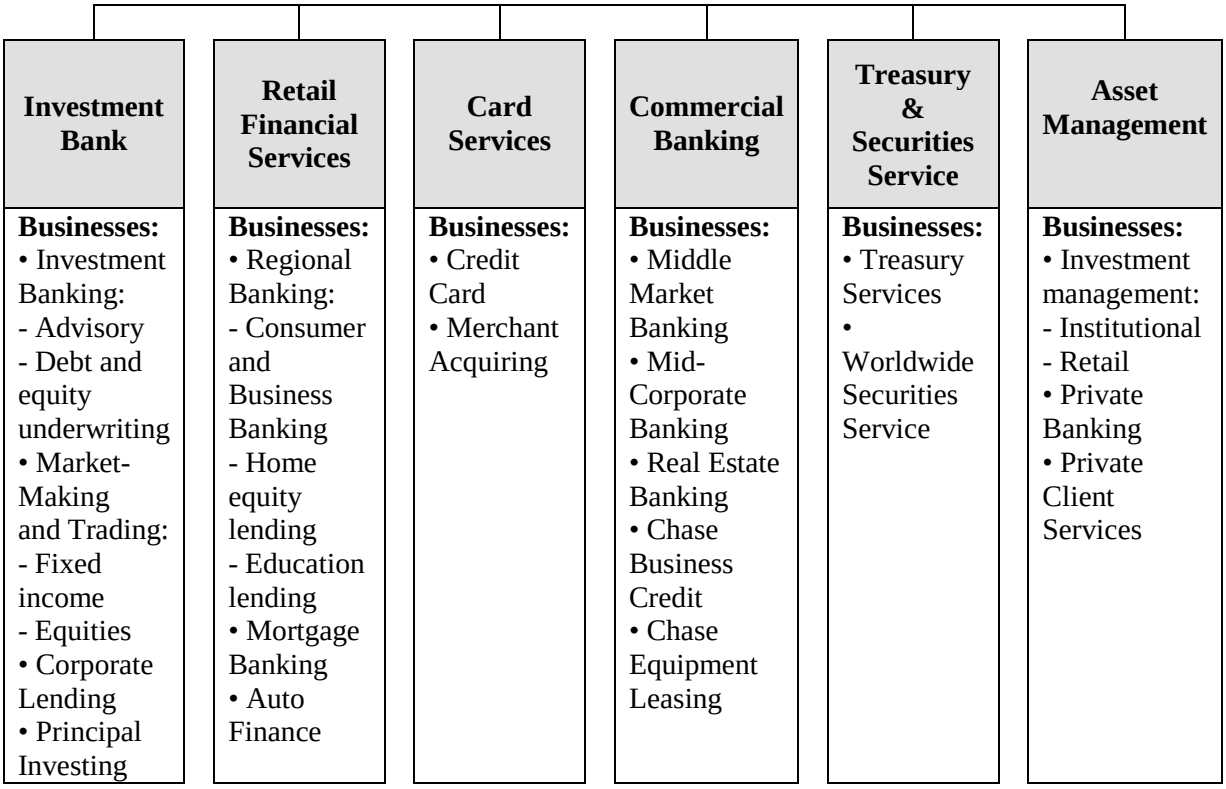
According to Kidwell, et al. (2008), Gardener and Molyneux (1995) investment bank's business can be categorized into five main areas:

1. Broking - the broking of securities is commodity business in which firms appeal to customers mainly on price and integrity.
2. Trading - the trading of securities drives on market volatility
3. Investment banking - represents the underwriting of new issues and advisory work also referred to as Mergers and Acquisitions.
4. Fund management - includes both retail and wholesale fund management.
5. Interest spread - income derivatives from borrowed funds.

Large investment banks aim to provide a global service in these five main sectors, the medium sized firms tend to specialize geographically and along specific product lines.

Figure 2.1 reflects the current organization of JPMorgan Chase. There are six major reportable business segments: the Investment Bank, Retail Financial Services, Card Services, Commercial Banking, Treasury & Securities Services and Asset Management. The segments are based upon the products and services provided, or the type of customer served.

Figure 2.1 JPMorgan Chase business segments



Source: JPMorgan Chase annual report for 2009

2.4 Addressing the management issue in the investment banking business

Management issue in the investment banking is addressed by analyzing the role of human resource management through culture and leadership, current structure and processes in the industry, and the issue of compensation for top management. All these factors determine the operational efficiency of these in institutions.

2.4.1 Human Resource Management

Investment banking is considered as the ultimate people business. It represents the magnet for highly ambitious individuals with a high degree of a self confidence and commitment to achieve the best both for themselves and their firm. Establishing a culture that channels their effort into a firm-wide effort is a major challenge, matched only by leadership needed to sustain and develop that culture. The bank only succeeds if such people feel empowered to work for the clients, enjoy the firm and work well with their colleagues.

Davis (2003) observes that interpersonal relationships in the competitive and volatile world of investment banking are particularly intense and durable. Loyalties to individuals and teams endure for decades despite changes in ownership, structure and job changes. According to the same author another important dimension of investment bank that have to be managed is the extent of built in conflicts, which are arising from differences viewing on how risk and capital should be committed, what is the right price of security, etc. Overshadowing these potential conflicts between banks traders and investment bankers generates fee income and stability for the bank.

Morrison and Wilhelm Jr. (2007) underline question of culture in investment banking as one of the fundamental forces that are responsible for its growth, development and power. All the great service companies have a culture of putting the client first, with personal integrity and teamwork at the heart of the culture. Institutions moving from commercial to investment banking have to create appropriate culture for the fast-moving, transaction-oriented investment banking world, which later on provides them with the deepness for better business understanding.

Leadership is the key to do and to have success in investment banking. It takes strong inspirational leadership to motivate teams of talented and diverse individuals. It all comes done to what is the best for certain moment or for specific bank.

2.4.2 Structure and processes in the investment banking

According to Morrison and Wilhelm Jr. (2007) investment banking business is constantly evolving, it is more complex, challenging and global with wider array of complex products, consolidated into larger banks and converted into stock owned banks.

Some of today's biggest competitors in investment banking were forced to go through painful transformation to transform their commercial banking business into an investment banking in order to succeed in the new surroundings.[1] US banks were first one to proceed

[1] JP Morgan was one of the banks who undertook the painful transformation of wholesale commercial banking to become investment banking competitor. For further readings see Davis (2003, pg. 60)

with this transformation, but same happened in Europe some time later, were US example was followed.[2]

Contrary to the transformation process in majority cases, Davis (2003) observes that some have preferred so called one bank model, where M&A and equities were split into separate entity with its own corporate structure compensation system and management processes. The biggest test for one bank model is client coverage, which demands a single investment banker with his role to build a close relationship with the clients CEO and other executives, to develop deeper understanding of the client's strategy, to identify marketing opportunities, and to bring the skills and resources of his firm to exploit these opportunities. In order to avoid putting everything on the shoulder of one individual, some banks have developed dual coverage model, which should help better performance and effectiveness of the organization. In this model the task of coverage is assigned to the two investment bankers to co-lead each other client relationship.

The challenge of successful execution is a major management preoccupation, whatever the client coverage model is used. Creation of appropriate working environment where information and relationship are shared freely and on proactive basis remains key success factor for all banks.

According to Morrison and Wilhelm Jr. (2007), and Davis (2003) a universal issue for all investment banks is to bridge gap between product specialties and relationship managers. Finding appropriate person capable of execution together with expertise and client relationships brings the long term success for the firm. The ultimate goal is to improve client focus, giving the client what he deserves, a service differentiated from the other

[2] Societe Generale in France created its Corporate and Investment Bank (CIB) in 1995 and was one of the first in Europe to do so, but others have followed.

investment banks. Geographical dimension together with client and product dimension creates three dimensional challenges for investment banks and their management teams.

2.4.3 Compensation

Davis (2003) underline compensation issue that lies in the heart of an investment bank's efforts to attract motivates and retains the unique human skills. Money is in the middle of relationship between investment bankers and their firms. Similarly, same author acknowledges compensation importance through time. In the 1990s it was important through weather any business could afford packages being offered in an unpredictable bull market, later in 2000 through concern about enormous compensation for top managers. In the present time, top managers are besides high level bonuses and packages offered and more problematical and unjustified fixed amount of future payouts.

Amongst investment banking leaders there is widespread agreement on the best practice in compensational strategy, where establishing single bonus pool tied to performance and issuing as much stock as possible to employees is the best solution.

2.5 Business strategies

The aim of this chapter is to introduce investment banking strategies that are important for empirical part of this thesis. We concentrate on risk management (which represents the top priority in the industry due to disasters and losses that have occurred or might occur), cost management (where maximization of the revenues is dealt by cost control) and special

focus on unique mix of businesses and skills over capital in order to create strategic performance framework.

2.5.1 Risk Management

Risk management is top priority in investment banking due to disasters and losses that have occurred or might occur, all driven by a risk management failure. The list of collapses and disasters in last 20 years is a long one. For example, first there were collapses of Drexel Burnham in 1990 and of Barings Brothers in 1995, as well as Kidder Peabody in 1990s. Then there were client losses due to investment banker's efforts to invent new ways of making and losing money – the Procter & Gamble/Orange County derivative losses in the mid 1990s, as well as Enron structured finance losses more recently. After there were losses with private equity/merchant banking investments at the beginning and end of 1990s, the massive fixed income losses taken in 1994 due to US interest rates going up, and the speculation on Russian government bonds in 1998. Lastly we had failure of Merrill Lynch and bankruptcy of Lehman Brothers in 2008.

Looking at the history we can say that the cycle of unprecedented shocks in investment banking might occur every four years.

According to Davis (2003) investment banking risks today can be divided in three basic types:

1. Credit or counterpart risk - the risk of loss of principal and interest,
2. Market risk - adverse movements of interest rates, equity prices or currencies,

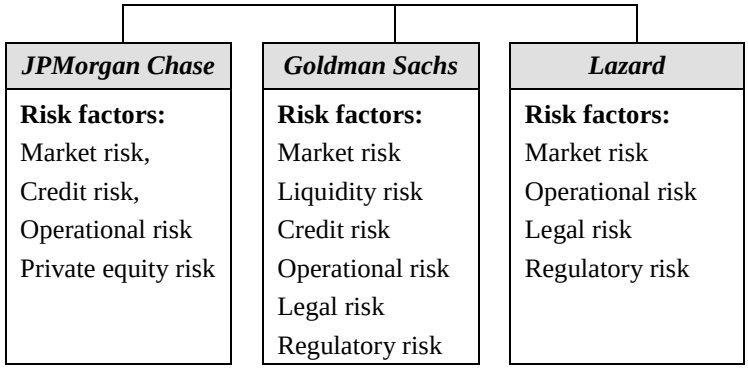
3. Operational risk (human and system failures which drive serious losses.

To surpass some of the potential risk investment banks are relying on proprietary trading to sustain revenue growth. Also they remain exposed to risk of loss in their lending, block trading, and private equity and underwriting.

Banks generally use diversification as a key dimension of risk control. It is also important to mention unexpected risk (risk that we are not even aware of), product risk (developing a new ways to meet customer needs), liquidity and funding risk, and insolvency risk.

Figure 2.2 reflects the current risk factors considered by some investment banks. However by focusing only on these risks, banks might be venerable to other risk that might occur.

Figure 2.2 Risk management in investment banking



Source: Banks annual reports for 2009

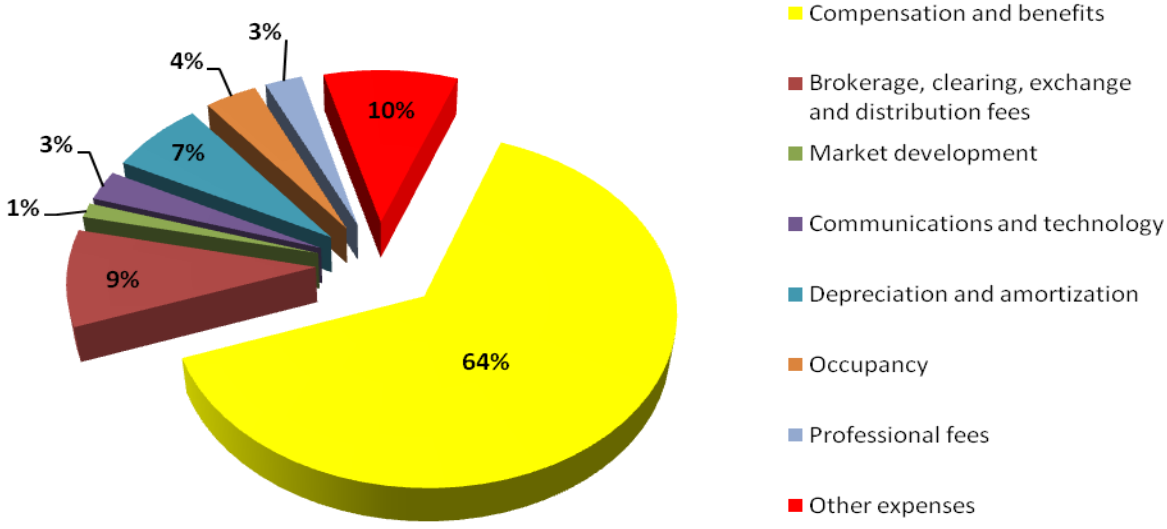
2.5.2 Cost Management

Managing the cost base was always dominated by human capital, and influenced by investment in global infrastructure and product platforms. Most widely used operating guideline in investment banking, in a sector where people cost can account for 60-70% of

total costs, is the compensation-revenue ratio. Another major cost driver is technology spending, which accounts for about 15% of total costs.

Figure 2.3 provides overview of the Goldman Sachs operating expenses for 2009.

Figure 2.3 Goldman Sachs operating expenses in 2009



Source: Goldman Sachs annual report for 2009

On the other side investment banking represents a revenue motivated business. According to Morrison and Wilhelm Jr. (2007) in order for management to maximize their share of revenue, they have to improve some or all sectors of investment banking business, and the first thing in that direction is to control cost base. Davis (2003) describes following techniques that can control cost base:

- Maximization the proportion of variable cost through partnership concept - which means that variable compensation represents dominant portion of professional costs, and theoretically in bad year it could be zero.

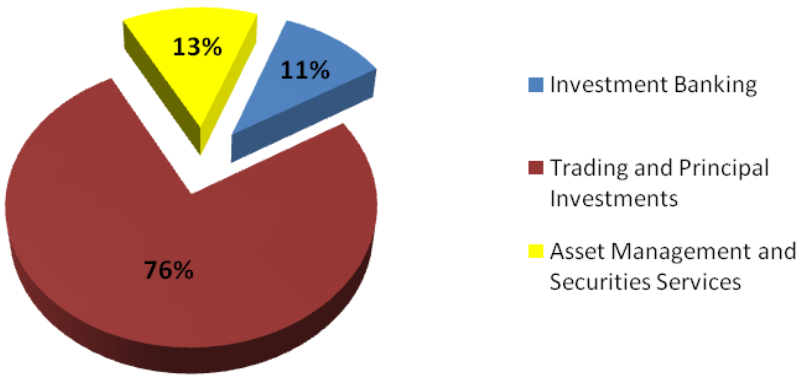
- Ratio of compensation to net revenues - key for management to limit the growth of headcount and compensation cost not matched by corresponding revenue generation.
- Cull staff regularly strategy - strategy forced into periodic crash lay-offs when revenues collapse.
- Top down review of all of the banks business, with a way to exit from the low profit segments.

Managing the cost bases raises also the issue of the relationship between cost and revenues, which means that banks can match its cost base to its revenue generating potential over time. Here the challenge is either to reduce cost base or to find other business to grow.

Investment banks diversify their business lines in order to have earnings more stable. For most investment banks today, investment banking represents only a portion of their overall income.

Figure 2.4 shows revenue sources for the Goldman Sachs in 2009 by segment of operating results:

Figure 2.4 Goldman Sachs revenue sources in 2009



Source: Goldman Sachs annual report for 2009

2.5.3 Financial performance

The business of investment banking is highly volatile and competitive. The successful banks have chosen to focus on unique mix of business and skills over capital, where each firm has focused on a strategic framework that it believes to be its core competency.

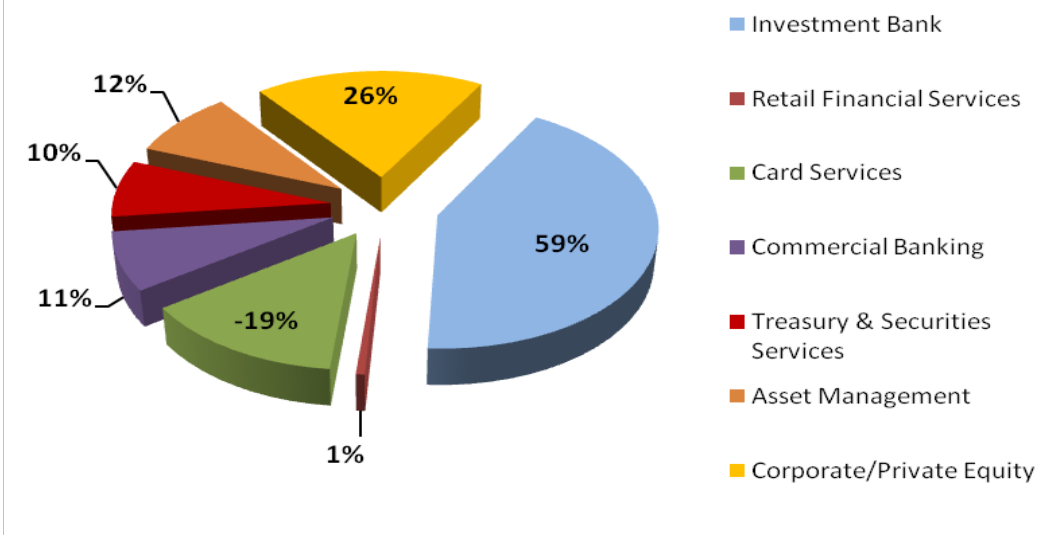
According to Liaw (2006) in order to achieve planned financial performance investment banks have to diversify their revenues, which will in the end make their earnings more stabile. Securities businesses by their nature are subject to volatility coming from changes in industry competition, interest and foreign exchange rates, and global economic and political trends. The menu of services is also changing. To achieve and maintain a leadership position in investment banking, a bank must have:

- Deep client relationship to obtain a flow of businesses;
- A strong product line to offer the best product and services;
- The ability to provide clients with an integrated solution to help them achieve superior results;
- A strong global presence and local knowledge;
- A strong financial strengths to establish the confidence of clients and maintain long-term relationships;
- An effective risk management process to ensure the firm's financial soundness and profitability;
- A solid governance structure to ensure compliance with internal policies and regulations;
- Integrity and professionalism to create trust and provide superior services;

- A compensation system that attracts and retains talents;

Figure 2.5 shows income sources for JP Morgan Chase business segment in 2009.

