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# **Performance Analysis of the German Banking Sector before and throughout the recent Financial Crisis 2001-2015**

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## Abstract

This dissertation was written as part of the Executive MBA at the International Hellenic University.

The aim of this study is twofold. On the one hand, it describes, using ratio analysis, certain aspects of the German Banking system, over the period 2001-2015, and on the other hand, it examines, the determinants of bank profitability (for all types of German banks) over the aforementioned period. A unique feature of the German banking system has to do with its “three-pillared” structure, as it comprises of three types of banking institutions, namely (a) private commercial banks, (b) savings banks, and (c) cooperative banks.

Despite the onset of the recent fiscal crisis of 2007/2008, and the somewhat significant decline in the banks’ efficiency (captured by a rising cost-to-income ratio), the profitability of the German Banking system remained almost intact, as it was reflected by Return on (Average) Assets. ROA and was not severely affected, as the annual average decline over the period under examination was a mere 0.91%. In addition, the German banking system came out of crisis with a larger capital adequacy, as the relevant ratio increased over the period under examination, and a higher liquidity, as this is captured by the ratio of bank credit to total deposits.

To measure bank performance, this study makes use of the banks’ Return on Equity (ROE) on a pretax basis. The empirical evidence showed that banking factors such as liquidity risk (ratio of bank credit to bank deposits), capital adequacy (ratio of bank capital to total assets), efficiency (ratio of operating income to cost), and the 5-bank concentration ratio have a positive effect on bank profitability.

Finally, I want to thank my supervisors, Dr. Stergios Leventis and Dr. Christos Grose, for their orientation and correspondence to all my questions. I am grateful to those people whose sapience and inspiration supported me during the writing of this study and I would like to acknowledge the hospitality of all the personnel of the International Hellenic University. At the end, I am grateful for my family’s financial support and encouragement throughout my studies and for giving me the opportunity to gain these experiences.

Keywords: Germany, Banking Sector, Return on Equity, Bank Profitability.

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# 1. INTRODUCTION

## 1.1 BACKGROUND TO THE STUDY

At the onset a distinction must be made between the terms “financial sector” and “financial system”. Initially, the financial sector comprises the financial institutions of a country, whereas the financial system describes the interactions between the financial sector, being a supplier of financial services, and the ‘real economy’, being the buyer of these services<sup>1</sup>. Financial systems are usually classified as being either bank-based or capital-market-based. Germany, along with Japan, is considered as the prototype of a country with a bank-based financial system (e.g. Allen and Gale 2001).

A distinctive characteristic of the German financial system is that the banking system prevails over the capital markets. Indeed, compared to the US, German firms are largely financed by the banking sector, while households hold a larger share of their financial wealth in the form of bank deposits (Detzer *et al.* 2014). As a result, the German capital markets exhibit a relatively small number of listed companies and own the virtue of a low stock and bond market capitalization, considered, consequently, as less developed.

German banks play a significant role not only in the German financial sector, but even in the entire international financial system. The German banking system is based on three pillars, i.e. three several types of banking institutions (or groups of banks), like (a) the large commercial banks, (b) the savings-group banks, and (c) the cooperative-group banks<sup>2</sup> (Behr and Schmidt, 2015). The first category of banks is more profit-oriented compared to the banks in the other two categories.

The Financial Crisis 2007/08, which began in the US, stabilized a trend, which had been unfolding since the 1990s, namely the financial markets liberalization, characterized by rapidly growing interbank and capital markets. Specifically, in the wake of the Lehman Brothers failure in September 2008 banks started facing a high liquidity risk, as it became more difficult and more expensive for banks to obtain funding from the interbank market.

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<sup>1</sup> See Schmidt and Tyrell (2004) on the importance of this terminological distinction

<sup>2</sup> The German banking system includes also an additional, “fourth pillar, namely that of ‘other banks’

Even though the German banking system was highly exposed to US assets (Detzer, 2014), the impact of the fiscal crisis on the country's financial system, which is predominantly bank-based, was not severe enough to lead to a credit crunch, thereby aggravating the crisis in Germany's real economy. This observation is rather interesting, particularly if we take into consideration the magnitude of the asset write-off, undertaken by the large German financial institutions (banks and insurance companies) throughout the financial crisis. In a detailed review, Detzer (2014) states that German financial institutions were forced to write off assets valued at €102 billion, for a period stretching from 2007 to 2009:08. This figure proves quite significant, especially if we compare it with total capital reserves of German banks (€428 billion at the end of 2007) and insurance companies (€284 billion for the same period) (Detzer,2014).

## **1.2 AIM AND IMPORTANCE OF THE STUDY**

### **1.2.1 The Aim of the Study**

The aim of the study is to assess the effect of the 2007/2008 financial crisis (henceforth "financial crisis") on the performance of the German banking sector, over the period 2001-2015. Two approaches shall be used to assess the performance of the German banking sector during the aforementioned period. The first, and more descriptive approach, shall examine the effect of the recent financial crisis on the three types of banking institutions using some performance indicators, such as the return on equity, the cost-income ratio, and lastly, interest margins.

Under the second, econometric approach, the determinants of German bank profitability will be detected. The literature on the determinants of bank sector profitability is vast and is divided into two broad categories. The first category involves empirical studies focusing on the determinants of bank profitability in specific countries, while the second group of studies makes use of panel data of countries. Some examples of the first group of studies involve those of Angbazo (1997) for US, Alexiou and Sofoklis, (2009) for Greece, Horvath (2009) for Czech Republic, Kupid et al., (2011) for Croatia and others. Examples of studies that have made use of panel data to examine the determinants of bank profitability are those of Molyneux and Thornton (1992), who investigated bank profitability in 18

European countries over the period 1986- 1989, and Goddard et.al (2004), who analyzed the bank profitability in 6 European countries over the period 1992- 1998.

So, within the framework of the first strand of analysis, performance of the German banking sector will be regressed against, a time-varying concentration ratio, its market share, several bank-specific variables, and a dummy variable envisaging the effect of the crisis on bank profitability. To assess bank performance, we shall rely on bank profitability measures, such as the bank's Return on Assets (ROA), or the bank's Return on Equity (ROE).