Figure 2.5 JPMorgan Chase net income by business segment in 2009



Source: JPMorgan Chase annual report for 2009

2.6 Conclusions

From the overview of existing literature, we can conclude that even if efficiency improvement through cost and revenue management is probably the most valid rationale for investment banks, potential efficiency gains are still not sufficiently explored. New evidence is particularly important not only from the perspective of efficient resources utilisation and maximisation of profits, rather because by investigating efficiency of these institutions worldwide, we can better understand the reasons behind their wrongdoings and failures.

In order to have a complete view of the investment banking phenomenon, a comprehensive overview of the competitive conditions in the market and their relationship with efficiency is necessary. In order to conduct such analysis we need to account for differences arising from environmental, firm specific and regulatory differences in the investment banking industry and between various countries.

The mentioned above will lead us to answering the following research questions:

RQ1: Are environmental influences including banks' risks, industry specific factors and macroeconomic conditions important to accurately assess cost and profit efficiency of investment banks?

RQ2: Which type of the investment banks is the most efficient one?

Our goal is to carry out a suitable comparison of banking efficiency across countries by using a global best-practice econometric frontier whereby the banks in each country can be compared against the same standard. From a methodological point of view we adjust the estimated cost and profit efficiency scores for environmental influences. Specifically, we introduce a large set of environmental variables to account for potential differences arising from certain country-specific risk exposure on the one hand and from the environmental and regulatory conditions on the other. We choose to consider both cost and profit efficiency because investment banking is traditionally a revenue-motivated business and competitive pressure (e.g. due to deregulation and globalisation) put further pressure for the efficiency enhancement.

To provide some additional explanation regarding efficiency results inside the investment banking industry, we create a cluster sample for investment bank type. Here we want to

analyze potential differences in efficiency of different investment bank types, and to see if full service investment banks still dominate the market.

In order to give an advance to the existing literature we investigate a third and fourth research question:

RQ3: What kind of competitive conditions characterise the investment banking industry?

RQ4: Is there a causality relationship between market power and efficiency for investment banks?

To answer the two questions from above we conduct our second empirical analysis which investigates the evolution of market structure as well as the dynamics of both competition and efficiency in the three regions (East Asia & the Pacific, Europe and North America). We test the degree of competition by using the Lerner index of monopoly power. Furthermore, we follow the empirical literature on competition in banking markets and employ Panzar and Rosse model, in order to deepen our comprehension of competitive conditions in the investment banking. Finally, we consider panel data and obtain estimates using the Generalized Methods of Moments (GMM) to test the direction of causality between market power and efficiency.

Chapter 3

Efficiency and risk-taking in pre-crisis investment banks

3.1 Introduction

In the 'great moderation' era, the investment banking industry in all advanced economies benefited from the processes of liberalisation, internationalisation and consolidation activities. An increasing number of financial institutions have been involved in cross-border activities and in providing banking services globally. Investment banks' main business is to intermediate between issuers and investors through the functions of M&A advisory services and underwriting of securities issues. They also provide trading and investing in securities and asset management.

Yet, investment banks' core function lays in the 'origination' of large and complex financial instruments that expose them to market risks and imply that their business relies predominantly on the short-term. The recent financial turmoil affected a relatively large number of investment banks. Under pressure for profits, these latter have contributed to the emergence of an unprecedented system of compensations, a highly leveraged industry and a pervasive risk culture. Post-crisis, surviving banks will have to comply with new constraints thus the evaluation of their operating efficiency will likely gain a new impetus, particularly on the cost side. In this context, the description of modern investment banks' production process should reflect the changes in their business focus. As well, it should account for risk and other environmental and regulatory factors.

The need for a correct evaluation of investment banks' efficiency can be explained by various reasons. First, investment banks typically have a large number of stakeholders since they engage in public and private market transactions for corporations, governments and investors. An inaccurate assessment of their operating efficiency could bias their performance analysis and, consequently, cover up their financial difficulties thus resulting in negative externalities for all investment banks' stakeholders (including governments, stake-issuers and, ultimately, investors). Second, the investment banking sector is probably one of the most globalised industries: investment banks from various countries compete with each other to acquire customers in all countries. As such, the assessment of investment banks' efficiency cannot accurately be made focussing on national banking market; rather it should take a worldwide perspective. Moreover, investment banking is a complex business mostly based on risk-taking and risk-transferring services. Therefore, a correct assessment and recognition of these risks play a key role in the investment banking efficiency estimation. Finally, investment banking is a revenue-motivated business. Managing the cost base has always been dominated by human capital, and influenced by investments in IT, global infrastructure and product platforms. However, this raises also the issue of the relationship between cost and revenues, which means that banks can match their cost base to the revenue generating potential over time. The most valuable of investment banks' tangible assets is staff, so that the largest expenses regard the workforce compensation and benefits.[3]

[3] Other operating expenses are generally lower than compensation expenses, and concern communication and technology, occupancy and depreciation, brokerage, clearing and exchanges fees, marketing and advertisements, office supplies, etc. For further details see e.g. Liaw (2006).

The contribution of this paper to the existing literature is manifold. This study is one of the few focussing on the investment banking industry, which is surprisingly inadequately explored (e.g. Berger and Humphrey 1997, Berger 2007, Hughes and Mester 2008 do not cite any study on investment banks). Moreover, we assess both cost and profit efficiency of the investment banking industries operating in the G7 countries (Canada, France, Germany, Italy, Japan, UK and US) and Switzerland. Our goal is to carry out a suitable comparison of banking efficiency across countries by using a global best-practice econometric frontier whereby the banks in each country can be compared against the same standard. From a methodological point of view we employ Coelli et al. (1999)'s approach to adjust the estimated cost and profit efficiency scores for environmental influences. Specifically, we introduce a large set of environmental variables to account for potential differences arising from certain country-specific risk exposure on the one hand and from the environmental and regulatory conditions on the other. We choose to consider both cost and profit efficiency because investment banking is traditionally a revenue-motivated business and competitive pressure (e.g. due to deregulation and globalisation) put further pressure for the efficiency enhancement.

The aim of this chapter is to present the empirical analysis conducted in order to answer the first two research question:

RQ1: Are environmental influences including banks' risks, industry specific factors and macroeconomic conditions important to accurately assess cost and profit efficiency of investment banks?

RQ2: Which type of the investment banks is the most efficient one?

The structure is the following:

- Section 3.2 reviews the bank efficiency literature with a particular focus on investment banks and studies accounting for environmental variables in the efficiency measurement;
- Section 3.3 define a methodological framework adopted for empirical analysis regarding the investment banking;
- Section 3.4 describes sample selection criteria and variables included in the cost and profit efficiency models;
- Section 3.5 presents main results for G7 countries and Switzerland;
- Section 3.6 concludes commenting our findings underlining the importance of accounting for environmental factors when performing efficiency analysis of this industry.

3.2 Literature Review

This section reviews the existing literature on the influence of the environmental variables on the banking efficiency studies. It is organized as follows: section 3.2.1 examines the studies on the efficiency of investment banks, whereas section 3.2.2 analyses the issue of the influence of environmental variables on banking performance.

3.2.1 The efficiency of the investment banks

Literature review by Berger and Humphrey (1997) quotes no studies on efficiency of investment banks. This is due to the difficulties of modelling successfully the peculiar nature of their production process (variables identification) and partially to the lack of good quality data. For example, the same authors mentioned only five studies that compare efficiency levels across countries where three of these studies took Nordic countries for comparison, and other two cross-country studies were applied for 11 OECD and 8 developed countries. Additionally, most financial institution efficiency studies have been applied to the U.S. banking industry.

Further motivation for our study comes from recent interest in comparison of banking efficiency. International comparisons of bank efficiency, literature review from Berger (2007), investigate 100 studies that compare bank efficiencies across nations. These comparisons differ in terms of how efficiency is measured. Studies that have compared efficiency of different nations by using common frontier have mainly focused on several European nations, and U.S (they have examined mainly developed nations). Efficiency comparisons of different nations by using nation specific frontiers have been applied for depository financial institutions and insurance companies covering mainly U.S. and individual European nations (most of these single-nation efficiency studies do not focus on international comparisons). A number of recent studies have expanded the bank efficiency literature by comparing the efficiencies of foreign-owned versus domestically owned banks within the same nation using the same nation-specific frontier and they have been dealing with developed and developing nations. Generally, problems with these studies were that their results aren't distinguished by the nation of origin of the foreign owned banks, where

only the most comprehensive developed nation studies have identified the nation of origin of the foreign owned banks.

Only a few studies have been made on efficiency of investment firms like Beccalli (2004), and Anolli and Resti (1996).Beccalli (2004) analyse new methods for cross country comparisons of the cost efficiency of UK and Italian investment firms over the period 1995-1998. The first method shows differences between the efficiency of the two countries by incorporating environmental variables into the cross country common frontier. The second method shows differences in the efficiency of the domestic versus foreign investment firms in the two countries, by testing the ability to monitor and control on a cross-border basis. Methodology used is based on parametric stochastic frontier approach (SFA) in order to model cost efficiency. Data in the study are taken from financial statements from both countries. The author found important to control for environmental variables since they had significant influence on cost efficiency and profitability in her research. In terms of cross country operations, it was found that more efficient firms go abroad, exporting a more efficient model while less efficient firms attract foreign investment firms with higher efficiency.

Over the past decade, substantial research has been done for measuring the efficiency of financial institutions, mainly commercial banks. Different efficiency concepts (cost, profit and alternative profit), different efficiency measurement methods (parametric and non parametric) have been employed to improve current methodology. Subsequently, we revise several such studies.

Looking at the study from Berger and Mester (1997) we can realize that there is still little information and no consensus on the sources of the substantial variation in measured

efficiency, although there has been significant research regarding the efficiency of financial institutions.

There is a consensus in the literature that differences in frontier efficiency among financial institutions exceed inefficiencies attributable to incorrect scale or scope of output. However, there is really no consensus on the preferred method for determining the best-practice frontier against which relative efficiencies are measured (Berger, Hunter & Timme 1993).

Recent studies such as those from Hughes and Mester (1993), McAllister and McManus (1993), Mester (1996), Berger and DeYoung (1997), Altunbas, et. al. (2001), suggest that risk characteristics need to be incorporated in the underlying industry cost or profit functions because, `unless quality and risk are controlled for, one might easily miscalculate a bank's level of inefficiency'. What these studies have in common is their focus only on one country.

Earlier consideration leads us to investigate efficiency and synergies on both cost and revenue side. We can find many studies dealing with banking changes in cost and profit efficiency, but they are mainly limited to US and Europe, while no study has treated the investment banking cross-country cost and profit efficiency. Some of the studies that have analyzed universal banking (which includes investment banking in their business) together with traditional banking are analyzed in next paragraphs.

Allen and Rai (1996) use distribution-free approach (DFA) and stochastic frontier approach (SFA) for a systematic comparison of X-inefficiency measures across 15 developed countries under different regulatory environments. The authors estimate a global cost function for international banks to test for both input and output inefficiencies. Results for

1988-1992 data (in the form of balance sheet and income statement) suggest the prevalence of input X-inefficiencies far outweighs that of output inefficiencies, and that the distribution-free model overestimates the magnitude of X-inefficiencies relative to the stochastic cost frontier approach.

Vander Vennet (2002) used a parametric methodology in order to measure cost and profit efficiency of European financial conglomerates and universal banks in 1995-1996. The sample consists of 2.375 EU banks from seventeen countries for which all the variables were available from their published annual statements. Results show that financial conglomerates are more revenue efficient than specialized banks and that universal banks are more efficient on both cost and revenue side. The author suggests, *''Further research should examine the sources of the efficiency differences between various types of banks'* (Vander Vennet 2002, p. 280)'.

3.2.2 The importance of the environmental variables in the studies of banking efficiency and performance

The paucity of efficiency studies in investment banking can be explained by three main factors: first, the lack of good quality data; second, the difficulties in successfully modelling the peculiar nature of investment banks' production process (i.e. a problem of variables identification); and third, the need to accurately account for different environmental conditions in various countries: investment banking is a global business and efficiency needs to be measured running an international comparisons of investment banks.

Recent developments in the literature dealing with commercial banks can help to circumvent the latter two problems. Regarding the variables identification to successfully modelling the production process, this is a serious problem since the investment banking business is multifaceted. Gardener and Molyneux (1995) categorise the investment bank's business into five main areas: broking (i.e. the broking of securities is commodity business in which firms appeal to customers mainly on price and integrity); trading (i.e. the trading of securities drives on market volatility); core investment banking (i.e. the underwriting of new issues and advisory work also referred to as Mergers and Acquisitions); fund management (i.e. both retail and wholesale fund management); interest spread (i.e. income derivatives from borrowed funds). As such, the accurate measurement of the investment banking risk-taking and risk-transferring is a key issue. Recent studies dealing with commercial banks included risk characteristics in cost or profit functions estimation, such as the liquidity risk exposure (Altunbas et al., 2000; Demirguc-Kunt and Huizinga, 2004; Brissimis et al., 2008; Fiordelisi and Molyneux, 2009); insolvency risk exposure (Lepetit et al., 2008); credit risk (Athanasoglou et al., 2008; Brissimis et al. 2008; Fiordelisi and Molyneux, 2009); capital risk exposure (Dietsch and Lozano-Vivas 2000, Lozano-Vivas et al. 2002, Altunbas et al. 2000, Athanasoglou et al. 2008, Brissimis et al. 2008, Lepetit et al. 2008); market risk exposure (Fiordelisi and Molyneux 2009); and the off-balance risk exposure (Casu and Girardone, 2005).

Berger et al. (1993) and Berger and Humphrey (1997) confirm that efficiency scores differ markedly across studies. According to Mester (1993, 1997) and Berger and Mester (1997), the failure to account for heterogeneity is a likely candidate to cause this instability of efficiency results. Consequently, controlling for heterogeneity results in efficiency scores

that more accurately reflect management's ability to minimize costs and maximize profits was also recognized by Bos et al. (2008).

Cross-border comparison of efficiency was somewhat of a paradox, since banks were compared to a common efficient frontier while assuming that different countries have access to the same technology. Some research papers were working on country specific environmental factors in order to avoid this technology problem (Lozano-Vivas et al. 2002, Dietsch and Lozano-Vivas 2000). According to Dietsch and Lozano-Vivas (2000), considering environmental conditions while measuring banking efficiency differences across countries is important because these differences should take into account the way in which banking services are produced. In the research from Beccalli (2004), author also proves the importance of environmental variables, for the cross-country comparisons of the cost efficiency of UK and Italian investment firms.

Looking at the cross-country differences in banking efficiency Valverde, et al. (2007) showed using data on large banks across 10 European countries for the period 1996-2002, that they are roughly equally efficient after controlling for differences in business environment, banking costs, and bank productivity. Parametric approach for measuring cost efficiency used in this study was the distribution free approach (DFA). Results suggest that the large banks in each of the 10 countries had almost identical average efficiency values and since no country has a strong efficiency advantage, it seems likely that state efforts to promote ‘‘national champions’’ through favourable mergers may determine the outcome.

Lapetite et al. (2008) investigate the relationship between bank risk and product diversification in the changing structure of the European banking industry. Based on a broad set of European banks for the period 1996–2002, authors show that banks expanding

into non-interest income activities present higher risk and higher insolvency risk than banks which mainly supply loans.

In existing studies that estimate the efficiency of banks in a cross-national scenario, the standard approach is to construct a common efficient frontier for all firms, regardless of their home country. However, this standard approach is unable to compare the different banking systems on an equal footing, because it does not account for cross-country differences in regulation, economic and demographic conditions, which are beyond the control of bank managers.

Without a common benchmark it is difficult to compare efficiency levels and rankings (Coelli et al., 2005; Bos and Schmiedel, 2007). Most recent studies therefore estimate a common benchmark, but seek to control for systematic differences across banks that are not due to inefficiency.[4]

Focussing on recent studies, various factors are used to account for countries' macro-economic differences, as the population density (Dietsch and Lozano-Vivas, 2000, Lozano-Vivas et al., 2002; Carbo-Valverde et al., 2007; Fiordelisi and Molyneux, 2009); the countries' wealth (e.g. the GDP procapita, as in Salas and Saurina, 2003; Carbo-Valverde et al., 2007; Fitzpatrick and McQuinn, 2007; Brissimis et al., 2008; Fiordelisi and Molyneux, 2009); the density of demand and per capita income (Dietsch and Lozano-Vivas, 2000; Lozano-Vivas et al. 2002); the FDI inflows and outflows (Beccalli, 2004); the short-term interest rate, foreign and public ownership (Brissimis et al., 2008); inflation and cyclical output (Athanasoglou et al., 2008).

[4] Deprins and Simar (1989), Kumbhakar and Lovell (2000) observe that it can be difficult to determine if an exogenous variable is a characteristic of production technology or a determinant of productive efficiency.

In this paper, we therefore have to account for potential differences arising from certain country-specific aspects of the banking technology on the one hand and from the environmental and regulatory conditions on the other. In particular, the economic environments are likely to differ significantly across countries. Three categories of environmental variables are taken into account: (1) variables that describe the structure of the banking industry and risks; (2) those that describe the main macroeconomic conditions, which determine the banking product demand characteristics; and (3) those that account for bank profitability. More explanation about given variables are provided in the data section of the paper.

3.3 Methodology

This section aims to define a common methodological framework for cross country comparison of efficiency in investment banking. The structure of the chapter is the following:

- Section 3.3.1 Stochastic Frontier Analysis and underlying assumptions,
- Section 3.3.2 describes how to accounts for the influences of environmental factors in Stochastic Frontier Analysis, by dealing with the problem of possible sample heterogeneity.

3.3.1 Measuring efficiency with the Stochastic Frontier Approach

Our empirical analysis aims to identify the framework for comparing investment banks' efficiencies across nations.[5] Two methods are adopted: first, where we estimate common frontier with only structural variables; and second method which accounts for the influences of environmental factors on the industry, by including indicator of these factors in a definition of a common frontier.[6]

Cost and profit efficiency are measured using the Stochastic Frontier Analysis (originally independently proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977)) that can be written as follows:

$$Y_i = x_i\beta + \varepsilon_i \qquad \varepsilon_i = \nu_i + u_i \qquad i=1,...,N \tag{3.1}$$

where:

- Y_i is the (logarithm of the) cost of production of the i-th firm;

- x_i is a k×1 vector of (transformations of the) input prices and output of the i-th firm;

- β is a vector of unknown parameters;

- ε_i is disentangled in two main components: The first is the random error term (ν_i), accounting for measurement errors, bad luck and other factors unspecified in the cost function. The ν_i are assumed to be iid normal random variables with mean zero and constant variance σV^2, $|N(0,\sigma_V^2)|$ and independent of the u_i; The second term is a non-

[5] According to Berger and Hannan (1994), efficiency measurements problems partially come from the fact that the measured efficiencies of the different industries may not be comparable to each other at all.
[6] Introduction of two methods is performed in order to overcome traditional limitations.

negative cost inefficiency term (u_i), added to the cost frontier representing minimum cost. It is generally assumed to have a half normal or truncated normal distribution, with variance equal to σ_U^2, $|N(0,\sigma_U^2)|$[7].

Firm-specific estimates of technical inefficiency, u_i, can be calculated by using the distribution of the inefficiency term conditional on the estimate of the composed error term, ε_i (Jondrow et al., 1982). The mean of this conditional distribution for the half normal model is shown as:[8]

$$E(\mu_i / \varepsilon_i) = \frac{\sigma\lambda}{1+\lambda^2}\left[\frac{\int(\varepsilon_i\lambda/\sigma)}{1-F(\varepsilon_i\lambda/\sigma)} + \left(\frac{\varepsilon_i\lambda}{\sigma}\right)\right] \tag{3.2}$$

Where $F(.)$ and $f(.)$ are respectively the standard normal distribution and the standard normal density function. $E(u_i/\varepsilon_i)$ is an unbiased but inconsistent estimator of u_i. The ratio of variability (standard deviation,σ) for u and ν can be used to measure the relative inefficiency of a firm, where $\lambda = \sigma_u/\sigma_v$ is a measure of the amount of variation stemming from inefficiency relative to noise for the sample.

Estimates of bank specific cost efficiency are obtained by calculating:

$$CE_i = [\exp(-u_i)]^{-1} \tag{3.3}$$

[7] Assuming a half-normal distribution with mean zero implies that most banks are closely located to the frontier and with small level of inefficiency. Another possibility is to relax this *a priori* assumption and estimate the mean of the truncated normal distribution from the data.

[8] For further readings see Beccalli (2004, pg. 1368)

This measure takes on a value between 0 and 1. Cost efficiency equals one for a fully efficient bank that operates on the efficient stochastic frontier.[9]

The method of maximum likelihood is proposed for simultaneous estimation of the parameters of the stochastic frontier and the model for the technical inefficiency effects. We utilize the parameterization of Battese and Corra (1977) who replace σ_V^2 and σ_U^2 with $\sigma^2=\sigma_V^2+\sigma_U^2$ and $\gamma=\sigma_U^2/(\sigma_V^2+\sigma_U^2)$. The parameter γ must lie between 0 and 1, where a value of zero means that all the deviations from the frontier are due to random error and a value of one indicates that all deviations are due to inefficiency. The technical efficiency of production for the i-th firm is defined by equation:

$$TE_i, = \exp(-u_i,) \qquad (3.4)$$

The prediction of the technical efficiencies is based on its conditional expectation, given the model assumptions.[10]

We choose to consider also alternative profit efficiency. Reason for consideration of alternative profit efficiency is in the case where assumptions underlying cost and profit efficiency are not met and are violated by the data. According to Berger and Mester (1999, pg.3), *''profit maximization is superior to cost minimization for most purposes because it is the more accepted economic goal of firm's owners, who takes revenues as well as costs into account when making decisions''*.[11]

[9] For further readings see Bos and Schiemdel (2007, pg.2086)
[10] For further readings see Battese and Coelli (1995, pg.328)
[11] Some of the studies employ an alternative profit function in which the firm maximizes profits given output quantities, rather than taking output prices as exogenous (Berger, Cummins and Weiss, 1996; Humphrey and Pulley, 1997; Akhavein, Berger, and Humphrey, 1997; Berger and Mester, 1997).

The frontier definition is the same as in the cost case, except for the dependent variable: we replace total cost with total profit and the inefficiency term (u_i) is subtracted as in the production case, given that the frontier represents maximum profit. Efficiency is given by the ratio of observed profit to frontier maximum profit (the ideal best practice for which u_i =0), equal to:[12]

$$PE_i = [\exp(-u_i)] \tag{3.5}$$

To define a common frontier we use the following translog[13] specification[14] with 2-input and 2-output for the cost and profit frontier model represented in logs as:

$$\ln TC_{kt}(orTP) = \beta_0 + \sum_{i=1}^{2}\beta_i \ln Y_i + \sum_{j=1}^{2}\alpha_j \ln P_j + \lambda_1 T$$
$$+\frac{1}{2}\left(\sum_{i=1}^{2}\sum_{j=1}^{2}\delta_{ij}\ln Y_i \ln Y_j + \sum_{i=1}^{2}\sum_{j=1}^{2}\gamma_{ij}\ln P_i \ln P_j + \lambda_{11}T^2\right)$$
$$+\sum_{i=1}^{2}\sum_{j=1}^{2}\rho_{ij}\ln Y_i \ln P_i + \sum_{i=1}^{2}\beta_{iT}T\ln Y_i + \sum_{j=1}^{2}\alpha_{jT}T\ln P_j$$
$$+\frac{1}{2}\tau_{EE}\ln E\ln E + \tau_E \ln E + \sum_{i=1}^{2}\beta_{iE}\ln Y_i \ln E + \sum_{j=1}^{2}\alpha_{jE}\ln P_j \ln E + \varepsilon_{kt} \qquad for\ i \neq j \qquad \varepsilon_{kt} = v_{kt} + u_{kt}$$

(3.6)

where TC_{kt} is the natural logarithm of total cost of bank k in period t, TP is the natural logarithm of total profit, Y_i is the vector of output quantities, P_j are the input prices, E represents bank's equity capital and is included as a fixed input, specifying interaction

[12] Fiordelisi and Ricci (2006, pg.11)
[13] Berger and Mester (1997) used the distribution free approach and stochastic frontier approach for both translog and the Fourier specification of the cost and profit function, and have concluded that difference between two methods are not relevant. Same was observed and stated also by Vander Vennet (2002).
[14] For further readings see Vander Vennet (2002, pg.264)

terms with both output and input prices in line with recent studies [e.g. (Altunbas et al., 2000), (Becalli 2004) and (Vander Vennet 2002)]. We specify the time trend t to capture technological change. The v_{kt} are assumed to be independently and identically distributed as two sided normal $v_{kt} \sim N(0, \sigma v2)$ and captures the effects of statistical noise. The error component u_{kt}, which captures the effect of technical inefficiency, is assumed to be distributed as half-normal $u_{kt} \sim |N(\mu, \sigma_u^2)|$, independently of v_{kt}, and to satisfy $u_{kt} \geq 0$.[15]

As usual, symmetry and linear homogeneity restrictions are imposed standardising total cost TC and input prices p_i by the last input price.

In this model we don't account for possible strong heterogeneity in the sample (so efficiency estimates could be biased). Many authors have stressed the importance of accounting for heterogeneity in the frontier definition. According to Dietsch and Lozano-Vivas (2000) the environmental conditions faced by financial institutions are likely to differ substantially and the specific environmental conditions of each country play an important role in the definition and specification of the common frontier of different countries.

3.3.2 Accounting for heterogeneity

In order to account for heterogeneity we follow Coelli et al. (1999) approach where there are two different ways for including environmental conditions or firms specific factors that the authors specify as Case 1 and Case 2 Model.[16]

[15] The choice of using the translog functional form is motivated by two main reasons. First, Altunbas and Chakravarty (2001) identify some problems associated with more flexible functional forms like the Fourier (Mitchell and Onvural, 1996) when dealing with heterogeneous data sets. Secondly, Berger and Mester (1997) observe that the translog and the Fourier-flexible are substantially equivalent from an economic viewpoint and both rank individual bank efficiency in almost the same order.

[16] Same approach was used by Fiordelisi and Ricci (2006) for Banc assurance in Europe.

Case 1 - Environmental factors have a direct influence on the production structure

One possibility is to consider that environmental conditions/firm specific factors have a direct influence on the production structure. In this case we have to include some control variables in the deterministic portion of the stochastic frontier: it implies *"assuming that every firm face a different production function"* (Coelli et al. 1999, p. 254). So we'll have:

$$\ln y_i = \beta_0 + \sum_{k=1}^{K} \beta_k \ln x_{ki} + \sum_{j=1}^{M} \theta_j \ln z_{ji} + v_i - u_i \tag{3.7}$$

where we account for M environmental/firm specific factors z_j assuming different values for each i-th firm.

This specification can be straightforwardly adjusted for the cost case by assuming the natural log of total cost as dependent variable and changing the sign of the inefficiency component (u_i). Using the translog specification, the deterministic portion of the cost frontier is the following:[17]

$$\begin{aligned}
&\ln TC_{kt}\left(orTP\right) = \beta_0 + \sum_{i=1}^{2} \beta_i \ln Y_i + \sum_{j=1}^{2} \alpha_j \ln P_j + \lambda_1 T \\
&+ \sum_{i=1}^{2}\sum_{j=1}^{2} \rho_{ij} \ln Y_i \ln P_i + \sum_{i=1}^{2} \beta_{iT} T \ln Y_i + \sum_{j=1}^{2} \alpha_{jT} T \ln P_j \\
&+ \frac{1}{2}\left(\sum_{i=1}^{2}\sum_{j=1}^{2} \delta_{ij} \ln Y_i \ln Y_j + \sum_{i=1}^{2}\sum_{j=1}^{2} \gamma_{ij} \ln P_i \ln P_j + \lambda_{11} T^2 \right) \\
&+ \frac{1}{2}\tau_{EE} \ln E \ln E + \tau_E \ln E + \sum_{i=1}^{2} \beta_{iE} \ln Y_i \ln E + \sum_{j=1}^{2} \alpha_{jE} \ln P_j \ln E + \sum_{j=1}^{M} \vartheta_j \ln z_j + \varepsilon_{kt}
\end{aligned} \tag{3.8}$$

[17] For further readings see Fiordelisi and Ricci (2006, pg.13)

Case 2 - Environmental factors influence the inefficiency distribution

A second possibility is to include the environmental/firm specific variables not directly in the production frontier, but to use them for modelling the inefficiency distribution. As noted by Battese and Coelli (1995), the stochastic frontier production function is estimated in the first stage under the assumption that the inefficiency effects (error term) are identically distributed, while in the second stage the predicted technical efficiencies are regressed upon a number of factors, hence suggesting the inefficiency effects are *not* identically distributed. A more appropriate approach involves the specification of a model in which both relations are estimated in a single stage. This accounts for a stochastic frontier production function in which the technical inefficiency effects are a function of firm characteristics.[18]

The inefficiency components u_i are assumed to be distributed independently, but not identically. For each i-th firm the technical inefficiency effect is obtained as truncation at zero of a normal distribution N (μ_i, σ^2) where the mean μ_i is a function of M factors representing the firm-specific environment:

$$m_{it} = \delta_0 + \sum_{j=1}^{M} \delta_j \ln z_{jit} \qquad (3.9)$$

The deterministic portion of the frontier remains the same as in equation 3.6. In this case we are supposing that all firms share the same technology, and environmental/firm specific factors have an influence only on the distance between each firm and the best practice. The

[18] For further readings see Coelli, et al.(1999, pg.255)

resulting efficiency estimates are incorporating the effect of environmental factors and can be viewed as gross measure of efficiency.[19]

We choose to consider both cost and profit efficiency because investment banking is traditionally a revenue-motivated business and competitive pressure (e.g. due to deregulation and globalisation) put further pressure for the efficiency enhancement.

3.4 Data and variables

The aim of this section is to describe the sample and the variables used in the research design. Section 3.4.1 presents sample selection criteria, Section 3.4.2 discusses the choice of input and output variables and Section 3.4.3 deals with firm specific factors and environmental conditions included in the frontier model.

3.4.1 Sample description

This study comprises bank's balance sheet, income statement and annual reports data of G7 countries (US, UK, Japan, Italy, Germany, France and Canada) and Switzerland over the 2001-2007 periods. The data were compiled from the International bank Credit Analysis Bankscope Database. Table 3.1 illustrates the breakdown by country of the number and asset size of the banks included in the sample. The total number of observations is 800; the US banks are the biggest on average by asset size, whereas Switzerland has the largest number of institutions both as a total and by year.

[19] For further readings see Bos, et al.(2005, pg.11)

Table 3.1

Sample description: number of banks and average asset size by country

Country/Year	2001	2002	2003	2004	2005	2006	2007	Total by country	Total assets of the average bank*
Canada	1	1	1	2	3	4	4	16	3,951,175
France	2	2	2	3	5	9	7	30	26,175,525
Germany	6	8	6	8	8	11	8	55	12,182,958
Italy	2	1	2	3	5	6	6	25	1,814,332
Japan	2	6	19	23	23	22	19	114	29,686,104
UK	9	9	10	20	27	32	25	132	36,565,124
USA	15	19	21	18	15	14	9	111	115,358,872
Switzerland	50	44	44	45	45	45	44	317	21,406,169
Total by year	87	90	105	122	131	143	122	800	

* All values are in thousand dollars.

3.4.2 Input and output definition

In the bank efficiency literature, the definition of inputs and outputs varies across studies and mainly depends on the researcher's assumptions on the production process of banks. For multi-product commercial banks, much of the debate is on how to treat deposits: the 'intermediation approach' assumes that they are inputs to the banks' production process

while the 'production approach' views them as outputs. The more common of these two approaches is probably the former, where inputs are identified as labour, physical capital and deposits. On the other hand, there seems to be some agreement on what constitutes output, i.e. the dollar volume of banks' assets and, more frequently, total loans and other earning assets (Hughes and Mester, 2008; Goddard et al. 2001; Berger and Humphrey, 1997).

Since investment banks' main business is not lending, it would be inaccurate to borrow the input/output definition used for commercial banks to describe the production process of investment banks. As discussed in Section 2, the extant literature on investment bank efficiency is rather limited. Beccalli (2004) employs the price of labour and price of physical capital as inputs, while debtors plus bank deposits is the single output.

In this study we accept the assumption that the main inputs of investment banks are the price of labor calculated as personnel expenses over total assets (P_1); and the price of physical capital, measured as other administrative expenses plus other operating expenses over total fixed assets (P_2). However we choose a novel output definition that in our view better reflects the investment banks' main business as follows: total earning assets (Y_1) and investment banking fees (Y_2). We choose to consider both stock and flow variables as outputs (as in Altunbas, et. al 2001). The main motivation stems from the particular nature of the investment banking business as derived from their financial statements, and on the assumptions we make on the investment banks' production process.[20]

[20] However in this study we carried out a number of robustness tests by using alternative models. First, the number of input and output specifications for our model has been tested. We have estimated alternative models with total funds both as inputs and outputs, and interest income as additional output. The chosen specification seems to best fit the available data.

In order to estimate cost and profit efficiency scores, we use as dependent variables total cost (*TC*), calculated as the sum of personnel expenses, other administrative expenses and other operating expenses; and total pre-tax profit (*TP*). The variable equity (*E*) controls for the differences in equity capital across banks. Table 3.2 reports the descriptive statistics of the inputs and outputs used in the empirical analysis.

Table 3.2

Descriptive statistics of inputs and outputs*

Variable	Description	Mean	Median	Std. Dev.	Min.	Max
TC	Total Cost	1,325,752	149,368	4,622,540	76	70,302,088
TP	Pre-Tax Profits	308,618	37,321	1,004,517	60	10,815,637
Y_1	Total Earning Assets	32,527,530	1,359,342	101,254,934	6,931	972,522,434
Y_2	Investment Banking Fees	660,916	112,575	1,916,440	52	21,082,186
P_1	Price of Labour	0.049	0.028	0.079	0.0001	1.093
P_2	Price of Physical Capital	20.491	2.871	98.088	0.143	1862.00
E	Total Equity	1,673,869	249,585	4,624,642	371	49,180,809

* All values are in thousand dollars, except for relative prices.

Using a translog specification we have to solve the problem of sample banks with negative values of profit, for which we can't take the logarithm. Therefore, the constant term $\theta=|\pi^{min}|+1$ is added to every firm's dependent variable in the profit function so that natural log is taken for a positive number. Thus, for the firm with the lowest value for that year, the dependent variable will be ln(1)=0.[21] However our analysis has shown that by using this measure, for dealing with losses, we obtain biased data. Based on that, and since the number of banks exhibiting a loss is small relative to the sample size (less than 10% of the sample), we choose to drop relative observations as in Humphrey and Pulley (1997).

3.4.3 Firm-specific and environmental conditions included to account for heterogeneity

In order to account for heterogeneity we follow Coelli et al. (1999)'s approach that proposes two different ways of including environmental conditions or firm-specific factors in the cost/profit function: Case I, where environmental factors have a direct influence on the production structure; and Case II, where environmental factors influence the inefficiency distribution.

Additionally to decide on which firm-specific factors to account for to tackle the heterogeneity problem in our sample, we follow the most recent empirical literature in this area. Accordingly, we account for potential differences arising from country-specific aspects of banking technology on one hand and from the environmental and regulatory conditions on the other. In particular, the economic environment is likely to differ

[21] For more readings see Berger and Mester 1997. Same adjustment have been used by Vander Vennet 2002, Casu and Girardone 2004, Fiordelisi 2007, Fitzpatrick and McQuinn 2007.

significantly across countries. Three categories of environmental variables are taken into account: (1) variables that describe the structure of the banking industry and risks; (2) those that describe the main macroeconomic conditions, which determine the banking product demand characteristics; and (3) those that account for bank profitability.

The first group of environmental factors, named ‘banking structure and risks’, consists of four specific risk variables (capital risk, liquidity risk, securities risk, insolvency risk) and six bank and market specific variables: asset diversification, bank asset size, Herfindhal index of concentration, income diversification, Off-Balance Sheet business and publicly listed banks. A detailed list with related literature can be found in Table 3.3 in the page bellow.