Also, under the same approach, every bank's revenues, as presented by the ratio of Interest Income to Total Earning Assets, will be regressed against the ratios (a) of personnel expenses to total assets; (b) of equity to fixed assets; and lastly (c) of interest expenses to overall funding. Additionally, a column vector of control variables will be included, comprising the following variables; (a) the ratio of loan-loss provisions to total assets, used as a proxy of credit risk (b) the natural logarithm of total assets, in an effort to control for the size effect on bank revenues, and (c) the GDP growth rate. As it was demonstrated by Panzar and Rosse (1987), differences regarding the market structure imply different constraints on the sum of input elasticities of this model.

At this point we need to stress that under the econometric approach, our sample will be limited to private banks. The exclusion of savings and cooperative banks is justified by their contradicting performance during the financial crisis. These banks' performance remained quite intact, whereas some of them even managed to record profits, during the turbulent period (Behr and Schmidt, 2015). Simultaneously, some important private German banks, like the two specialized private banks, Hypo Real Estate (HRE) and Industrie-Kreditbank (IKB) and the two 'big banks' Deutsche Bank and Commerzbank, were severely hit by the global fiscal crisis (Behr and Schmidt, 2015).

So, the research hypotheses (RH) that shall be tested in this dissertation are the following:

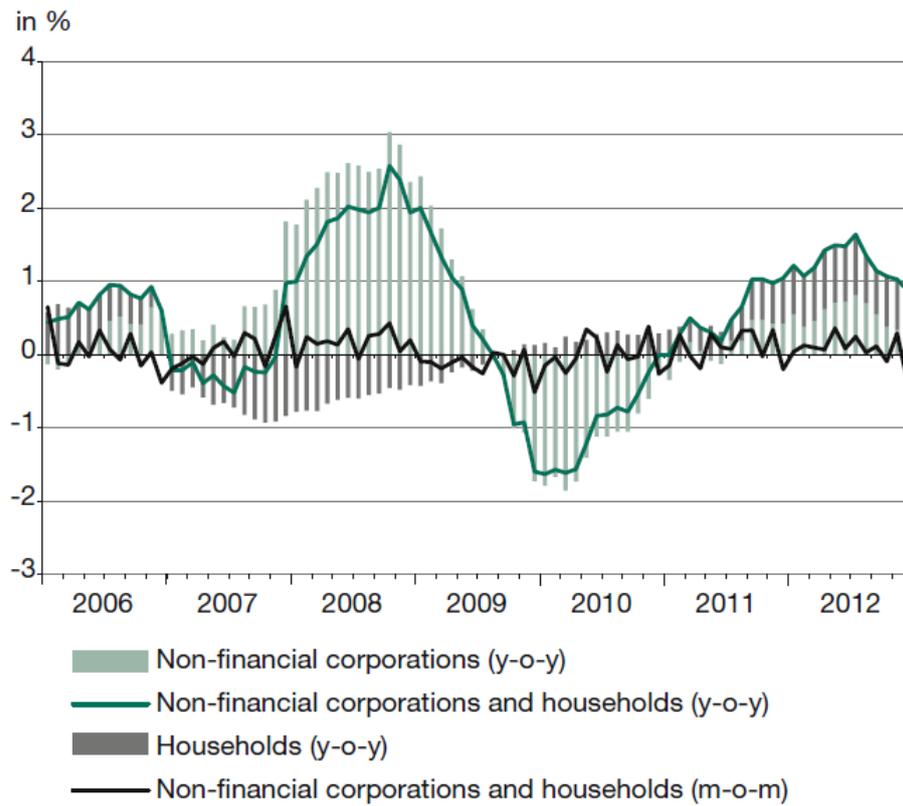
- RH 1: The domestic credit granted in the economy is positively related to banks' profitability. Goddard et.al (2004), in their study, used domestic credit as a control variable for the determination of bank profitability, in 6 European countries over the period 1992- 1998.
- RH 2: The liquidity risk in the banking system (proxied by the ratio of loans to customer deposits) is positively associated with bank profitability. This ratio has

been used, as an explanatory variable of bank profitability, in the studies of Horvath (2009) and Kundid et al., (2011).

- RH 3: The more capitalized the banking institution, (i.e. the higher its capital relative to assets), the higher its profitability. Studies suggested (see for example Kosmidou et al (2005), Flamini et al (2009)) a positive effect of bank capital on bank profitability. However, other studies (Asthanosoglou et al (2006) in the case of South Eastern European banks) have documented the opposite empirical finding, namely, an inverse relationship between bank equity capital and bank profitability.
- RH 4: The less efficient the banking institution (in terms of managing its costs relative to its revenues), the lower its profitability. A relevant metric that captures the degree of bank efficiency, is the ratio of cost to income (see ECB (2010)). The relationship between bank profitability and efficiency has been a popular issue in relevant literature. A positive relationship is expected to exist between the aforementioned variables (see Akbas, 2012).

### 1.2.2 The Importance of the Study

The importance of the topic stems from the fact that, since most German firms are financed by bank credit, the effect of the fiscal crisis on Germany's banking sector could easily spill over to the real economy, should a credit-flow restriction on the private sector takes hold, in the wake of the crisis. Indeed, as Figure 1-1 shows, bank credit growth to Germany's non-financial private sector (i.e. non-financial corporations and households) was quite dynamic, lasting until November 2008, when it was heavily disrupted. In fact, as of January 2009, the growth of bank credit was negative, and it was not until December 2010, that it bounced back to a positive growth rate.



**Figure 1-1:** Bank Credit Growth to the Domestic Non-Financial Sector, Germany

Source: Bundesbank

### **1.3 STRUCTURE OF THE STUDY**

The rest of the dissertation is organized as follows. Chapter 2 presents some main facts concerning the German banking system. German firms financing is mostly relied upon the banking sector, and households hold a larger share of their financial wealth in the form of bank deposits, compared to US counterparts. As a result, the German capital markets, based on their, relatively small, number of listed companies and low stock and bond market capitalization, became less developed. Section 3 present the literature review. Section 4 presents the econometric model that will be employed to assess the effect of the fiscal crisis on bank performance. Section 5 presents the empirical results of the study, and finally Section 6 concludes the dissertation.

## 2. THE GERMAN BANKING SYSTEM

This Chapter begins with the presentation of the “three-pillared” nature of the German banking system, comprising of three separate groups of banks (Section 2.1).

Then, since any bank-business model can be analyzed along the structure of liabilities and assets (see Deutsche Bundesbank, 2015), these dimensions are discussed in terms of the German banking system (Section 2.2). Next, since the bank’s business activities have a major bearing on its earnings structure, the latter is the second dimension; put differently it is possible to differentiate between bank-business models in terms of their profitability and risk profile, and the impact of a fiscal crisis (Section 2.3). The third dimension is the institution’s legal form, which can largely dictate an individual bank’s size, the number of similarly structured institutions and branches as well as the density of the branch network (not discussed in this dissertation).

### 2.1 THE STRUCTURE OF THE GERMAN BANKING SECTOR

As it has already been pointed out, a unique feature of the German banking sector is its “three-pillar” structure, comprised of (a) private commercial banks, (b) savings banks, and (c) the cooperative banks; strictly speaking, there is an additional pillar, namely that of ‘other banks’ (see Table 2-1).

**Table 2-1:** The Structure (“Four Pillars”) of the German Banking System

<b>A. Private Commercial Banks</b>	<b>B. Savings-Banks Group</b>	<b>C. Cooperative- Banks Group</b>	<b>D. Special Banks</b>
A1. Big Banks	B1. Primary Savings Banks (“Sparkasen”)	C1. Primary Co-operative banks	D.1 Realkredit.
A2. Regional Banks	B2. Landensbanken	C2. Regional Institutions	D2. Bausparkassen
A3. Branches of Foreign Banks			D3. Banks with Special Tasks

Source: Deutsche Bundesbank

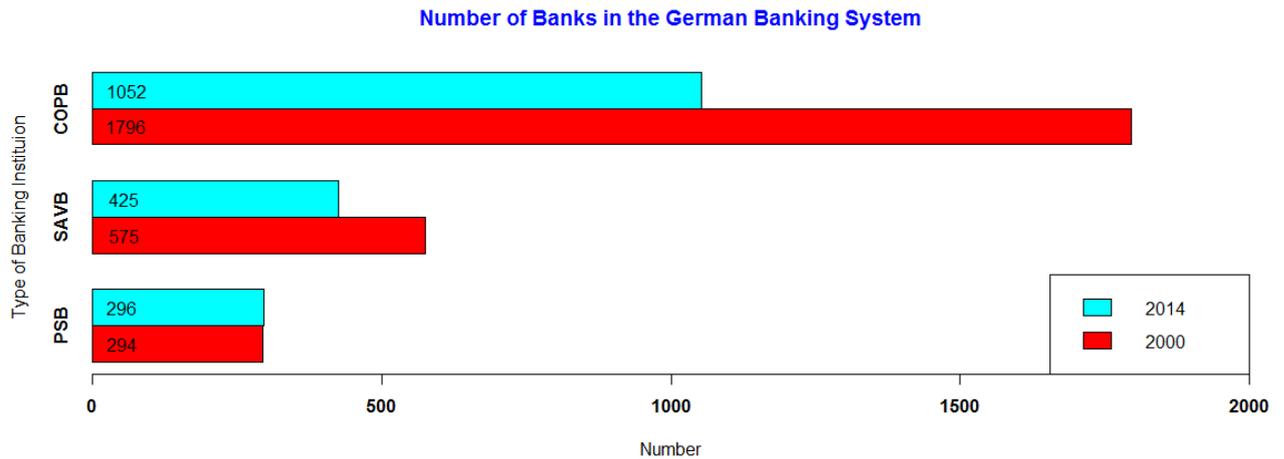
Private sector banks (Pillar 1), having a private-ownership structure, are profit-oriented. By contrast, the banks in the second and the third pillar are not profit oriented, as the task of

the primary institutions in the savings-banks group (Pillar 2) and the cooperative- banks group (Pillar 3) is that of providing “financial services to the public and acting as house banks to German small and medium-sized companies” (Detzer, 2014). The institutions that belong to the two aforementioned groups, adopt the generally accepted ‘regional principle’. This principle is translated in geographical concentration of their business activities, and simultaneously, in loose competition among counterparts. These institutions cooperate rather than compete in the market.

An overview of the basic characteristics of Germany’s banking system, in 2000 and 2014, is provided in what follows.

To begin with, Figure 2-1 presents the absolute number of institutions, in each pillar, for the years 2000 and 2014. The figure 2-1 indicates that in year 2000, the German Banking system consisted of 294 private commercial banks, 575 saving-group banks, and 1.796 cooperative-group banks. Fourteen years later, in year 2014, the German Banking system consisted of almost the same number of private commercial banks (296), less saving-group banks (425), and significantly less cooperative-group banks (1,052).

Deductively, in 2000 there were 2,700 banking institutions in total. The second and third pillar aggregate (savings and cooperative-group banks) accounted for about 86% (=2371/2740) of total banking institutions in the German banking system, while private commercial banks accounted for only 10% (=294/2740). Fourteen years later, the total number of German banking institutions dropped sharply to 1,830 and consequently the percentage of banks falling into the second and third pillar fell to about 81% (=1477/2740) of total banking institutions, while that of private commercial banks increased to 16% (=296/2740) of total banking institutions.