Table 3.3 Environmental variables included in the estimation and related literature

	Variable name	*Symbol*	*Studies*
	Risks, bank and market-specific factors		
CASE I	* Capital risk exposure	CAR	Dietsch and Lozano-Vivas 2000, Lozano-Vivas et al. 2002 as control variable, Altunbas et al. 2000, Athanasoglou et al. 2008, Brissimis et al. 2008, Lepetit et al. 2008
	* Liquidity risk exposure	LIQ	Altunbas et al. 2000, Demirguc-Kunt and Huizinga 2004, Brissimis et al. 2008, Fiordelisi and Molyneux 2009
	* Securities risk exposure	SR	Authors estimate
	* Insolvency risk exposure	IR	Lepetit et al. 2008
CASE II	Asset Diversification	AD	Laevena and Levine 2007
	Bank asset size	BAS	Altunbas et al. 2000 as proxy, Lozano-Vivas, et al. 2002 asset quality as control variable, Carbo-Valverde, et al. 2007 use total asset per bank, Athanasoglou et al. 2008, Lepetit et al. 2008, Fiordelisi and Molyneux 2009
	Herfindhal index of concentration	CONC	Dietsch and Lozano-Vivas 2000, Vander Vennet 2002, Athanasoglou et al. 2008, Fiordelisi and Molyneux 2009
	Income Diversification	ID	Laevena and Levine 2007, Fiordelisi and Molyneux 2009
	Off-Balance Sheet	OBS	Altunbas et al. 2000, Casu and Girardone 2005
	Publicly listed bank	LB	Beccalli 2004, Fiordelisi and Molyneux 2009
	Macroeconomic Conditions		
	Population density	PD	Dietsch and Lozano-Vivas 2000, Lozano-Vivas et al. 2002, Carbo-Valverde et al. 2007, Fiordelisi and Molyneux 2009
	GDP per capita	GDP	Salas and Saurina 2003, Carbo-Valverde et al. 2007, Fitzpatrick and McQuinn 2007, Brissimis et al. 2008, Fiordelisi and Molyneux 2009
	FDI Inflows	FDII	Beccalli 2004
	FDI Outflow	FDIO	Beccalli 2004
	Profitability		
	ROA	ROA	Athanasoglou et al. 2008, Lepetit et al. 2008
	ROE	ROE	Berger et al. 1993, Allen and Rai 1996, Lozano-Vivas et al. 2002, Vander Vennet 2002, Beccalli 2004, Athanasoglou et al. 2008, Lepetit et al. 2008

Notes: CAR is calculated as equity over assets; LIQ is calculated as liquid assets over assets; SR is calculated as total securities over total assets; IR=(1+average ROE)/SDROE; AD = 1- |(Net loans - Other earning assets)/Total earning assets|; BAS= total assets; CONC is obtained as the sum of the squares of market shares for all banks operating in the industry; ID = 1- |(Net interest income - Other operating income)/Total operating income|; OBS is measured as off-balance sheet items over total assets; The bank is publicly listed or otherwise, where 1 = listed; 0= non-listed; ROA=Net profits over total assets; ROE=Net profits/Shareholders equity (total assets - total liabilities).

Many efficiency studies outlined the importance of accounting for bank risk preferences (see for example Mester, 1997; Altunbas et al. 2000; Lepetit et al. 2008). In our study we use five measures of risk, based on annual accounting data and determined for each bank throughout the period. Capital risk exposure represents a proxy for regulatory conditions, and we measure it as equity over total assets. Usually, a lower capital ratio leads to lower efficiency levels because less equity implies higher risk taken at greater leverage, which normally results in greater borrowing costs.

Low level of liquidity is one of the major causes of bank failures. During periods of increased uncertainty, financial institutions may decide to diversify their portfolios and/or raise their liquid holdings in order to reduce their risk. Banks would therefore improve their efficiency by improving screening and monitoring of liquidity risk, and such policies involve the forecasting of future levels of risk. Following the empirical literature, we use the ratio of liquid to total assets (LIQ) to proxy liquidity risk.

Given the nature of the investment banking business and specifically their securities issuance and underwriting, has led us to introduce one more risk variable. We call it securities risk exposure, and define it as total securities over total assets.

We also compute insolvency risk measures which proxies the probability of failure of a given bank based on its 'Z-score' as in Lepetit et al. (2008) as follows:

$$\text{Z-score} = (100 + \text{average ROE}) / \sigma\text{ROE} \tag{3.10}$$

Higher values of Z-scores imply lower probabilities of failure.

Asset diversity is a measure of diversification across different types of assets and is calculated as:

$$AD = 1- |(\text{Net loans} - \text{Other earning assets}) / \text{Total earning assets}| \quad (3.11)$$

Other earning assets include securities and investments, and total earning assets is the sum of net loans and other earning assets. Asset diversity takes values between 0 and 1 with higher values indicating greater diversification (see, for more details, Laeven and Levine, 2007).

One of the most important questions underlying bank policy is which size optimizes bank efficiency. Generally, the effect of a growing size on efficiency has been proved to be positive to a certain extent. However, for banks that become extremely large, the effect of size could be negative due to bureaucratic and other reasons. Even if there are no clear conclusions and results change depending on the methodologies applied (as outlined in Weill, 2004) accounting for size differences is certainly significant. Another important environmental variable is banking industry concentration that is measured by the Herfindahl-Hirshmann Index. This is defined as the sum of squared asset market shares of all banks in each country. Higher concentration may be associated with either higher or lower costs.

Income diversity is a measure of diversification across different sources of income and is calculated as:

$$ID=1-|(\text{Net interest income}-\text{Other operating income})/\text{Total operating income}| \quad (3.12)$$

Income diversity takes values between zero and one with higher values indicating greater diversification. The asset and income diversity measures are complementary in that asset diversity is based on stock variables and income diversity is based on flow variables.

We also account for the level of off-balance sheet (OBS) items over assets and assume that they generate additional (and 'hidden') financial exposures for banks. Although OBS business has originally developed to help banks prepare for contingencies, recent events have shown that often this type of business produces additional risks for the parties involved in these types of contract.

The publicly listed bank is not just a pure scale measure, but represents the opportunity for diversification offered by the market to the clients of investment firms. Our sample includes both listed and unlisted banks. Beccalli et al. (2006) showed the existence of a positive relationship between efficiency and stock performance. Therefore our hypothesis is that listed banks could be more efficient since they are more exposed to competitive pressures.

The second group is called 'macroeconomic conditions' and includes a measure of population density, GDP per capita, inflows and outflows of foreign direct investment (FDI). These indicators describe the main conditions under which banks operate. The supply of banking services in areas with a low population density generates higher banking costs, and does not encourage banks to increase their efficiency levels. GDP per capita affects numerous factors related to the demand and supply of banking services. Countries with a higher GDP per capita have a banking system that operates in a mature environment resulting in more competitive interest rates and profit margins. Finally, FDI is a measure of foreign ownership of productive assets. Cross-border mergers and acquisitions in the developed world as well as direct and portfolio investment in emerging markets have fuelled the profitability of these sectors, primarily US-based banks, which have had the relationship and networks to capture these flows. We expect to find, respectively, a positive and negative relationship with cost and profit efficiency.

The final category of environmental variables is bank-specific profitability determinants, measured by the return on assets (ROA) and the return on equity (ROE). In principle, ROA reflects the ability of a bank's management to generate profits from the bank's assets, although it may be biased due to OBS activities. ROE indicates the return to shareholders on their equity.

Previous research focussing on cross-country comparison of bank efficiency measure (Dietsch and Lozano-Vivas, 2000; Beccalli, 2004; Fiordelisi and Molyneux, 2006), has pointed out the importance of country-specific characteristics. In line with the main literature, we choose to include country dummies (CD_k) to control for different national conditions.[22]

3.5 Empirical results

In our empirical analysis we assess the efficiency of investment banks. In order to account for sample heterogeneity, three models are estimated: 1) the "Base model", i.e. a common frontier that includes only the structural variables described in equation (3.6); 2) the Case I model, where environmental conditions/firm- specific factors have a direct influence on the production process (equation 3.8); and 3) Case II, where environmental factors influence the inefficiency distribution, i.e. the Battese and Coelli's (1995) model (equation 3.9). In the first case, our estimates provide a 'net' measure of efficiency, i.e. the managerial efficiency. In the second case, our estimates provide us with a 'gross' measure of efficiency since firm-specific (i.e. measured as mean at the national industry

[22] As usual one dummy (Canada) is dropped from the model to avoid multicollinearity. So we have a total of seven country dummies.

level) and macro-economic factors are considered as determinants of inefficiency effects to account for country differences.[23]

Figure 3.1 (see Figure 3.1 in the Appendix) displays the estimated mean cost and profit efficiency levels as calculated in the three alternative models. In line with the (predominantly commercial) bank efficiency literature (see Berger and Mester, 1997 for a review, Maudos et al., 2002), the mean cost efficiency scores are on average higher than the profit ones in all models. Moreover, estimated efficiency scores also suggest marked differences in efficiency across the countries included in our sample (see Table 3.A.1 in the Appendix).

Results show that, on average, the efficiency scores estimated using the base model are generally similar to those derived from Case I for both cost (panel a) and profit (panel b). In contrast, Case II shows substantial differences in average values for all countries for both cost and profit efficiency. Furthermore on the profit side, it seems clear that average efficiency scores are consistently underestimated in the base model[24]. Our results are consistent with Coelli et al. (1999) who found that Case I efficiency estimates are generally lower than those obtained under Case II and these differences are mostly explained by the way in which the environment variables are included in these models. We also agree with Coelli et al. (1999) in preferring the Case II estimates for two reasons: first, these estimates represent the outer boundary of the production possibility set; and second, gross efficiency measures obtained from Case II are the closest to the intuitive notion of efficiency being about converting physical inputs into physical outputs.

[23] Only the combination of structural characteristics and environmental ones allows us to capture the industry efficiency and explain national differences.

[24] Unfortunately, statistically testing which model would best fit the data is not straightforward. As suggested by the relevant literature (see for example Coelli et al. 1999), one would need to create an artificial nested model. Due to data constraints and to different set of environmental variables used in the two models, we can only decide on the basis of theoretical motivations.

3.5.1 Case I model

In Case I model we focus on bank risk-taking variables (omitting to consider macro-economic variables) by including these in the deterministic portion of the stochastic frontier function. We posit that bank risk-taking variables have a direct impact on bank cost and profit efficiency, while macro-economic variables and industry-level features only impact on the distribution of the inefficiency components, but not on the efficiency of a single bank (i.e. these variables influence in the same manner the efficiency to all banks in the same nation). We found all risk variables significant at 1% level in the cost case, while on the profit side we found statistically significant (at the 10% confidence level or less) the coefficients for liquidity and securities risk exposure (see Table 3.4 in the page bellow). Since these variables are measured at the bank level, coefficient estimates can be directly interpreted to measure the relationship between these factors with cost and profit efficiency estimates.

Specifically, coefficient estimates are negative (and high) for the capital risk and security risk exposures, while they are positive for the liquidity risk and insolvency risk exposures. In the profit function estimation, coefficients for liquidity and securities risk are found to be statistically significant (the first is positive and the second is negative), while the other two risk exposure measures are insignificant. These results provide evidence that capital and securities risk have a positive effect on the cost efficiency while the relationship with liquidity and insolvency risk exposures is negative. The liquidity risk has also a positive effect on profit efficiency while the securities risk has a negative impact.

The interpretation of these results is particularly interesting considering the investment bank crisis that began in 2007: our results show that, by including bank risk-taking factors to assess the efficiency in the pre-crisis period, investment banks with a higher

liquidity are penalized in the case of cost efficiency, but have an advantage in generating profits, while the opposite is found for the securities risk exposure (i.e. more securities holding, more cost and less profit efficiency). As such, highly capitalized banks incur lower costs to provide banking services probably by developing more careful management systems and internal auditing processing. However, highly capitalized banks cannot exploit the leverage effect and this negatively impact on profitability. On the other hand if a bank's capital level decreases, managers have an increasing incentive to take on excessive risk, engaging in activities that fail to create value for shareholders.[25] During periods of increased uncertainty, financial institutions may decide to diversify their portfolios and/or raise their liquid holdings in order to reduce their risk: this would have a negative impact on bank cost efficiency, but will result in higher profits (less risk, less opportunity cost of capital).

Table 3.4

Environmental factors affecting the shape of the cost and profit functions (Case I)

Variable	***Description***	***Inefficiency effect (Cost)***	***Inefficiency effect (Profit)***
Z1 (CAR)	Capital risk	-1.1357***	-0.1547
Z2 (LIQ)	Liquidity risk	0.0542***	0.0808***
Z3 (SR)	Securities risk	-0.0823***	-0.0884***
Z4 (IR)	Insolvency risk	0.0652***	-0.0122

*, **, *** means statistically significant at the 10%, 5% and .1% respectively.

Note: CAR =calculated as equity over assets; LIQ =liquid assets over assets; SR = total securities over total assets; IR=(1+average ROE)/SDROE.

[25] These results are similar with Casu and Girardone (2004).

3.5.2 Case II model

Turning to the results on Case II (see Table 3.5 in the page bellow), environmental variables are measured at the industry level so coefficient estimates can be interpreted as a measure of the relationship between the national industry features (e.g. the mean level of capital risk exposure in the country considered) and cost and profit efficiency estimates: this analysis provides particularly useful insight for economic policy-makers and regulators. The influence of the environmental variables on the inefficiency is in line with our expectations and a number of variables have been found statistically significant at the 10% confidence level or less.

Regarding the four risk variables tested in Case I, estimated coefficients for capital and liquidity risk exposures are negative and positive (statistically significant at the 1% confidence levels) in cost and profit inefficiency estimates, respectively. These results provide evidence that the mean industry level of capital ratio and the liquidity risk exposures have a positive impact on cost efficiency (by reducing the mean of the cost inefficiency component), while have a negative influence to profit efficiency (by increasing the mean of the profit inefficiency component). Capital risk exposure results in both Case I and II are strongly consistent with each other confirming that higher capital level increase the cost efficiency (e.g. enhancing internal auditing systems and managers motivation) and reduce the profit efficiency (e.g. reducing the financial leverage effect). Our results for bank liquidity risk exposure are slightly different: banks working in countries with a higher level of liquidity have a positive impact on cost efficiency, while have a negative impact in profit efficiency. A possible explanation is that banks operating in more liquid banking systems find it cheaper to manage liquidity so that these benefit from lower costs. However, cost of funds and credit spreads will be probably low and this would negatively impact on bank lending by reducing profits.

Concerning the remaining environmental factors, Table 3.5 shows that in the majority of cases the chosen variables are highly significant. This gives a preliminary (although rather crude) indication that failing to account of these additional factors can potentially bias the estimated efficiency scores.

Table 3.5

Environmental / Firm-specific factors determining the inefficiency distribution (Case II)

Variable	Description	Inefficiency effect (Cost)	Inefficiency effect (Profit)
Risks, bank and market-specific factors			
Z1 (CAR)	Capital risk	-1.1209***	5.1352**
Z2 (LIQ)	Liquidity risk	-1.2875***	12.0503***
Z3 (SR)	Securities risk	0.1234	0.1456
Z4 (IR)	Insolvency risk	0.1101	-0.6277*
Z5 (AD)	Asset diversification	-0.6730	-3.1355***
Z6 (BAS)	Bank asset size	-0.1355**	-0.4820**
Z7 (CONC)	Concentration	0.5905***	1.4813***
Z8 (ID)	Income diversification	0.0535	8.5812***
Z9 (OBS)	OBS business	-0.0928	-0.5467***
Z10 (LB)	Listed banks	-1.2976***	-3.9457***
Macroeconomic Conditions			
Z11 (PD)	Population density	0.3283**	-0.4003
Z12 (GDP)	GDP per capita	-0.8065***	1.9647***
Z13 (FDII)	FDIs inflows	-0.1929***	0.5770
Z14 (FDIO)	FDI outflows	0.0879	-1.5560***
Profitability			
Z15 (ROA)	Return on Assets	2.6002**	-39.7617*
Z16 (ROE)	Return on Equity	-0.1681*	-0.5750
Country dummies			
Z17	France Dummy	1.6615***	-0.7228
Z18	Germany Dummy	1.4109***	0.8338
Z19	Italy Dummy	0.5187	-9.5681***
Z20	Japan Dummy	0.3711	-0.6215
Z21	Switzerland Dummy	-2.0076***	-8.6367***
Z22	UK Dummy	1.8746***	7.2744***
Z23	US Dummy	-6.5516***	20.7140***

*, **, *** means statistically significant at the 10%, 5% and .1% respectively.

Note: CAR =calculated as equity over assets; LIQ =liquid assets over assets; SR = total securities over total assets; IR=(1+average ROE)/SDROE; AD = 1- |(Net loans - Other earning assets)/Total earning assets|; BAS= total assets; CONC =sum of the squares of market shares for all banks; ID = 1- |(Net interest income - Other operating income)/Total operating income|; OBS =off-balance sheet items over total assets; The bank is publicly listed or otherwise, where 1 = listed; 0= non-listed; ROA=Net profits over total assets; ROE=Net profits/Shareholders equity (total assets - total liabilities).

Focusing on the cost side (column 1 in Table 3.5), the magnitude of the coefficients is particularly high for the dummy of listed banks (LB) and the profitability ratio (ROA). Indeed, listed companies seem to have a negative relationship with both cost and profit inefficiency, thus providing strong evidence that on average banks that are quoted in stock markets tend to be less inefficient.[26] On the other hand, our findings for ROA suggest that the most profitable banks are less cost and more profit efficient.

Turning to the inefficiency effect in profits (column 2 in Table 3.5), asset and income diversification (AD and ID respectively) seem to be remarkably high and significant. Nevertheless, they are both insignificant on the cost side and they seem to have an opposite effect on profit efficiency. This is likely due to the higher volatility of income streams, and the possibility that more diversified banks may have been affected by trading losses over the studied period. However, banks doing more OBS business seem to be more profit efficient on average.

Special attention should be paid to bank asset size (BAS) and market concentration (CONC): our evidence implies that size matters for both cost and profit efficiency; however, this is not necessarily reflected in more efficient concentrated markets.[27] These findings have some interesting implications. First of all because they give further support to the assumption that efficiency and performance are amongst the main motives for bank mergers and acquisitions, and secondly, because they indicate that on average more concentrated markets are less likely to be cost and profit efficient.[28]

[26] On the relationship between efficiency and stock performance see e.g. Beccalli et al. (2006).

[27] To further confirm these results, we carried out several robustness tests. Specifically, we carried out a t-test to the two subsamples of the largest and smallest banks in the sample (i.e. the fourth and first quartile of the size distribution). Results are robust only for the cost case where smaller investment banks are more efficient then larger banks at 10% significance level.

[28] Actually these findings could even be signaling some evidence of the validity of Hick's *quiet life* hypothesis in investment banking and thus should be explored in more detail (Hicks, 1935).

Lastly, the macroeconomic variables included in the models (PD, GDP and FDI) seem to affect the inefficiency levels in various ways. Focusing on the most significant and larger coefficients, it seems that investment banks operating in more developed economies (with higher GDP per capita) present higher profit and lower cost inefficiencies. Finally, the sign and magnitude of the coefficient estimate for FDI outflows suggests that the most efficient investment banks are more likely to operate abroad (for similar findings see e.g. Beccalli, 2004).

3.5.3 Robustness Checks

In order to further confirm the aforementioned findings, a number of robustness checks were conducted by testing alternative models.

First, numbers of input and output specifications for our model have been tested. We have tried to include total funds as input and output variable, interest income have been tested as output together with current outputs, and based on our comprehension presented input and output specification best suits available data.

Second, according to our results for Case II Cost and Profit Model (table 3.5) investment banks size are found to be important efficient determinant. To further confirm this conclusion, we considered two subsamples focussing on the largest and smallest banks.

In the Table 3.6 we considered two subsamples focussing on the largest and smallest banks (i.e. the fourth and first quartile of the size distribution).

Table 3.6

Small vs. Big investment banks

Case II Model	Small Mean (200 Obs)	Big Mean (200 Obs)	Mean Diff.	T-Stat	P-Value
Cost	**0.6861**	**0.6216**	**0.0644**	**2.6133**	**0.0093*** **
Profit	**0.5522**	**0.5120**	**0.0401**	**1.6450**	**0.1008**

NOTES: Small: smallest investment banks, Big: biggest investment banks (fourth and first quartile of the size distribution).

*** indicates significance at 10% level

a Two sample t-test of differences in mean between Small and Big, under the assumption of unequal variance.

H0: mean(Small)-mean(Big)=0 H1: mean(Small)-mean(Big)≠0

As reported in Table 3.6 for the cost case, smaller investment banks are more efficient then larger banks, with 10% significance.

To provide some additional explanation regarding efficiency results inside the investment banking industry, we create a cluster sample for investment bank type. Accordingly we consider two basic types of investment banks[29]: full-service and boutique. Full service investment banks (FSIB, also known as the Wall Street bulge bracket) offer clients a range of service including underwriting, merger and acquisition advice, trading, merchant banking and prime brokerage. Boutique investment banks (BIB) specialize in particular segments of the market. They do not offer a range of service and are not part of larger financial institution. Beside these two basic types of investment banks it is important to mention financial holding companies, which operate full-service investment banking, and can besides that offer clients large sums of credit (for example Citigroup, HSBC, Credit Suisse, JP Morgan Chase and Bank of America).

[29] For more see Davis 2003, and Gardener and Molyneux 1995.

In the Table 3.7 we give overview of the cluster sample, diversified by type of the investment bank:

Table 3.7

Number of FSIB and BIB in each country

Country	FSIB	BIB	Total
Canada	2	2	4
France	4	5	9
Germany	7	9	16
Italy	3	7	10
Japan	11	15	26
Switzerland	24	35	59
UK	25	15	40
USA	19	7	26
Total	**95**	**95**	**190**

NOTES: FSIB - Full service investment banks, BIB - Boutique investment banks.

In the Table 3.8 we considered two subsamples focussing on the cluster sample.

Table 3.8

Full service investment banks vs. boutique investment banks

Case II Model	FSIB Mean (415 Obs)	BIB Mean (385 Obs)	Mean Diff.	T-Stat	P-Value
Cost	0.6727	0.6231	0.0495	-2.8431	0.0046***
Profit	0.5047	0.5949	-0.0902	5.6493	0.0000***

NOTES: FSIB: Full service investment banks, BIB: boutique investment banks.

*** indicates significance at 10% level

a Two sample t-test of differences in mean between FSIB and BIB, under the assumption of unequal variance.

H0: mean(FSIB)-mean(BIB)=0 H1: mean(FSIB)-mean(BIB)≠0

From the Table 3.8 we can notice that in the cost case full service investment banks are more efficient, while in the profit case we have that boutique banks have higher

efficiency scores. The results confirm theoretical assumptions where cost management for bigger banks needs to provide operational efficiency and to ensure that resources are used in the best possible way. Higher results for boutique investment banks approve our expectation, where only way for these banks to survive and remain competitive in this industry is specialization along certain business areas which would lead to maximization of profits.

3.6 Conclusions

The recent financial turmoil has uncovered a number of weaknesses of the banking industry and has left the international community with challenging questions about the evolving role of (commercial and investment) banks in the economy and the primary objective of ensuring financial stability. Over the last two decades investment banks' operations, functions and strategies have been increasingly market-driven and have contributed to the emergence of an unprecedented system of compensations, a highly leveraged industry and a pervasive risk culture. It is expected that post-crisis investment banks will have to comply with new constraints thus the evaluation of their operating efficiency will likely gain a new impetus, particularly on the cost side. In this context, the description of modern investment banks' production process should reflect the changes in their business focus. As well, it should account for risk and other environmental and regulatory factors.

This paper investigates the operating efficiency of the investment banking sector over 2001-2007 for the G7 countries (Canada, France, Germany, Italy, Japan, UK and US) and Switzerland. We follow Coelli et al. (1999)'s methodology to adjust the estimated cost and profit efficiency scores for environmental influences including key

banks' risks, bank- and industry specific factors and macroeconomic conditions. Specifically we estimate three models: a "Base model", i.e. a common frontier that ignores environmental variables; Case I model, where environmental conditions/ firm-specific factors have a direct influence on the production process; and Case II model, where environmental factors influence the inefficiency distribution.

Overall, our evidence suggests that not accounting for environmental factors can considerably bias the efficiency scores of investment banks. Specifically, our analysis indicates that profit efficiency estimates are consistently underestimated in the base model. Moreover, in comparing the results between Case I and Case II, we observe that the difference in average efficiency levels is around 1% on the cost side, while on the profit side the results diverge by almost 10 percentage points. The vast majority of the tested environmental factors in the two models were found statistically significant: for example we find strong evidence that by including bank risk-taking factors to assess the efficiency in a pre-crisis period, investment banks with a higher liquidity are penalized in the case of cost efficiency, but have an advantage in generating profits.

Turning to bank and industry-specific factors, results are mixed on the relationship between inefficiencies, asset size and market concentration. While our evidence implies that size matters for both cost and profit efficiency, we find that this does not imply that more concentrated markets are more efficient. Finally, among the most significant results on the macro-factors, are that the general economic development of a country and the banks' level of openness contribute to reducing inefficiencies.

Finally, when efficiency is compared based on cluster constructed to provide differentiation between types of investment banks we find that in the cost case full service investment banks are more efficient, while in the profit case we have that boutique banks have higher efficiency scores.

Chapter 4

Competition and efficiency in worldwide investment banking

4.1 Introduction

During the last twenty years or so, the investment banking industry around the world has experienced continual transformations due to new technologies, deregulation, the globalization of the economy, economic integration, etc., all of which have altered the conditions in which banking firms compete. Increased competition has been considered as the driving force behind the acceleration in the recent consolidation process which is raising concerns about increased concentration in the banking sector and its potential implications for public policy. Furthermore, the recent financial crisis has intensified the public policy debates about the banking regulatory environment and whether they make financial systems more efficient and stable.

Numerous studies have been investigating impact of concentration on the banking sector efficiency or competition. For example, according to Amel et al. (2004), impact of increased concentration on banking sector efficiency and competition existing studies are usually treating as separate issues. However, to our comprehension they are highly interrelated and, given the unique role of investment banks in the economy and the potential non-trivial implications for welfare, they deserve special attention. Specifically, the relationship between efficiency and competition in the investment banking also needs to be addressed and investigated.

In this chapter we analyze the relationship between market power and efficiency in worldwide investment banking and the direction of causality. The majority of the empirical studies have focused on the market structure and efficiency analysis for

commercial banks, including the relationship with concentration. To the best of our knowledge there are no studies focusing on the causal links between market power and the efficiency of the investment banking sector.

This paper contributes to the existing literature by investigating the evolution of market structure as well as the dynamics of both competition and efficiency for the investment banking sector operating in three regions (East Asia & the Pacific, Europe and North America). Specifically, first we calculate concentration measures for individual countries using the Herfindahl-Hirshman Index and then we estimate cost efficiency by employing a parametric approach (Stochastic Frontier Analysis). To test the degree of competition we use two non-structural measures: the Lerner index of monopoly power, and the Panzar and Rosse (1987) H-statistics model. Finally, we employ panel data analysis and the Generalized Methods of Moments (GMM) to test the direction of causality between market power and efficiency. This approach allows to control for endogeneity and for country-specific effects.

In this chapter we present the empirical analysis conducted in order to answer the third and fourth research questions:

RQ3: What kind of competitive conditions characterise the investment banking industry?

RQ4: Is there a causality relationship between market power and efficiency for investment banks?

The chapter is structured as follows. Section 4.2 reviews the main literature on competition and efficiency in the banking industry. Section 4.3 discusses the method and empirical approach we use. Section 4.4 presents the data and variables. Section 4.5 discusses the results and section 4.6 concludes.

4.2 Literature review

The study of competition in the banking sector and its relationship with bank efficiency is of great relevance – for various reasons. On one hand, increased competition is expected to foster efficiency by providing incentives to managers to cut costs in order to remain profitable. On the other hand, as pointed by Allen and Gale (2004) competition can be detrimental to financial stability – particularly if deregulation allows banks to take on more risks. In this context the authors' emphasise that the issue of regulation and its effect on competition and financial stability is complex and multi-faceted, and that careful consideration of all the factors at work both at a theoretical and empirical level is required. Similary, Claessen and Leaven (2004) indicate that the relationship between competition and banking system performance is complex and that the view that competition is unambiguously good is more naive in banking than in other industries.

For example, in later study, and using data on 69 countries from 1980 to 1997, Beck et al. (2006) found that crises are less likely to occur in economies with more concentrated banking systems even after controlling for differences in commercial bank regulatory policies, national institutions affecting competition, macroeconomic conditions, and shocks to the economy.[30]

The existence of a link between market structure and efficiency was first proposed by Hicks (1935) and the *quiet life* hypothesis, which assumed that monopoly power allows managers a *quiet life* free from competition and therefore increased concentration, should bring a decrease in efficiency. Leibenstein (1966) argued that inefficiencies are reduced by increased competition as managers respond to the challenge. Contrary to these findings Berger and Hannah (1998) provide evidence that suggest that banks in

[30] However the assumption that more concentration implies less competition is debatable because it appears that recently as a result of deregulation in various instances actual and potential competition has actually increase in markets that are more concentrated (e.g. Casu and Girardone, 2006)

more concentrated markets exhibit poorer cost efficiency. The *efficient structure* hypothesis (Demsetz, 1973) on the other hand, posits a reverse causality between competition and efficiency: more efficient firms have lower costs, which in turn lead to higher profits. Therefore, the most efficient firms are able to increase their market share, resulting in higher concentration.[31] According to the New Empirical Industrial Organization literature factors such as entry/exit barriers and the general contestability of the market may also affect competitive behavior.[32]

Concerning the relationship between the competition and efficiency, we find only a handful of studies in the literature and typically these studies focus on commercial banking. The recent studies on the EU banking sector by Casu and Girardone (2006) and Weill (2004) find an inverse relationship between competition (proxied by the Rosse- Panzar H-statistic) and efficiency. They also suggest that the most efficient banking systems tend to be the least competitive. More recent studies include the evaluation measures at the firm level. For example, Maudos and Fernandez de Guevara (2007) examine the relationship between market power (proxied by the Lerner index) and cost efficiency and their results indicate the existence of a negative relationship between competition and cost efficiency in the European banking sectors.

Finally, Schaeck and Čihák (2008)'s study on the relationship between efficiency, competition and soundness in EU and US banking also finds evidence that increases in market power precede increases in cost efficiency.

[31] Possible drawback of these studies is that they proxy competition with concentration measures (Herfindahl-Hirshman index or concentration ratios).

[32] These studies usually measure the degree of competition in banking markets by using the Lerner index, the Panzar and Rosse's H-statistics; Bresnanhan's mark-up test and conjectural variation approaches. For more redings see Baumol et al., (1982) and for a review of recent studies, see Berger et al., (2004).

4.3 Methodology

This section describes the empirical methods used in this chapter. This section is organised as follows:

- In section 4.3.1 we present the stochastic frontier approach to model cost efficiency scores at the bank level;
- Section 4.3.2 and 4.3.3 describe the Lerner Index of monopoly power and the Panzar and Rosse model respectively to investigate the degree of market power that characterise the investment banking industry;
- Finally, section 4.3.4 introduces the Generalized Method of Moments (GMM) model.

4.3.1 Stochastic Frontier Approach

In this study cost efficiency is estimated by using the parametric Stochastic Frontier approach[33]. Specifically, x-efficiency scores are estimated using the Battese and Coelli's (1992) time-varying stochastic frontier approach for panel data with firm effects which are assumed to be distributed as truncated normal random variables, and are also permitted to vary systematically with time (see also Battese and Coelli, 1993; and Coelli et al., 2005; Casu and Girardone, 2009). To define a common frontier for the cost function we use the translog[34] specification with three inputs, one output (total assets) and a time trend. The final specification is as follows:

[33] This method was originally proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977).

[34] Berger and Mester (1997) used the distribution free approach and stochastic frontier approach for both translog and the Fourier specification of the cost and profit function, and have concluded that difference between two methods are not relevant. Same was observed and stated also by Vander Vennet (2002).

$$\ln TC_{it} = \alpha_0 + \sum_{i=1}^{1} \alpha_1 \ln Q_i + \sum_{j=1}^{3} \beta_j \ln P_j + \frac{1}{2}[\sum_{i=1}^{1}\sum_{j=1}^{3} \delta_{ij} \ln Q_i \ln Q_j + \sum_{j=1}^{3}\sum_{i=1}^{1} \gamma_{ij} \ln P_j \ln P_i] +$$
$$+ \sum_{i=1}^{1}\sum_{j=1}^{3} \rho_{ij} \ln Q_i \ln P_j + t_1 T + \frac{1}{2} t_{11} T^2 + \sum_{i=1}^{1} \theta_{ti} T \ln Q_i + \sum_{j=1}^{3} \psi_{tj} T \ln P_j + \varepsilon_{it}$$

(4.1)

The single-equation stochastic cost model is represented by $\ln TC_{it} = \ln TC^*(Q_{it}, P_{jt}; B) + \varepsilon_{it}$ where *TC* is total costs; Q_1 is total assets; P_1 is the price of labor (personnel expenses/total assets); P_2 is the price of physical capital (other administrative expenses and other operating expenses/total fixed assets) and P_3 is the price of funds (interest expenses/total funds); T is a time trend; *B* is a vector of unknown parameters to be estimated: α, β, δ, γ, ρ, t, θ, ψ.[35] Finally ε_{it} is a two-components error term that for the *i*-th firm can be written as follows: $\varepsilon_{it} = u_{it} + v_{it}$ where v_{it} is a two-sided error term capturing the effects of statistical noise, assumed to be independently and identically normal distributed with zero mean and variance σ_v^2 and independent of the $u_{it} = \{u_i \exp[-n(t-T)]\}$ where u_i is a one-sided error term capturing the effects of inefficiency and assumed to be half normally distributed with mean zero and variance σ_u^2; *n* is an unknown parameter to be estimated capturing the effect of inefficiency change over time.

[35] We apply the common restrictions of standard symmetry and homogeneity in prices to the translog functional form.

4.3.2 The Lerner Index of Monopoly Power

The Lerner Index of monopoly power is an indicator of the degree of market power and it is a well established measure of competition in the banking literature. It represents the extent to which market power allows firms to fix a price above marginal cost (MC). MC is calculated from the estimation of a translog cost function as specified in equation (4.1) above with three inputs (labor, physical capital and funds) and a single output (proxied by total assets[36]) as follows:

$$MC_{it} = \frac{TC_{it}}{Q_{it}}\left(\alpha_1 + \delta \ln Q_{it} + \rho_j \ln Q_{it} + \theta_t T + \varepsilon_{it}\right) \tag{4.2}$$

Marginal costs derived from equation (4.2) are used to calculate the Lerner index:

$$LERNER = \frac{p_{it} - MC_{it}}{p_{it}} \tag{4.3}$$

where *p* is the price of output Q and is calculated as total revenue (interest plus non-interest income) divided by total assets. LERNER=0 it indicates perfect competition, while LERNER=1 indicates monopoly.[37]

[36] Following the established literature (Shaffer, 1993; Berg and Kim, 1994; Angelini and Cetorelli, 2003; and Fernandez de Guevara et al., 2005; Casu and Girardone, 2009) we use a single indicator of banking activity because of problems in the empirical estimations of separate prices for bank output using Bankscope data. The assumption is that the flow of banking goods and services produced by a bank is proportional to its total assets.

[37] The interpretation of the Lerner index as an indicator of market power may incur some problems: a) it is influenced by the criteria followed in the definition of revenue and costs; b) it is general practice not to consider the cost of risk, despites its relevance on bank costs and revenues; c) banking output is usually proxied by the total assets of each firm mainly because of data problems; finally, d) the Lerner index may not be an appropriate measure of market power when a firm solves a dynamic problem (Pindyck, 1985 and Perloff et al., 2007).

4.3.3 The Panzar and Rosse H Statistic

Panzar and Rosse (1987) developed models of oligopolistic, competitive and monopolistically competitive markets and derived test statistics to distinguish among them. The test is called *H* statistics and is calculated from a reduced form revenue equation; it measures the sum of elasticities of total revenue of the firm with respect to the firm's input prices that can be written as follows:

$$H = \sum_{K=1}^{m} \frac{\partial R_i^*}{\partial w_{ki}} \frac{w_{ki}}{R_i^*} \tag{4.4}$$

where R_i refers to revenues of bank i (* indicates equilibrium values) and w_i, is a vector of *m* factor input prices of bank i. Market power is measured by the extent to which a change in factor input prices ∂w_{ki}, is reflected in the equilibrium revenues ∂R_i^* earned by bank i.[38]

The Panzar-Rosse *H* statistic is interpreted as follows. *H* is equal to zero or negative when the competitive structure is a monopoly, or a perfectly colluding oligopoly. When *H* is equal to 1, it indicates perfect competition and $0 < H < 1$ indicates monopolistic competition.

In the empirical analysis, the following reduced-form revenue equation is estimated (run on a panel data set) in order to derive the Panzar-Rosse *H* statistic:

$$\ln TR_{it} = \alpha + \beta_1 \ln P_{1,it} + \beta_2 \ln P_{2,it} + \beta_3 \ln P_{3,it} + \gamma_1 \ln EQAST_{it} + \gamma_2 \ln AST_{it} + \varepsilon_{it} \tag{4.5}$$

[38] For more readings on derivation of the *H* statistics, see Panzar and Rosse (1987), Bikker and Haaf (2002) and Casu and Girardone (2006).

for t = 1, . . , T, where *T* is the number of periods observed, and i = 1, . . . , I, where I is the total number of banks. Subscripts i and t refer to bank i at the time t. The dependent variable is lnTR.