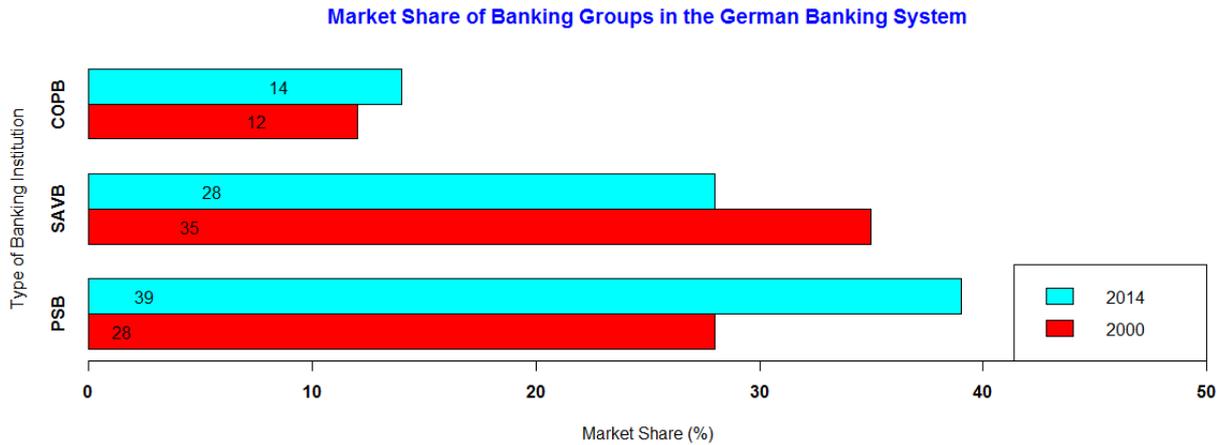
**Figure 2-1:** Number of Banks by Banking Group, 2000 and 2014

Note: PSB= Private Sector Banks, SAVB= Savings Banks, COPB= Co-operative Banks. The total number of banking institutions was 2,700 in 2000 and 1.830 in 2014.

Source: Deutsche Bundesbank (for the data)

Then, Figure 2-2 presents the market share, in terms of the value total assets, of each banking group in 2000 and 2014. In 2000, the 294 private commercial banks controlled 28% of banking-sector assets, that is, each private commercial bank controlled, on average 0.10% of total German banking assets, while in 2014, the 296 private commercial banks controlled 39% of banking-sector assets; hence the group increased its grip on banking-sector assets by about 40%, each private commercial bank controlled, on average 0.13% of total German banking assets.

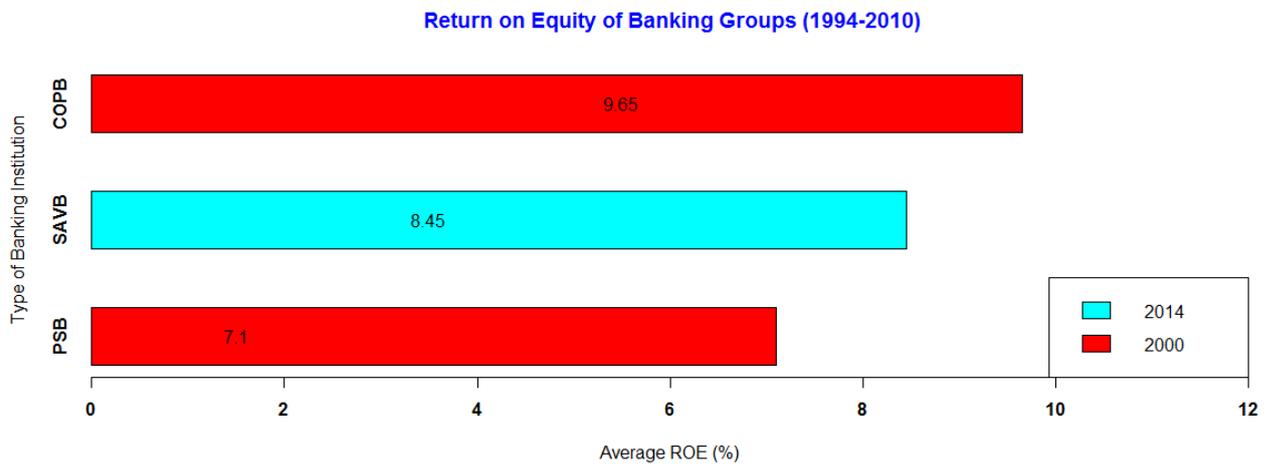
When it comes to the savings-group banks, in 2000, the 575 financial institutions of this category had under their control 35% of banking-sector assets, while in 2014, the by-then 425 banks of the group controlled 28% of banking-sector assets. So, hence this group of banks reduced its control over total bank assets by 20%, each bank in the savings-banks group controlled, on average, 0.07% of total German banking assets. Finally, as far as the co-operative-group banks is concerned, in 2000, the 1,726 co-operative banks held 12 % of total German banking-sector assets, while in 2014, there were 1,052 banks in that group controlling 14% of banking-sector assets. So, in total the third-pillar banks increased their markets over total bank assets by about 17%, while each co-operative bank controlled, on average, 0.01% of total German banking assets.



**Figure 2-2:** Market Share (in terms of Total Assets) of Banks by Banking Group, 2000 and 2014

Note: PSB= Private Sector Banks, SAVB= Savings Banks, COPB= Co-operative Banks,  
 Source: Deutsche Bundesbank

Figure 2-3 depicts average profitability, in terms of the average Return on Equity (ROE), of each banking group over the period 1994- 2010. Over the aforementioned period, the average, pre-tax ROE was 7.1% for private commercial banks, 8.45% for the Saving-Banks group, and 9.65% for the co-operative banks group. Within, the Savings-Banks group, the average pre-tax ROE of the primary savings banks was 12.8%, while that of the Landesbanken just a mere 4.1%.



**Figure 2-3:** Profitability by Banking Group, 2000 and 2014

Note: PSB= Private Sector Banks, SAVB= Savings Banks, COPB= Co-operative Banks,  
 Source: Deutsche Bundesbank

### 2.1.1 The Private Commercial Banks

Private commercial banks, in Germany, consist of (a) the Big (Four) Banks, (b) the Regional Banks, and (c) Branches of Foreign Banks (Behr and Schmidt, 2015) (see Table 2-1).

#### *The Big Four Banks*

Four big German banks, namely Deutsche Bank, Commerzbank, UniCredit, and Postbank prevail in the first pillar of the national banking system. These banks operate an abundance of branch networks and offer all types of banking services to a wide spectrum of clients in Germany and worldwide. (Behr and Schmidt, 2015)

Until the onset of the recent crisis, there were five (and not four) Big Banks, which dominated the German system, namely Commerzbank, Dresdner Bank, Deutsche Bank, Deutsche Postbank AG and HypoVereinsbank (IMF, 2011). Then during the fiscal crisis, the Big Banks came on the brink of bankruptcy only to be rescued by the state's intervention. Specifically, the German government created in October 2008 a rescue scheme, by the name Sonderfonds Finanzmarktstabilisierung (SoFFin), which raised about 480 billion euros (that is, around 9.1% of German GDP) to bail out the German banking system. Eventually, Dresdner Bank and Deutsche Postbank AG were absorbed by Commerzbank, in which the German State holds 17%, and Deutsche Bank, respectively.

These institutions adopt an international orientation in business activities and engage in numerous transactions in international capital markets. They are considered to be strong profit seekers. Traditionally, the Big Banks acted as the main banking partners of Germany's major industrial enterprises (Deutsche Bundesbank 2015), providing them with long-term credit for investment. Interestingly these close ties materialized in cross-shareholdings and supervisory board seats. This phenomenon altered when the big banks' business model came under pressure in the late 1970s. Consequently, they gradually moved into investment banking and trading activities reducing, simultaneously, their links to the industrial sector. The rest of the private banking sector consists of regional banks or branches of foreign banks.

### *Regional Banks and Foreign Subsidiaries*

Many institutions falling within the first pillar of the German banking system are regional banks and other commercial banks. These are comparatively smaller in size (Deutsche Bundesbank 2015). Their operations are geographically concentrated and focused on household and non-financial corporation lending. Capital adequacy is secured via a large depositor base. Hence, their business models resemble that of savings banks and credit cooperatives. As already pointed out, competition is loose between savings banks and credit cooperatives; this characteristic derives from their regional focus.

Lastly, this category of private commercial banks also includes Germany-based subsidiaries of international banks, adding up to the heterogeneous character of the grouping.

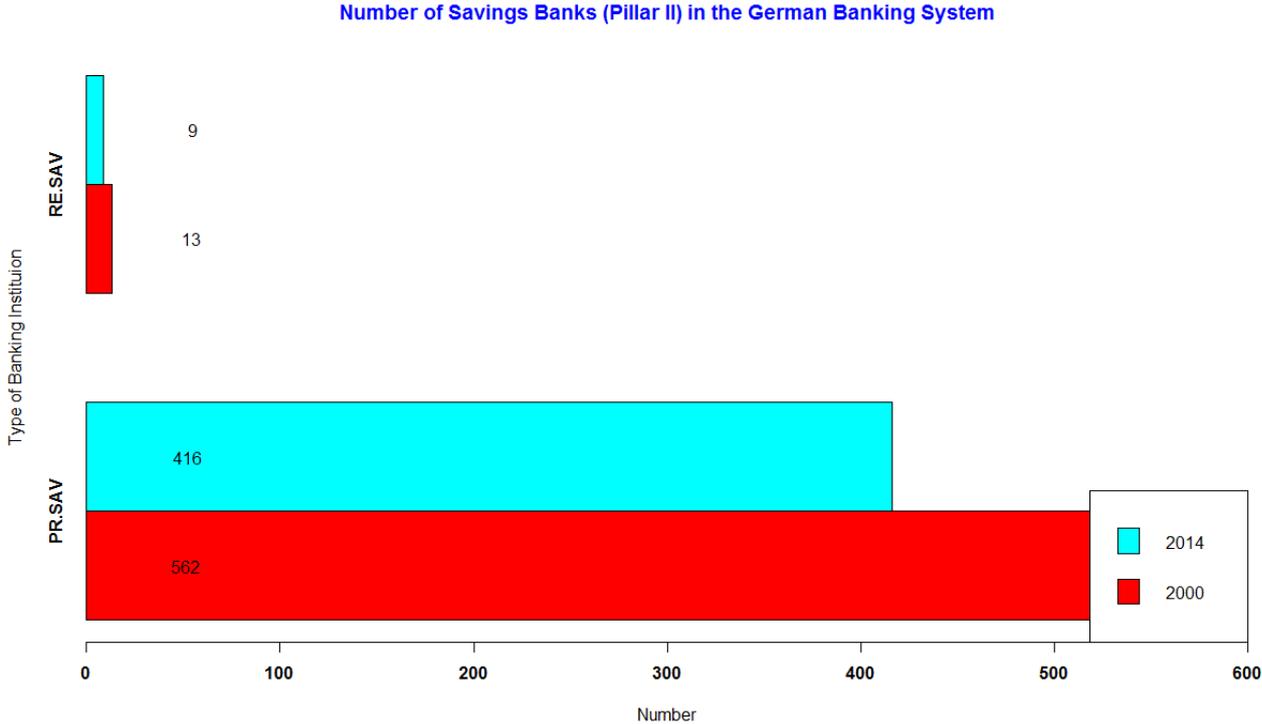
#### 2.1.2 The Savings-Banks Group

The second pillar of the German banking system involves the savings-bank group, which consists of (a) the primary savings banks, called “Sparkassen”; and (b) the regional banks called “Landesbanken”; these banks are primarily owned by the public savings banks (Deutsche Bundesbank, 2015). In 2014, the savings-group banks consisted of 416 entities (legally independent) whereas the regional Landesbanken numbered 9 entities (see Fig. 2-4).

The primary savings banks are municipally, or county controlled. Their founding objective is to act in favor of the public interest. This objective moderate profit seeking, nonetheless loss making remains quite unacceptable. These institutions promote local cultural, social and economic development (see Hakenes et al. (2015)).