We assume that banks use three inputs, labor, physical capital and funds: P_1 is the price of labor (personnel expenses/total assets); P_2 is the price of physical capital (other administrative expenses and other operating expenses/total fixed assets) and P_3 is the price of funds (interest expenses/total funds).

The input prices are followed by a set of bank-specific factors that are relevant to the modern banking business, and they reflect differences in size and risk. The bank-specific control variables include In EQAST, i.e. the ratio of total equity to total assets; In AST, i.e. total assets. All variables are in logarithmic form.

Equation (4.5) is estimated by running a panel data set of banks (with fixed effects); thus ε_{it} , includes a systematic (time-varying) and bank-specific component.[39]

An important feature of the *H* statistic is that the tests must be undertaken on observations that are in long-run equilibrium. The equilibrium test can be performed by recalculating the Panzar and Rosse *H* statistic replacing the dependent variable total revenue with the natural log of ROA[40] as shown in equation (4.6). The findings will be interpreted as follows: $H < 0$ indicates disequilibrium and $H = 0$ indicates equilibrium (see Claessens and Laeven., 2004; Casu and Girardone., 2006).

$$\ln ROA_{it} = \alpha + \beta_1 \ln P_{1,it} + \beta_2 \ln P_{2,it} + \beta_3 \ln P_{3,it} + \gamma_1 \ln EQAST_{it} + \gamma_2 \ln AST_{it} + \varepsilon_{it} \quad (4.6)$$

[39] The choice of the fixed effects estimators versus random effects estimators is confirmed by the implementation of the Hausman test and it is consistent with previous studies (Claessens and Laeven., 2004; Casu and Girardone., 2006).

[40] It should be noted that, the measure of ROA included in (4.6) is equal to ln (l + ROA) and thus is adjusted for small negative values due to banks' losses in any year.

4.3.4 Generalized Method of Moments (GMM)

In order to ascertain whether there is a causality relationship between market power and efficiency for our sample of investment banks, we employ dynamic panel data methods and the Generalised Method of Moments (GMM) procedures developed by Arellano and Bond (1991) and then developed by Blundell and Bond (1998).[41] Consider following equation:

$$y_{i,t} = \alpha' X^{1}_{i,t-1} + \beta' X^{2}_{i,t} + \mu_i + \gamma_t + \varepsilon_{i,t} \qquad (4.7)$$

Where y is the dependent variable, X^1 is the lagged dependent variable, X^2 are the explanatory variables, the μ is the unobserved country-specific effects, γ is the time-specific effect and ε is the white noise term, while i and t are the observations and time respectively. Several problems arise with this equation, there could be a correlation between the country-specific effects and the explanatory variables since it is part of the error; when the lagged dependent variable is included it may be correlated with the country-specific effects; the set of explanatory variables may be endogenous, thus their inference may not be accurate, and they may be correlated with lagged effect of the dependent variable (Beck et al., 2000).

Arellano and Bond (1991) propose to differentiate the first equation to eliminate the country-specific effect, furthermore they suggest using the lagged values of the variables as instruments to correct endogeneity in the explanatory variables, and lastly, they assume no serial correlation in the error term and consider the explanatory variables weakly exogenous. Arellano and Bover (1995) introduce system estimator that

[41] These methods are useful for panels characterized by a relatively low number of years and a large number of cross-sections per year (see Roodman, 2006) and they help deal with possible problems of endogeneity and measurement error.

is very useful at eliminating the problems stated beforehand about the difference estimator.

Therefore, the equation estimated for the aims of this study can be written as follows:

$$LER_{i,t} = \alpha_{i,t} + \beta_1 LER_{i,t-1} + \beta_2 LER_{i,t-2} + \beta_3 LER_{i,t-3} + \beta_4 SFA_{i,t} + \beta_5 SFA_{i,t-1} + \beta_6 SFA_{i,t-2} + \beta_7 SFA_{i,t-3} + \beta_8 FDI_{i,t} + \beta_9 GDP_{i,t_t} + \beta_{10} INF_{i,t} + \beta_{11} HTE_{i,t} + \beta_{12} WRCE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (4.8)$$

where Lerner Index measures competition in the industry, SFA is a measure of banking efficiency, FDI represents foreign direct investments, GDP represents the growth in GDP, INF is the Rate of inflation, calculated by log difference of GDP deflator, HTE is high-technology exports, WRCE is workers' remittances and compensation of employees received, μ_i are the unobserved country-specific effects, and $\varepsilon_{i,t}$ is the disturbance term.

The next step of the study is to reverse the endogenous variable and the dependent variable in order to test the reverse causality between these variables. The control variables remain in order to observe their relationship with the new dependent variable, as explained in equation (4.8):

`

$$SFA_{i,t} = \alpha_{i,t} + \beta_1 SFA_{i,t-1} + \beta_2 SFA_{i,t-2} + \beta_3 SFA_{i,t-3} + \beta_4 LER_{i,t} + \beta_5 LER_{i,t-1} + \beta_6 LER_{i,t-2} + \beta_7 LER_{i,t-3} + \beta_8 FDI_{i,t} + \beta_9 GDP_{i,t_t} + \beta_{10} INF_{i,t} + \beta_{11} HTE_{i,t} + \beta_{12} WRCE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (4.9)$$

Finally, two tests are analyzed to assess the GMM methodology: the Hansen J-test and the second autocorrelation test. The Hansen J-test assesses the correct identification of the variables used in the model and the model should not have a second order autocorrelation.

4.4. Data and variables

The aim of this section is to describe the sample and the variables used in the research design. Section 4.4.1 presents sample selection criteria, and section 4.4.2 discusses the choice of input and output variables.

4.4.1 Sample description

This study comprises banks' balance sheet, income statement and annual reports data for a sample of investment banks operating in 15 countries from the developed world over 2001-2008. The data used in this study was obtained from two different sources: International Bank Credit Analysis Bankscope Database, and from the World Development Indicators, from World Bank. Table 4.1 illustrates the breakdown by country of the number and asset size of the banks included in the sample. The total number of observations is 1609. The US banks are the biggest on average by asset size, whereas Switzerland has the largest number of institutions in total.

It is important to note that we consider three regions (East Asia & the Pacific, Europe and North America) to estimate efficiency scores, while for investigations of competitive conditions (i.e. for both the Lerner Index and the H:Statistics) estimates are obtained by country. Due to data limitations for certain countries (i.e. number of observations for some countries), it is impossible to obtain efficiency scores for every country[42]. Furthermore, our previous cost efficiency analysis in Chapter 3 showed no significant improvement of efficiency scores when considering environmental variables to account for heterogeneity. Accordingly, we choose to obtain estimates by regions.

[42] For this reason we can justify only the use of structural variables in the analysis. However, different robustness models have been tested, and estimates obtained confirm our previous conclusion.

Table 4.1. Overview of the selected sample

Country/Year	2001	2002	2003	2004	2005	2006	2007	2008	Total obs. by country	Tot. assets of the average bank*
Australia	4	3	3	9	9	8	8	5	49	12,217,772.3
Austria	4	4	4	4	5	5	4	3	33	924,995.4
Canada	4	4	4	5	6	6	6	6	41	12,146,415.3
France	8	5	6	9	14	13	10	9	74	21,429,634.9
Germany	12	12	13	14	13	15	17	3	99	11,544,862.1
Hong Kong	15	9	5	16	16	13	9	4	87	1,290,752.0
Ireland	6	6	5	7	6	7	4	2	43	38,593,756.8
Italy	3	3	2	4	8	11	10	10	51	6,062,276.8
Japan	22	19	18	24	28	27	25	6	169	27,855,958.7
Luxembourg	7	7	7	7	9	11	10	3	61	4,443,755.4
Netherland	4	6	5	7	6	5	4	2	39	1,988,112.0
Sweden	4	7	7	8	8	8	5	4	51	2,179,624.8
Switzerland	54	47	48	50	50	48	48	4	349	20,215,079.8
UK	20	21	20	37	49	59	47	20	273	48,395,397.0
USA	24	28	28	27	26	24	21	12	190	86,217,566.5
Total obs. by year	191	181	175	228	253	260	228	93	1609	
East Asia & the Pacific	88	72	62	116	125	109	87	31	690	
Europe	122	118	117	147	168	182	159	60	1073	
North America	28	32	32	32	32	30	27	18	231	

* All values are in thousand dollars.

NOTE: We select banks with available balance sheets and income statement in Bankscope for the years 2001-2008.

4.4.2 Input and output definition

In the banking literature, the definition of inputs and outputs varies across studies and mainly depends on the researcher's assumptions on the production process of banks. In this study we accept the assumption that the main inputs of investment banks are the price of labour calculated as personnel expenses over total assets (P_1); the price of physical capital, measured as other administrative expenses plus other operating expenses over total fixed assets (P_2); and price of funds measured as interest expenses

over total funds (P_3). We choose only one output definition proxied by total assets (Y_1)[43]. In order to estimate cost efficiency scores, we use as dependent variable total cost (*TC*), calculated as the sum of interest, personnel expenses, other administrative expenses and other operating expenses. It is also important to notice that this definition of inputs differs from the one in Chapter 3, due to data problems and limitations. Namely, in order to consider a large cross-countries sample and to be able to employ the methodology discussed above some changes were necessary. In addition, we can say that we have been testing both definitions of inputs and outputs in Chapter 3 and those results were very similar.

Table 4.2 presents the description of the variables used in the empirical estimation. The macroeconomic control variables are *foreign direct investment, real GDP growth, high-technology exports, inflation* and wo*rkers' remittances and compensation of employees*.

As discussed in Chapter 2 and tested in Chapter 3, we choose to include these variables for their historical importance in the development of the investment banking industry. In this study, to account for the compensation practice in the industry we also add the variable wo*rkers' remittances and compensation of employees*.

[43] Following the established literature (Shaffer, 1993; Berg and Kim, 1994; Angelini and Cetorelli, 2003; and Fernandez de Guevara et al., 2005, Casu and Girardone 2009) we use a single indicator of banking activity because of problems in the empirical estimations of separate prices for bank output using Bankscope data. The assumption is that the flow of banking goods and services produced by a bank is proportional to its total assets.

Table 4.2. Variable definitions and sources

Variable name	Description
Bank market structure and competition[1]	
Herfindahl Index	A measure of the degree of concentration in the banking industry, calculated by the sum of the squares of market shares for all banks operating in the industry.
Lerner Index	It is an indicator of the degree of market power, and a well established measure of competition in the banking literature. LERNER=0 it indicates perfect competition, while LERNER=1 indicates monopoly.
H-statistic	A measure of the degree of competitiveness of the industry, with less than 0 being a monopoly, less than 1 while larger than 0 being monopolistic competition, and 1 being perfect competition .
Macroeconomic variables[2]	
Foreign direct investment	Net inflows (current US$).
GDP growth	The growth in GDP.
High-technology exports	Calculated as % of manufactured exports.
Inflation rate	Rate of inflation, calculated by log difference of GDP deflator.
Workers' remittances and compensation of employees	Workers' remittances and compensation of employees, received (current US$).

Data Sources:

1 Calculated based on Fitch IBCA's Bankscope Database

2 World Development Indicators, World Bank

4.5 Empirical Results

Table 4.B.1 in the appendix shows the means of the structural indicators of market concentration across our sample of countries over the period 2001-2008. The Herfindahl-Hirshman Index (HHI) represents the market share (in terms of total assets, loans, securities, funds, investment banking fees, off-balance sheet items) of every firm in the market.

The data shows that national conditions still vary considerably across countries. In addition it appears that most countries have experienced an increase in concentration during the period of analysis. The only exception is Italy, where concentration has decreased in all cases apart from investment banking fees.

4.5.1 The evolution of investment banks' efficiency

The yearly SFA results for the regions included in our sample over the studied period are reported in Table 4.3. The average efficiency scores for the EU countries over period is 59.08%, thus indicating a 40.92% average potential savings from better input utilization. Similarly, for East Asia & the Pacific we found average efficiency scores of 58.58% and for North America 61.51%, indicating respectively potential reduction in inputs utilization of 41.42% and 38.49%. The graphical representation of the evolution of bank efficiency by regions by using yearly averages is shown in Figure 4.A.1 in the Appendix.

Table 4.3. SFA Efficiency scores by year and region

Region/Countries	Mean	2001	2002	2003	2004	2005	2006	2007	2008	2001-2008
East Asia & the Pacific	0.5858	0.6589	0.6180	0.5979	0.5895	0.5823	0.5628	0.5421	0.4947	-24.92%
Europe	0.5908	0.6053	0.6002	0.5911	0.5793	0.5938	0.5937	0.5924	0.5495	-9.22%
North America	0.6151	0.5809	0.5845	0.5899	0.6015	0.6252	0.6409	0.6647	0.6559	12.91%

On average our estimations carried out using the SFA methodology indicate inefficiency scores of about 40%, a result that is slightly different from the main literature on bank efficiency (see Goddard et al., 2007)[44].

4.5.2 Competition patterns in worldwide investment banking

Measuring market power is fundamental to the analysis of bank competition: the lower the competition faced by a bank, the greater its market power, as reflected by its ability to set price above marginal costs. Figure 4.1 (see page bellow) shows the mean values for marginal costs and the Lerner index of monopoly power over the sampled period by country. The investment banking sectors in the Republic of Ireland and Italy seem to enjoy the lowest relative margin and Germany the highest. These results are opposite from those of Fernandez de Guevara and Maudos (2005), however it is necessary to bear in mind that most previous studies consider the whole banking sector whereas we concentrate on investment banks only.

In all countries (apart from Germany) the Lerner Index is relatively high, thus suggesting less competitive conditions, implying existence of colluding oligopoly. For more details on the Lerner Index estimates see Table 4.B.2 in the Appendix.

In order to confirm above results, we also estimate Panzar and Rosse (1987) H-statistics that allows us to measure alternative models of oligopolistic, competitive and monopolistically competitive markets.

Following the empirical literature on competition in banking markets, we estimated the reduced-form revenue equation specified in (both equation 4.5 and 4.6) above, by using a panel data framework. Estimations are carried out at each individual country level.

[44] However, literature concerned is based on commercial banks studies and not on the investment banks.

Figure 4.1. Mean value for Marginal Cost and Lerner Index of monopoly power

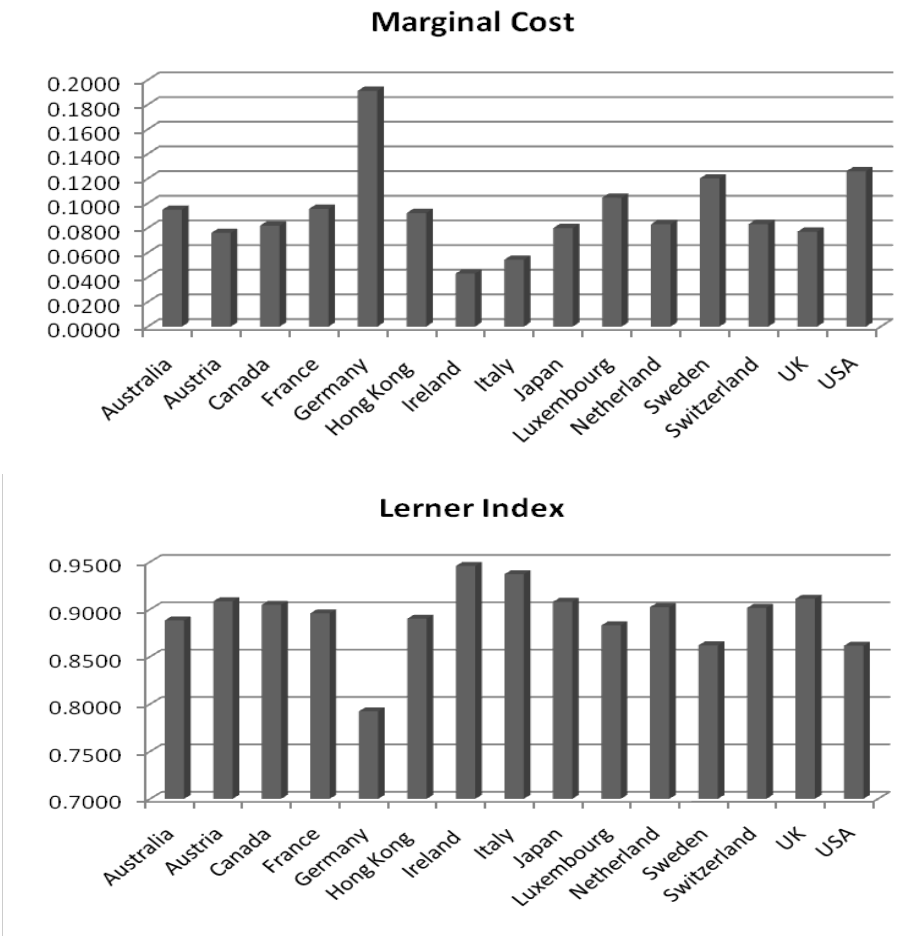


Table 4.4 (see page bellow) reports the estimated *H*-statistics regression results by country. As discussed in section 4.3.3, it is important to notice that *H*-statistics is interpreted differently from the Lerner Index. Estimates obtained report the value of the *H* statistic which ranges from -0.0961 for Italy and -0.0003 for Ireland, thus indicating monopoly or perfectly colluding oligopoly. Evidence of monopolistic competition[45] is found in Canada 0.0006, France 0.0067 and Luxembourg with H statistic results 0.0218. These results differ from the current literature, that as pointed above, focuses predominantly on commercial banks, which finds monopolistic competition the prevalent market structure in European countries (see, Molyneux *et al.,* 1994; Bikker and Haaf, 2002; Claessens and Laeven, 2004, Casu and Girardone 2006).

[45] F test results indicate that the hypothesis *H* statistic = 0 (monopoly) provides mixed results, and that the hypothesis *H:*statistic = 1 (perfect competition) is rejected in all countries. Therefore, we can assume that there is presence of colluding oligopoly in investment banking markets.