Indeed, it has been documented (see for example Behr et al. (2013)) that the lending practices of the German savings banks have contributed to the reduction of financial constraints, which Small and Medium-Size (SMEs) face in Germany. Further, there is no evidence that savings banks underperform their privately-owned peers of the first-pillar banks (Behr et al. 2013). Finally, it needs to be emphasized that German savings banks seem to follow, relatively, less cyclical lending practices (Behr et al.,2015), that is, they tend to reduce lending in bullish conditions of the business cycle and step it up in the bearish equivalents.

As, it was pointed out (see Fig. 2-2), the entire savings-group, in terms of aggregate total assets, is less that of the private commercial banks, while the respective total assets of the local savings banks and the Landesbanken are almost equivalent. Indicatively, in 2000, the 562 primary savings banks (see Fig. 2-4) had under their control 16% (see Fig. 2-5) of banking-sector assets, while in 2014, the 461 banks of the group controlled 14% of banking-sector assets. On average, each primary savings bank controlled 0.03% (=16%/562) of total German banking assets in 2000 and 2014. When it comes to the Landesbanken, 13 of them in 2000 controlled 20% of banking-sector assets in that year, and the 9 such banks in 2014 controlled 14% of banking-sector assets. On average, therefore, each Landesbank controlled 1.5% of total German banking assets in 2000 and 1.56% in 2014.



**Figure 2-4:**Number of Banks in the Savings-Banks Group, 2000 and 2014

Note: PR.SAV= Primary Savings Banks, RE.SAV=Regional Savings Banks (Landesbanken)  
 Source: Deutsche Bundesbank

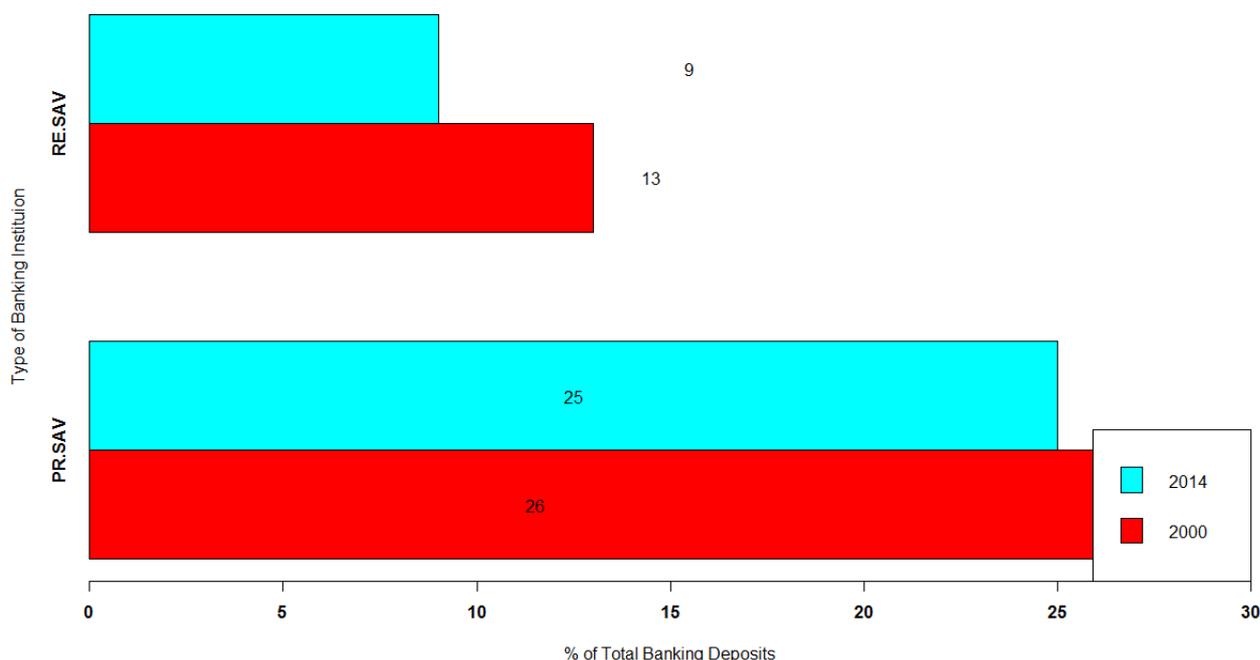


**Figure 2-5:**Market Share, in terms of Total Banking Assets, of Banks in the Saving-Group, 2000 and 2014

Note: PR.SAV= Primary Savings Banks, RE.SAV=Regional Savings Banks (Landesbanken)  
 Source: Deutsche Bundesbank

In terms of bank deposits, in 2000, the 562 primary savings banks held 26% of banking-sector assets, and in 2014, the 461 banks of the group still controlled the same volume (25%) of banking-sector deposit (see Fig. 2-6). When it comes to the Landesbanken, 13 of them in 2000 controlled 13% of banking-sector deposits in that year, and the 9 such banks in 2014 controlled 9% of banking-sector deposits.

Market Share (in terms of Deposits) of Savings Banks (Pillar II)



**Figure 2-6:** Market Share, in terms of Total Bank Deposits, of Banks in the Saving-Group, 2000 and 2014

Note: PR.SAV= Primary Savings Banks, RE.SAV=Regional Savings Banks (Landesbanken)  
Source: Deutsche Bundesbank

In 2001, the EU ruled that state guarantees provided to public banks (Anstaltslast and Gewährträgerhaftung) are illegal, impeding healthy competition. In 2001-2, an agreement was reached between the German government, the public-sector banks and the EU; as a result, the German law adjusted, and some 600 public banks spent a transitional period until the guarantees were abolished.

The public banking sector held, through this pillar 28% of the total assets of Germany's banking sector in 2014 (see Fig. 2-2). The sector is organized horizontally (spatially) and vertically, as municipalities and local authorities control the local "Sparkassen", while the regions, Länder, control the Landesbanken. Other public institutions control development banks (Förderbanken), like for example the KfW development bank, which constitutes the main pillar of the country's development activity.