Table 4.4. H:Statistics results

Variables	AUS	AUT	CAN	FRA	GER	HK	IRE	ITA	JAP	LUX	NET	SWE	SWI	UK	USA
P1	0.0308**	-0.0045	0.0026	-0.00001	-0.0225	-0.0272*	-0.0002	0.0088	-0.0177	0.0076	-0.0423*	-0.04061	-0.0049	-0.0019	-0.0019
	(0.0138)	(0.0069)	(0.0025)	(0.0024)	(0.0116)	(0.0111)	(0.0007)	(0.0569)	(0.0129)	(0.0052)	(0.0186)	(0.0204)	(0.0055)	(0.0048)	(0.0073)
P2	0.0095	0.0105***	0.0011	0.0025	-0.0003	0.0021**	-0.0006	-0.0826*	0.0028	0.0001	-0.0037	0.0008	-0.0003	0.0009	-0.0085*
	(0.0063)	(0.0025)	(0.0012)	(0.0019)	(0.0049)	(0.0067)	(0.0007)	(0.0297)	(0.0039)	(0.0052)	(0.0073)	(0.0035)	(0.0018)	(0.0037)	(0.0043)
P3	-0.0501*	-0.0123*	-0.0031	0.0042***	0.0002	-0.0028	(0.0005)	-0.0223	-0.0217***	0.0142**	-0.0031	-0.0252*	-0.0005	-0.0021	-0.0129***
	(0.0276)	(0.0056)	(0.0022)	(0.0016)	(0.0086)	(0.0055)	0.0018	(0.0313)	(0.0038)	(0.0050)	(0.0064)	(0.0101)	(0.0017)	(0.0039)	(0.0025)
EQAST	-0.0227	0.0151	-0.0010	0.0059**	0.0076	0.0142	0.0038**	0.0631	-0.0034	0.0006	0.0153	-0.0099	0.0023	0.0013	0.0053
	(0.0169)	(0.0113)	(0.0017)	(0.0029)	(0.0085)	(0.0112)	(0.0014)	(0.0494)	(0.0115)	(0.0065)	(0.0113)	(0.0182)	(0.0046)	(0.0062)	(0.0045)
AST	-0.1125***	-0.0178	-0.0098**	-0.0002	-0.0336*	-0.0113	-0.0017	0.1094	-0.0264	-0.0188*	-0.0732**	-0.0788***	-0.01691**	-0.0285***	-0.0199*
	(0.0225)	(0.0135)	(0.0048)	(0.0036)	(0.0139)	(0.0153)	(0.0027)	(0.0603)	(0.0136)	(0.0092)	(0.0251)	(0.0167)	(0.0060)	(0.0078)	(0.0084)
CONS	-.17654	-0.1062	0.0521**	-0.0203	0.0264	-0.1938***	0.0179*	-1.328*	-0.4478***	0.1728**	0.0483	-0.0604	-0.0663*	0.0848	-0.1437*
	(-0.1766)	(0.0602)	(0.0235)	(0.0259)	(0.0603)	(0.0702)	(0.0077)	(0.5814)	(0.1214)	(0.0528)	(0.0881)	(0.1027)	(0.0328)	(0.0732)	(0.0622)
H:statistic	-0.0714	-0.0064	0.0006	0.0067	-0.0226	-0.0279	-0.0003	-0.0961	-0.0365	0.0218	-0.0491	-0.0650	-0.0058	-0.0032	-0.0234
	(0.0318)	(0.0089)	(0.0045)	(0.0035)	(0.0166)	0.0143	(0.0021)	(0.0481)	(0.0123)	(0.0090)	(0.0232)	(0.0209)	(0.0062)	(0.0082)	(0.0089)
F test (H stat=0)	5.04	0.51	0.02	3.61	1.85	3.81	0.02	3.99	8.81	5.86	4.49	9.70	0.88	0.15	6.84
Prob>F	0.0329	0.4762	0.8996	0.0575	0.1734	0.0511	0.8927	0.0582	0.0036	0.0155	0.0341	0.0038	0.3480	0.6969	0.0097
F test (H stat=1)	1133.89	12738.32	50405.46	78767.43	3809.66	5148.43	230000	519.09	7091.97	11750.74	2045.65	2604.15	26685.14	14883.62	13096.19
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: *, **, *** means statistically significant at the 10%, 5% and .1% respectively.

Standard errors in parentheses. All variables arc expressed in logs.

AUS, Australia; AUT, Austria; CAN, Canada; FRA, France; GER, Germany; HK, Hong Kong; IRE, Ireland; ITA, Italy; JAP, Japan; LUX, Luxembourg; NET, Netherlands; SWE, Sweden; SWI, Switzerland; UK, United Kingdom; USA, United States of America.

P_1 price of labour; P_2 price of physical capital; P_3 price of funds; EQAST equity/assets; AST total assets.

Source: Author's own elaboration on Bankscope data

4.5.3 The relationship and causality between market power and efficiency

As discussed in section 4.3.4, the system GMM is very useful when faced with possible endogeneity in the model being estimated, as it provides efficient and more accurate estimators when analyzing cross-country data. The next step of this study is to estimate Generalized method of moments (GMM) specifically designed for panel data estimation, following Windermeijer (2005) two step robust methodology by using the previously elaborated Lerner Index for each investment bank per country. We employ two tests that must be satisfied in order to assess the identification of variables and the second order autocorrelation. First is the Hansen J-test of over-identification that must be accepted[46], and second test for which there should be no second order autocorrelation.

In Table 4.5, LER (Lerner Index) is treated as the dependent variable and SFA (the cost efficiency level) as the endogenous explanatory variable whilst FDI, GDP, INF, HTE and WRCE are strictly exogenous and used as instruments.

The significance of LER and SFA at time t is not confirmed in model that also includes the three lags of LER among the independent variables, and three lags of SFA among the endogenous explanatory variables. However no statistical significance for the lagged LER and SFA (t-1, t-2 and t-3) variables was found. Overall the results indicate that relationship running from market power to efficiency is insignificant for our sample of investment banks.

Turning to the control variables, foreign direct investments (FDI), the growth in GDP (GDP), and the rate of inflation (INF) are also found to be not significant. Furthermore,

[46] The null hypothesis of the Hansen J tests suggests over-identification of the variables used. The tests suggest that all the regressions satisfy the specification tests indicating that the instruments used are valid.

the HTE variable is negative and significant in relationship with LER, whilst WRCE is positive and significant.

Table 4.5

Two-step system GMM dynamic panel data model, LER as the dependent variable

	LER
LER L1	0.0475
LER L2	-0.1787
LER L3	-0.3350
SFA L1	0.04957
SFA L2	-0.0625
SFA L3	0.0678
FDI	0.0095
GDP	0.6811
INF	-0.5179
HTE	-0.3088**
WRCE	0.0049*
CONS	0.7208***
AR(1)	-2.08
p-value	(0.038)
AR(2)	1.28
p-value	(0.202)
Hansen J test	86.31
p-value	(0.531)
Observations	562

Note: LER is a measure of competition in the industry, SFA measures banking efficiency, FDI represents foreign direct investments, GDP represents the growth in GDP, INF is the Rate of inflation, calculated by log difference of GDP deflator, HTE is high-technology exports, WRCE is workers' remittances and compensation of employees received.

We test two-way causality, and therefore the second step is to focus on the causality running from efficiency to market power, i.e. when the variable SFA is included as independent variable in the model and LER as the endogenous explanatory variable whilst FDI, GDP, INF, HTE and WRCE are strictly exogenous and used as instruments. Results are reported in table 4.6.

As expected the first and second lags (t-1, t-2) of the SFA variable are positive and statistically significant. Also it is possible to identify a strong positive and significant LER coefficient. That implies that higher market power (lower competition in the investment banking industry) tends to be associated with higher cost efficiency in the investment banking sector.

Table 4.6

Two-step system GMM dynamic panel data model, SFA as the dependent variable

	SFA
SFA L1	0.2802***
SFA L2	0.1614*
SFA L3	0.1062
LER L1	0.5367**
LER L2	-0.160
LER L3	0.1109
FDI	0.0020
GDP	0.6323
INF	-0.5705
HTE	0.3487
WRCE	-0.0076**
CONS	-0.2558
AR(1)	-3.18
p-value	(0.001)
AR(2)	-0.36
p-value	(0.720)
Hansen J test	84.31
p-value	(0.591)
Observations	562

Note: SFA is a measure of banking efficiency, LER measures competition in the industry, FDI represents foreign direct investments, GDP represents the growth in GDP, INF is the Rate of inflation, calculated by log difference of GDP deflator, HTE is high-technology exports, WRCE is workers' remittances and compensation of employees received.

Turning to the control variables evidence suggests that WRCE is negatively associated with SFA and LER. This result can be important for authorities, because higher bonuses lead to higher market power, indicating less competition. If we have less competition in investment banking sector, employees will have no intention to offer more competitive

and cheaper products, and will be less willing to switch between banks. On the other hand, the variables FDI, GDP, INF and HTE are found to be not significant.

Due to lack of studies in investment banking efficiency and market power, these results are new in literature and while we find no causal relationship between market power and cost efficiency; they are supportive of a positive reverse causality. Results also imply that greater cost efficiency has strong implications with greater market power. The results for workers' remittances and compensation of employees received and their relationship with both the market power and cost efficiency are mixed and they deserve special attention in future research. This becomes particularly important in today's investment banking industry where authorities worldwide consider high compensational packages as one of the biggest problems in the industry.

4.6 Conclusions

Competition is generally considered as a positive force, often associated with increased efficiency and enhanced consumers' welfare. However, in the investment banking sector it is a more controversial issue. In the most developed markets such as US, there have been a numbers of hearings against investment banks based on anti-competitive conditions and actions exercised by these institutions. Policymakers are faced with the contrasting issues as to whether competitive forces are positively impacting on bank performance and efficiency or whether the consolidation wave poses a threat to competition in the sector. This in turn can have implications for the safety and soundness of the sector.

Using bank level balance sheet data for investment banks operating in advanced economies, this paper aims to provide evidence on the recent developments in

competition, concentration and bank-specific efficiency levels. In particular this study investigates the relationship between market power and efficiency and accounts for the possibility of a two-way causality between these two variables.

The analysis has highlighted that the investment banking markets worldwide are becoming progressively more concentrated and less cost efficient. However this is not the case for all the countries. The results show that national conditions still vary considerably across countries, and that we have an increase in concentration during the period of analysis with Italy as the only exception. On the average the SFA results indicate inefficiency scores of about 40%, a result that is higher compared with the main literature on commercial bank efficiency (see Goddard et al., 2007). More specifically we find a clear decrease in cost efficiency for East Asia & the Pacific and Europe over the period under study, while for the North American region we find evidence of an increase in cost efficiency levels.

Further, investment banks seem to have reduced their marginal costs faster than price falls and this led to an increase in the Lerner index thus suggesting greater market power. In all countries (apart from the Germany) the Lerner index is relatively high, thus indicating less competitive conditions, implying existence of colluding oligopoly. Results from H-Statistics lead to similar conclusions, generally indicating lack of competition in the market. These results differ from the current literature, which finds monopolistic competition the prevalent market structure in European countries (see, Molyneux *et al.*, 1994; Bikker and Haaf, 2002; Claessens and Laeven, 2004, Casu and Girardone 2006). However, earlier studies were from mainly commercial banking but not investment banking industry.

Our results of the causality running from market power to efficiency are insignificant and provide no statistical evidence that increases in market power lead to efficiency

increases.

On the other hand the reverse causality running from efficiency to market power is positive, and significant. Specifically higher cost efficiency in the investment banking sector is associated with higher market power, i.e. less competition in the market. Therefore, our findings find no evidence to support Hick's *quiet life* hypothesis as they indicate that an increase in banks' monopoly power does not translate into a decrease in cost efficiency. In contrast, it may have a positive effect on efficiency if it enables banks to operate at lower costs.

These findings imply that the relationship between market power and efficiency is not straightforward and that other factors (such as among others, risk incentives, regulatory framework and contestability) may influence both the magnitude and the direction of the relationship and therefore should be accounted for in future research in this area. This general implication is similar to the one found for commercial banks by Casu and Girardone 2009.

Finally our results suggest that a special focus should be given to the compensation issue in the investment banking industry and its implications on market power.

Chapter 5

Summary and concluding remarks

5.1 Summary

This thesis has presented three essays on investment bank efficiency and competition. These essays combine both theory and applied statistical work and contribute to the existing banking literature in various ways. Chapters 3 and 4 add to the investment banking literature by means of two empirical studies. The former examines the cost and profit efficiency for a sample of investment banks for the G7 countries (Canada, France, Germany, Italy, Japan, UK and US) and Switzerland prior to the recent financial crisis; while the latter investigates the relationship between market power and efficiency, and explores characteristics of competitive conditions in worldwide investment banking. Chapter 2 reviews the literature on investment banking and provides indication on the recent trends in the industry. In what follows, we summarize each chapter and discuss the main empirical findings of the thesis.

5.2 Concluding remarks

The thesis intends to provide an in-depth investigation of the investment banking industry focusing in particular on the efficiency and market structure, including concentration and competition. The empirical contribution of the thesis is to assess the factors that might impact investment bank efficiency (Chapter 3), and investigates causality between market power and efficiency in the industry (Chapter 4).

In particular can be disentangled in the following research questions:

RQ1: Are environmental influences including banks' risks, industry specific factors and macroeconomic conditions important to accurately assess cost and profit efficiency of investment banks?

In addition to this, as we are aware, there are no empirical evidences on efficiency of investment banks. This is due to the difficulties of modelling successfully the peculiar nature of their production process (variables identification), partially to the lack of good quality data, and to the need to accurately account for different environmental conditions in various countries. In order to give an innovative contribution to the existing literature we do not limit the analysis only for one country, rather we concentrate on cross country comparison. However, we also investigate efficiency differences among different organisational models. This led us to answer a second research question:

RQ2: Which type of the investment banks is the most efficient one?

In the 'great moderation' era, the investment banking industry in all advanced economies benefited from the processes of liberalisation, internationalisation and consolidation activities. Until the recent financial crisis investment banking has proved to be a highly competitive sector, bringing in high profit and high margin business. Recent crisis has raised many questions and concerns regarding the industry, and has led us to investigate conditions in which these banks operate. Furthermore, relationship between market power and efficiency became highly relevant research issue, especially for practitioners. This led us to answer a third and fourth research question:

RQ3: What kind of competitive conditions characterise the investment banking industry?

RQ4: Is there a causality relationship between market power and efficiency for investment banks?

In order to answer the first and the second research question we conduct a frontier analysis on the both cost and profit efficiency of the investment banking industries operating in the G7 countries (Canada, France, Germany, Italy, Japan, UK and US) and Switzerland. We choose to consider both cost and profit efficiency because investment banking is traditionally a revenue-motivated business and competitive pressure (e.g. due to deregulation and globalisation) put further pressure for the efficiency enhancement.

This study is one of the few focussing on the investment banking industry, which is surprisingly inadequately explored (e.g. Berger and Humphrey 1997, Berger 2007 and Hughes and Mester, 2008 do not cite any study on investment banks). This is due to the difficulties of modelling successfully the peculiar nature of their production process (variables identification) and partially to the lack of good quality data. Recent literature dealing with financial firms' performance suggests that sample heterogeneity can strongly bias efficiency estimates: given that we are comparing various countries, we have to consider this problem, incorporating in the model several firm specific factors. From a methodological point of view we employ Coelli et al. (1999)'s approach to adjust the estimated cost and profit efficiency scores for environmental influences, where there are two different ways for including environmental conditions or firms specific factors. In first model we assume that environmental conditions/firm specific factors have a direct influence on the production structure, while in second we use the environmental/firm specific for modelling the inefficiency distribution. In order to overcome data limitations and to successfully model the peculiar nature of the investment bank production process we choose a novel output definition that in our view better reflects the investment banks' main business as follows: total earning assets

and investment banking fees. We choose to consider both stock and flow variables as outputs (as in Altunbas, et. al 2001). The main motivation stems from the particular nature of the investment banking business as derived from their financial statements, and on the assumptions we make on the investment banks' production process.

Results are estimated for mean cost and profit efficiency levels in the three alternative models. In line with the (predominantly commercial) bank efficiency literature (see Berger and Mester, 1997 for a review, Maudos et al., 2002), the mean cost efficiency scores are on average higher than the profit ones in all models. Moreover, estimated efficiency scores also suggest marked differences in efficiency across the countries included in our sample.

Results show that, on average, the efficiency scores estimated using the base model are generally similar to those derived from Case I for both cost and profit. In contrast, Case II shows substantial differences in average values for all countries for both cost and profit efficiency. Furthermore on the profit side, it seems clear that average efficiency scores are consistently underestimated in the base model. Our results are consistent with Coelli et al. (1999) who found that Case I efficiency estimates are generally lower than those obtained under Case II and these differences are mostly explained by the way in which the environment variables are included in these models. We also agree with Coelli et al. (1999) in preferring the Case II estimates for two reasons: first, these estimates represent the outer boundary of the production possibility set; and second, gross efficiency measures obtained from Case II are the closest to the intuitive notion of efficiency being about converting physical inputs into physical outputs.

With reference to the first research question relative to the importance of environmental influences on efficiency analysis, we can conclude that evidence suggests that not accounting for environmental factors can considerably bias the efficiency scores of

investment banks. Specifically, our analysis indicates that profit efficiency estimates are consistently underestimated in the base model. Moreover, in comparing the results between Case I and Case II, we observe that the difference in average efficiency levels is around 1% on the cost side, while on the profit side the results diverge by almost 10 percentage points. The vast majority of the tested environmental factors in the two models were found statistically significant: for example we find strong evidence that by including bank risk-taking factors to assess the efficiency in a pre-crisis period, investment banks with a higher liquidity are penalized in the case of cost efficiency, but have an advantage in generating profits. Turning to bank and industry-specific factors, results are mixed on the relationship between inefficiencies, asset size and market concentration. While our evidence implies that size matters for both cost and profit efficiency, we find that this does not imply that more concentrated markets are more efficient. Finally, among the most significant results on the macro-factors, are that the general economic development of a country and the banks' level of openness contribute to reducing inefficiencies.

In order to answer the second research question, we conduct an empirical analysis on efficiency scores inside the investment banking industry, where we create a cluster sample for investment bank type. Accordingly we consider two basic types of investment banks: full-service and boutique.

On the cost side we find strong evidence in favour of full service investment banks which are more efficient, while in the profit case we have that boutique banks have higher efficiency scores. The results confirm theoretical assumptions where cost management for bigger banks needs to provide operational efficiency and to ensure that resources are used in the best possible way. Higher results for boutique investment banks on the profit side approve our expectation, where only way for these banks to

survive and remain competitive in this industry is specialization along certain business areas which would lead to maximization of profits.

With reference to the third and fourth research question, we are interested in investigating competitive conditions inside the investment banking and relationship between market power and efficiency as well as the possibility of a two-way causality. At this aim we consider bank level balance sheet data for investment banks worldwide, to provide evidence on the recent developments in concentration, competition and bank-specific efficiency in the industry.

We find only a handful of studies directly addressing the issue of the relationship between the competition and efficiency, and usually considering commercial banking. More recent studies include the evaluation measures at the firm level. For example, Maudos and Fernandez de Guevara (2007) examine the relationship between market power (proxied by the Lerner index) and cost efficiency and their results indicate the existence of a negative relationship between competition and cost efficiency in the European banking sectors.