## *The Landesbanken*

The Landesbanken are the central credit institutions of the system's second pillar, and they perform transactions which the primary savings banks themselves cannot, because they are either too small, or operate only in each region.

As an implication of the role described above, these banks play a vital role in wholesale banking and capital market businesses, contending an equal role with large private commercial banks, first and foremost the big banks. Local institutions of credit cooperatives, surpass the Landesbanken in redistributing liquidity among the associated primary institutions. Consequently, they operate mainly in the interbank and capital market.

The Landesbanken are established on a dual objective. Firstly, they offer banking services to regional authorities. Secondly, they act as central institutions for the savings banks in their prefectures. Additionally, they offer a wide range of commercial and investment banking activities.

Almost all local savings banks are governed by public law. They are closely affiliated with the public bodies administering the local area in which they function. Their operations are legitimately restricted to local level. County and municipal authorities have no ownership rights in Landesbanken, at the same time they act as owner-like supporting institutions.

In most cases, the mayor or the political head of a county is the chairperson of a savings bank's administrative council. Formerly, a supporting entity had the formal responsibility to assure the functioning of 'its' savings bank (the so-called maintenance obligation) and to guarantee all obligations of a savings bank (the so-called guarantee obligation). These public guarantees were abolished in 2005, based on an agreement between the German Government and the EU Commission, as already discussed previously. This agreement was reached in 2001 after the Association of Private Banks had filed a complaint against the public banks, arguing that these forms of public support were incompatible with the EU rules concerning state aid and EU competition laws; for details see Schmidt (2009). However, as far as savings banks are concerned, these guarantees were never invoked after World War II.

Even though local authorities play a vital role in Landesbank functions, they are not normally entitled to declare any share of their profits. Landesbanks retain the largest portion of their profits either to secure their capital base, or to finance public welfare projects. This is consistent to the savings bank main objective, namely the assistance of local population and authorities towards a developing local economy, neglecting, if necessary, profit seeking. Nevertheless, they are obliged to function effectively and in a prosperous manner.

### 2.1.3 The Cooperative Banking Group

The structure of the cooperative banking sector resembles the savings bank counterpart. In 2014, the sector consisted of 1,050 primary cooperative banks, 2 regional institutions and a range of specialized institutions at the national level.

These types of banks comprise the third pillar of the German banking system. Cooperative banks possess an incremented degree of independency. In terms of size, this grouping represents about half the size of the two other pillars; if the criterion of total assets is applied. The cooperative banking group is composed of two parts: the local cooperative banks and the central financial and non-financial institutions of the group.

The cooperative banks also adopt a dual mission: they must support the economic undertakings of their customers and at the same time operate as sustainable businesses.

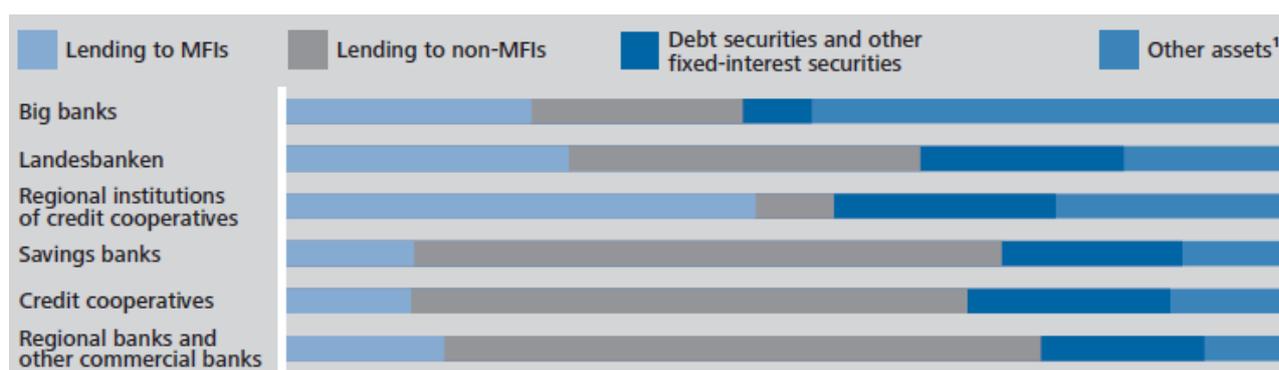
### 2.1.4 Other Banks

As already discussed, the German banking system composes of three pillars. Some economists argue the existence of a fourth pillar, named 'other banks' which includes mortgage banks, building and loan associations and the so-called special purpose banks, ('Förderbanken'), such as the government-owned KfW (Kreditanstalt für Wiederaufbau) banking group, currently Germany's second largest bank. However, the heterogeneity of the entities comprising this group is significant. Therefore, this group is not referred as the fourth pillar. In what follows, we do not take this group into account

## 2.2 THE ASSET AND LIABILITIES STRUCTURE OF THE GERMAN BANKING SYSTEM

A bank-business model can be studied and analyzed along three dimensions (Deutsche Bundesbank 2015). The first dimension involves the banking institution's sources of funding and its lending activities, i.e. the structure of assets (sub-section 2.2.1) and liabilities (sub-section 2.2.2). The earnings structure stemming from the bank's business operations is the second dimension; put differently it is possible to differentiate between bank-business models in terms of their profitability and risk profile, and the impact of a fiscal crisis (Section 2.3). The third dimension is the institution's legal form, which can largely influence an individual bank's size, the number of similarly structured institutions and branches as well as the density of the branch network (not discussed in this dissertation)