In order to conduct analysis of the countries competitive conditions and regional efficiency level, first we use stochastic frontier approach to model cost efficiency, and second we investigates Lerner index of monopoly power to test the degree of the market power in the investment banking industry. To further comprehend competition pattern in the industry we use Panzar and Rosse model to assess the degree of competition in worldwide investment banking. Lastly, to investigate the relationship between market power and efficiency, we apply a causality test. Data used was obtained from balance sheet, income statement and annual reports data for the 15 countries over 2001-2008 periods. Following the established literature (Shaffer, 1993; Berg and Kim, 1994; Angelini and Cetorelli, 2003; and Fernandez de Guevara et al., 2005, Casu and

Girardone 2009) we use a single indicator of banking activity because of problems in the empirical estimations of separate prices for bank output using Bankscope data. The assumption is that the flow of banking goods and services produced by a bank is proportional to its total assets.

Estimates show that most countries have an increase in concentration during the period of analysis, with Italy being the only exception. On the average SFA methodology indicate inefficiency scores of about 40%, a result that is slightly different from the main literature on bank efficiency (see Goddard et al., 2007).

Measuring market power is fundamental to the analysis of bank competition: the lower the competition faced by a bank, the greater its market power, reflected by its ability to set price above marginal costs. The investment banking sectors in the Ireland and Italy seem to enjoy the lowest relative margin and Germany the highest. These results are opposite from those of Fernandez de Guevara and Maudos (2005), however it is necessary to bear in mind that most previous studies consider the whole banking sector whereas we concentrate on investment banks only. In all countries (apart from the Germany) the Lerner index is very high, thus suggesting less competitive conditions, implying existence of colluding oligopoly. Result from H:Statisitcs provide similar results as with Lerner, indicating colluding oligopoly as well. These results also differ from the current literature, which finds monopolistic competition the prevalent market structure in European countries (see, Molyneux *et al.*, 1994; Bikker and Haaf, 2002; Claessens and Laeven, 2004, Casu and Girardone 2006).

Furthermore, results of the causality running from market power to efficiency are inconclusive and provide no evidence that increases in market power lead to efficiency increases. The reverse causality running from efficiency to market power is significant and positive. When we have higher cost efficiency in the investment banking sector,

higher is the market power thus indicating less competition in the market. These findings imply that the relationship between market power and efficiency is not straightforward and that other factors (such as among others, risk incentives, regulatory framework and contestability) may influence both the magnitude and the direction of the relationship and therefore should be accounted for in future research in this area. Special focus should be given to the compensation issue in the investment banking industry and its implications on market power.

5.3 Future Research

The findings of this thesis not only contribute to the efficiency and competition in the investment banking literature in different respects, but they also outline possible avenues for future research.

In the light of the above considerations, and by considering that this study is not an end in itself, we suggest that: further studies must be considered in order to investigate the post 2008 investment banking crisis worldwide, and to analyze determinants of market power and competition in the industry (with special focus on regulatory compliance and standards). Lastly, based on our results special priority in new research studies should be given to the link between efficiency and/or market power with compensation packages in the investment banking industry.

Appendix

Figure 3.1

Cost and profit efficiency estimates (means)

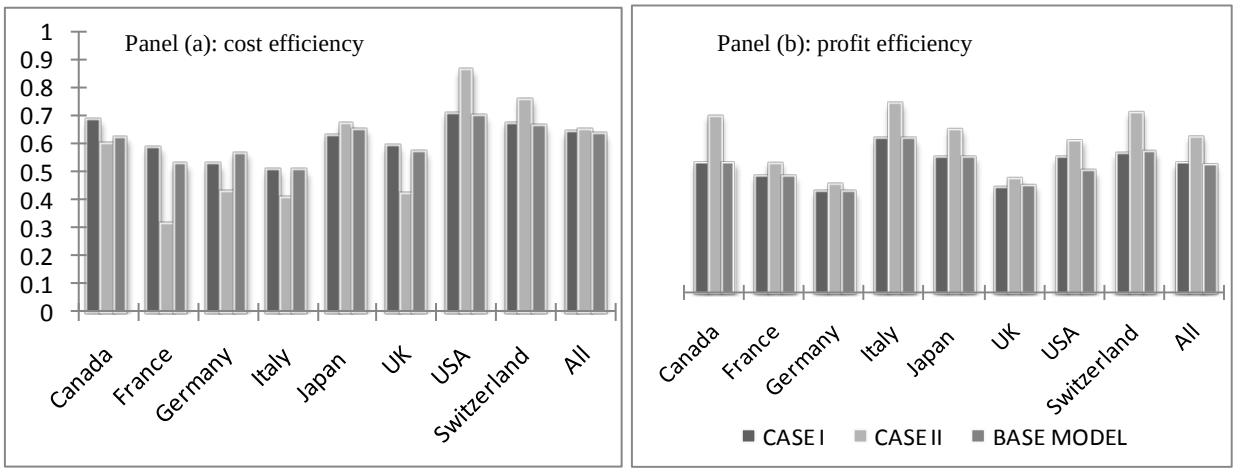


Table 3.A.1

Cost and profit efficiency scores by model and by country

Country	Base Model	Case I	Case II
Cost Efficiency			
Canada (16)	0.6183	0.6801	0.5965
France (30)	0.5245	0.5844	0.3131
Germany (55)	0.5658	0.5235	0.4307
Italy (25)	0.5021	0.5030	0.4062
Japan (114)	0.6494	0.6291	0.6665
UK (132)	0.5682	0.5877	0.4167
USA (111)	0.6956	0.7056	0.8602
Switzerland (317)	0.6588	0.6726	0.7565
Profit Efficiency			
Canada (16)	0.4559	0.4527	0.6205
France (30)	0.4089	0.4087	0.4559
Germany (55)	0.3537	0.3548	0.3809
Italy (25)	0.5362	0.5367	0.6624
Japan (114)	0.4742	0.4744	0.5728
UK (132)	0.3750	0.3650	0.3972
USA (111)	0.4241	0.4716	0.5345
Switzerland (317)	0.4918	0.4871	0.6319

Source: Authors' own elaboration on Bankscope data.

Table 4.B.1

Concentration Measures: Herfindahl-Hischman Index (HHI)

	2001	2002	2003	2004	2005	2006	2007	2008	2001-2008
HH Total Assets									
Australia	3263	3357	3596	5575	6664	6940	6104	6726	106.13%
Austria	4168	4003	3554	3610	3047	2977	3256	9232	121.50%
Canada	4380	4216	3527	3305	3136	2999	3107	5118	16.85%
France	2560	5052	4237	3769	6155	4532	4730	5668	121.41%
Germany	3730	3747	5810	5349	8209	7456	6890	6275	68.23%
Hong Kong	6509	2041	3334	4553	5031	1708	2149	4296	-34.00%
Ireland	2568	2479	3367	4417	5735	4745	5174	9438	267.52%
Italy	4280	5906	7999	4975	2295	1966	1786	3662	-14.44%
Japan	1733	1943	1838	1443	1212	1396	1440	2861	65.09%
Luxembourg	3812	3661	3696	5270	4510	2386	2297	3358	-11.91%
Netherland	4748	4111	5751	5489	7187	5785	7108	6792	43.05%
Sweden	6422	5095	5179	3319	2893	2737	2941	5635	-12.25%
Switzerland	1277	1189	4368	3906	6382	6342	5917	4305	237.12%
UK	2079	2177	2459	1283	1117	852	1051	2459	18.28%
USA	1438	1417	1547	1888	1878	2300	2500	3971	176.15%
HH Total Loans									
Australia	4730	4797	3459	5642	6189	6599	5975	6018	27.23%
Austria	4604	4984	6284	6767	4389	4894	4184	9770	112.21%
Canada	4069	3956	4161	3322	3865	3699	3633	5719	40.55%
France	8859	9995	8132	7886	9176	5632	6243	2666	-69.91%
Germany	3693	3285	3257	7193	6885	5831	5052	7994	116.46%
Hong Kong	4651	2414	4057	1475	1411	1511	2023	4892	5.18%
Ireland	2965	2824	4506	8139	4662	4603	3949	6896	132.58%
Italy	5967	7857	5666	5647	4139	2671	3167	3655	-38.75%
Japan	1979	2280	1093	3076	2314	1948	1523	2198	11.07%
Luxembourg	6093	3316	4005	4833	6506	4248	4425	9614	57.79%
Netherland	8669	6255	6207	5456	8066	7424	7713	9370	8.09%
Sweden	7575	7349	8036	5507	6346	5037	5496	8210	8.38%
Switzerland	1463	1283	5257	3998	4465	4430	4126	5274	260.49%
UK	2359	3569	5116	3025	2821	2772	2685	1828	-22.51%
USA	4768	3832	3525	3133	3091	3178	3457	3108	-34.82%

Source: Authors' own elaboration on Bankscope data.

	2001	2002	2003	2004	2005	2006	2007	2008	2001-2008
HH Total Securities									
Australia	5013	5000	5006	5600	7830	7385	6647	6719	34.03%
Austria	\	\	\	\	\	\	\	8928	\
Canada	6085	5350	4700	4469	4734	5109	5295	4580	-24.73%
France	9453	9982	9842	\	9983	7731	7364	4839	-48.81%
Germany	7168	7682	9407	5593	9786	9655	9608	9214	28.54%
Hong Kong	8036	2852	4707	7506	8728	4167	4993	6057	-24.63%
Ireland	2550	2413	3375	2670	2642	2817	3769	9800	284.31%
Italy	8877	9086	9221	5908	5900	5972	6939	3977	-55.20%
Japan	2445	2245	2243	1607	1384	1550	1435	2868	17.30%
Luxembourg	5694	8033	6158	9613	9316	8787	9171	9915	74.13%
Netherland	4290	3948	4935	8065	9313	9589	9278	5021	17.04%
Sweden	9391	4952	4282	3988	3136	6187	6241	6732	-28.31%
Switzerland	1733	2370	5296	4876	8541	8216	7914	3632	109.58%
UK	6184	7237	7348	2663	4067	2767	4618	3290	-46.80%
USA	1376	1331	1535	1882	1968	2396	2645	4231	207.49%
HH Total Funds									
Australia	3441	3419	3558	5492	6565	6917	6191	6584	91.34%
Austria	4478	4280	3769	3876	2961	2948	3301	9284	107.32%
Canada	4484	4337	3624	3514	3662	3450	3423	5405	20.54%
France	2924	5670	5311	6936	9083	1981	3374	4021	37.52%
Germany	3985	4085	6409	5363	8402	7694	7158	5982	50.11%
Hong Kong	3725	3261	3946	4879	6066	2253	3083	5044	35.41%
Ireland	2495	2365	3232	4649	3440	3564	4217	9507	281.04%
Italy	4439	5367	8595	5488	2973	2083	1865	3674	-17.23%
Japan	1833	2009	1879	1464	1263	1478	1492	2957	61.32%
Luxembourg	3913	3874	3853	5562	5377	2501	2435	9957	154.46%
Netherland	6756	5088	5724	6143	7904	6451	7559	6871	1.70%
Sweden	6445	5517	5585	3572	3210	2943	2994	5695	-11.64%
Switzerland	1449	1374	4297	3715	5877	5724	5203	4475	208.83%
UK	2510	2655	2851	1437	1370	1010	1234	2754	9.72%
USA	1516	1475	1627	1993	2013	2471	2704	4275	181.99%

Source: Authors' own elaboration on Bankscope data.

	2001	2002	2003	2004	2005	2006	2007	2008	2001-2008
HH Total Investment Banking Fees									
Australia	\	\	\	7310	7395	4331	4454	7903	8.11%
Austria	4136	3122	2957	3133	2651	2753	3013	\	-27.15%
Canada	\	\	\	6282	3894	4241	4385	3210	-48.90%
France	5028	4734	4533	1912	1926	1751	2662	5004	-0.48%
Germany	2554	2916	3264	2431	3168	2630	2685	10867	325.49%
Hong Kong	4800	5868	5476	1756	2436	2767	3111	5630	17.29%
Ireland	3743	3398	\	8477	5495	6085	6412	\	71.31%
Italy	3813	3545	5616	4194	3185	1827	1748	7471	95.93%
Japan	1118	1753	1491	1193	1183	907	2372	2743	145.35%
Luxembourg	7904	8045	6583	2736	2064	3540	3651	\	-53.81%
Netherland	2914	2739	2364	2754	2984	3054	3437	\	17.95%
Sweden	4193	3795	4875	3471	3319	3123	3582	\	-14.57%
Switzerland	542	587	3564	3313	5122	5547	4864	2952	444.65%
UK	2549	1805	2091	1076	884	743	915	\	-64.10%
USA	1366	1309	1350	1438	1513	1809	3955	\	189.53%
HH Total Off-Balance Sheet Items									
Australia	4082	3419	4296	4741	4370	3565	4402	5216	27.78%
Austria	4244	3105	2681	2604	3909	3370	6181	8971	111.38%
Canada	\	\	\	\	\	\	\	\	\
France	5688	8304	4673	8777	4833	8712	9107	7329	28.85%
Germany	3005	5025	2458	5060	4710	4667	5717	\	90.25%
Hong Kong	7962	4088	5011	4108	4100	3660	4839	9738	22.31%
Ireland	8523	8670	\	9291	7835	8760	9206	\	8.01%
Italy	7991	7959	5079	4282	5035	7948	4669	7913	-0.98%
Japan	\	\	\	\	\	\	\	\	\
Luxembourg	4765	3988	3917	3591	5991	5795	6284	9777	105.18%
Netherland	6417	7300	8010	5589	6234	8501	9052	7700	19.99%
Sweden	6701	8214	8847	9859	4610	4362	6726	8008	19.50%
Switzerland	4357	5411	9220	4758	8958	9203	9451	9224	111.71%
UK	1978	8630	9237	5483	6369	5957	8507	8373	323.31%
USA	4826	5057	3830	3792	4704	5737	7816	7686	59.26%

Source: Authors' own elaboration on Bankscope data.

Figure 4.A.1

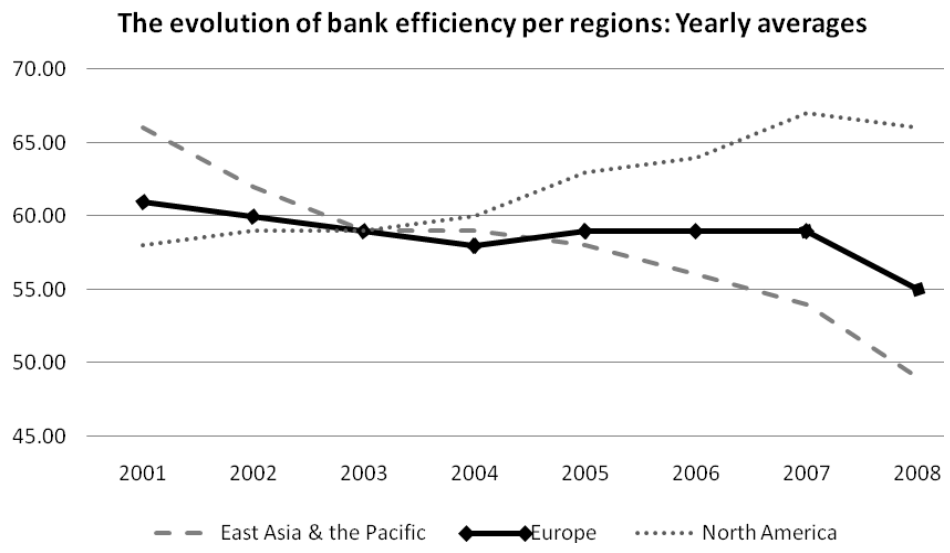

The evolution of bank efficiency per regions: Yearly averages
70.00
65.00
60.00
55.00
50.00
45.00
2001
2002
2003
2004
2005
2006
2007
2008
East Asia & the Pacific
Europe
North America

Table 4.B.2

Lerner Index and Marginal Cost per countries

Country	Mean	Std. Dev.	Min.	Max.
Australia (n=49) Lerner Index	0.8882	0.1006	0.4515	0.9608
Australia (n=49) Marginal Cost	0.0948	0.0948	0.0293	0.5282
Austria (n=33) Lerner Index	0.9084	0.0311	0.8379	0.9674
Austria (n=33) Marginal Cost	0.0759	0.0284	0.0234	0.1417
Canada (n=41) Lerner Index	0.9046	0.0721	0.6043	0.9818
Canada (n=41) Marginal Cost	0.0819	0.0674	0.0140	0.3669
France (n=74) Lerner Index	0.8957	0.1517	0.1590	0.9935
France (n=74) Marginal Cost	0.0955	0.1596	0.0047	0.8949
Germany (n=99) Lerner Index	0.7923	0.2153	0.1248	0.9917
Germany (n=99) Marginal Cost	0.1913	0.2136	0.0061	0.8881
Hong Kong (n=87) Lerner Index	0.8901	0.1258	0.2793	0.9979
Hong Kong (n=87) Marginal Cost	0.0921	0.1150	0.0013	0.6702
Ireland (n=43) Lerner Index	0.9457	0.0268	0.8753	0.9903
Ireland (n=43) Marginal Cost	0.0429	0.0214	0.0072	0.0906
Italy (n=51) Lerner Index	0.9369	0.0454	0.7347	0.9988
Italy (n=51) Marginal Cost	0.0543	0.0438	0.0009	0.2505
Japan (n=169) Lerner Index	0.9078	0.0823	0.6332	0.9983
Japan (n=169) Marginal Cost	0.0799	0.0751	0.0011	0.3458
Luxembourg (n=61) Lerner Index	0.8831	0.1706	0.2147	0.9903
Luxembourg (n=61) Marginal Cost	0.1045	0.1634	0.0077	0.7529
Netherland (n=39) Lerner Index	0.9022	0.0458	0.7943	0.9646
Netherland (n=39) Marginal Cost	0.0830	0.0425	0.0281	0.1773
Sweden (n=51) Lerner Index	0.8619	0.0926	0.6108	0.9711
Sweden (n=51) Marginal Cost	0.1202	0.0850	0.0234	0.3633
Switzerland (n=349) Lerner Index	0.9014	0.0762	0.1306	0.9871
Switzerland (n=349) Marginal Cost	0.0832	0.0736	0.0098	0.8692
UK (n=273) Lerner Index	0.9111	0.1108	0.3244	0.9974
UK (n=273) Marginal Cost	0.0770	0.1052	0.0017	0.6690
USA (n=190) Lerner Index	0.8615	0.1324	0.3367	0.9886
USA (n=190) Marginal Cost	0.1260	0.1292	0.0072	0.6483

Source: Authors' own elaboration on Bankscope data.

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