### 2.2.1 The Structure of the German Banks' Assets



**Figure 2-7:** Asset Structure for German Banking Groups, 2015

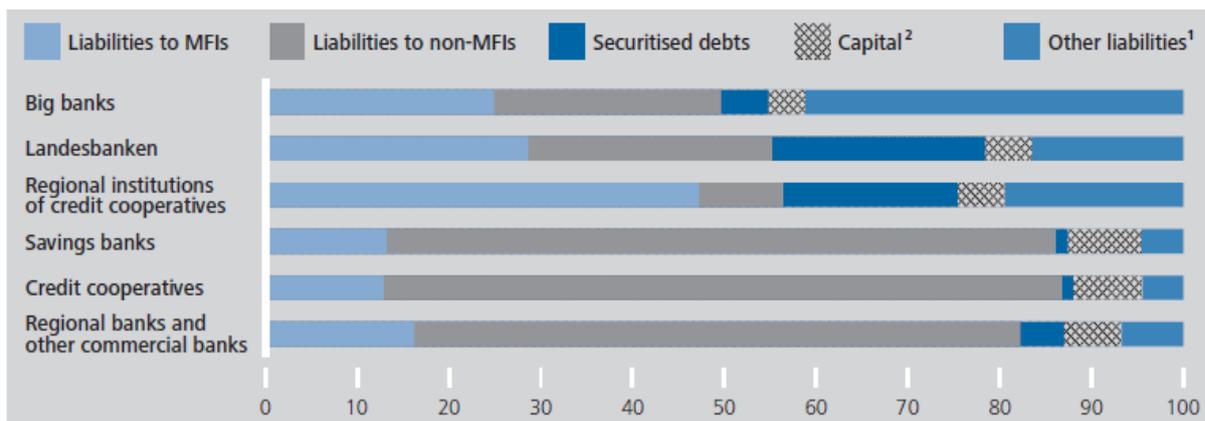
Note: **1** Inter alia derivative financial instruments in the trading portfolio

Source: Deutsche Bundesbank

### 2.2.2 The Structure of the German Banks' Funding

A bank's funding mix is one of the main factors along which a banking institution can be categorized (see Bank for International Settlements, 2014).

The major bulk of bank funding comes from three sources, namely, (a) through the creation of liabilities to (a1) the non-bank private sector and (a2) the MFI sector; and (b) through (securitized) debt issuance (see Fig. 2-8). Two additional sources of bank funding consist of equity capital, and, as of the 1990s, derivatives funding, in the form, for example, of liquidity swaps (Deutsche Bundesbank, 2015).



**Figure 2-8:** Liabilities Structure for German Banking Groups, 2015

Note: **1** Inter alia derivative financial instruments in the trading portfolio. **2** Subscribed capital, reserves, less reported loss, plus the “fund for general banking risks” item from the banking statistics.

Source: Deutsche Bundesbank

### *Liabilities Creation as a Source of Bank Funding*

A bank can obtain funding by creating liabilities to the non-bank private sector and the Monetary Financial Institutions (MFI) sector.

The prominent source of funding for German banking institutions, nearly 45% of total assets on a long-run average, is liabilities to entities other than financial ones, namely households’ deposits and deposits of non-financial corporation’s (Deutsche Bundesbank, 2015). Such deposits materialize via overnight deposits, savings deposits and time deposits. Furthermore, insurers, which mainly provide long- term funding (interalia registered bank bonds), are a major creditor group in the non- bank segment.

Liabilities to MFIs, account, on average, for another 25% of total assets funding for the German banking institutions (two thirds domestically and one- third from abroad). Short-term interbank liabilities are used mainly to settle liquidity in the money market. Moreover, long-term interbank liabilities make up more than 50% of total equivalents, having duration two years or more. Besides intra- group or intranet-work funding, these are primarily deposits.

### *Bond Issuance and Equity Capital as a Source of Bank Funding*

Banks issue bank bonds to raise both short- and long- term capital. Bonds represent 20% of German banks' capital on a long- run average.

A typical bank business model is described by the vital role of debt capital in proportion to total assets. Therefore, equity to total assets ratio is supposed to be significantly lower than that of non- financial corporations. The German banking system is characterized by an equity to total assets ratio of 4% (on long term average), classifying it to the 13rd position in European scale, a record well below midtable.

## **2.3 EARNINGS STRUCTURE AND THE IMPACT OF THE FINANCIAL CRISIS ON THE GERMAN BANKING SECTOR**

The structure of a bank's earnings has implications concerning how hard a credit institution could be hit whenever a fiscal crisis strikes the economy.

On the one hand, a "traditional" bank-business model based mainly on deposit-financed lending could have survived the crisis almost entirely unscathed. However, a consistently low interest rate environment, like currently, causes serious doubts on the sustainability of the institution's interest income, deriving from traditional lending operations. The seemingly simple solution to the problem would be the expansion of the volume of the institution's lending and deposit business.

On the other hand, a "non-traditional" model of banking, because it does not focus primarily on traditional lending and deposit funding, could be hit hard by a fiscal crisis. This is so because "non-traditional" banking involves a greater diversification of income sources, through an expansion into the field of investment banking or proprietary trading, and an increasing role for non-interest income relative to interest income. This type of business diversification comes in hand with incremented income volatility.

Put differently, during a fiscal crisis, the weak bank profitability, which normally accompanies the adoption of a non-traditional banking model, would be down to losses generated from the trading section of the bank business. In turn, reduced bank earnings imply a higher dependence of the banking institution on its shareholders' willingness to cover any losses with capital injections. Although the prospect of weak bank profitability, during a fiscal crisis, is a relatively established fact, many big banks (in Germany and all over the world) instead do not opt for traditional lending practices (which, other things being equal, offer hefty earnings opportunities), because they tend to require more capital for regulatory reasons (Deutsche Bundesbank, 2015).

The period preceding the financial crisis, was characterized by superior return figures for big banks as opposed to Landesbanken (and in general other larger German banking institution) despite the active engagement of the former in investment banking.

Up until the fiscal crisis, the big banks had a superior profitability than the Landesbanken (and in general other larger German banking institution) and the regional

institutions of credit cooperatives, albeit some of the former were significantly more active in investment banking than the latter (Deutsche Bundesbank, 2015). However, since both Big Banks and the Landesbanken relied, to a larger or a smaller degree, on the non-traditional banking model, their potential for generating extra capital during the fiscal crisis – considering their weak profitability– was severely limited, and they would have been liquidated had it not been for government support. Specifically, over the period 2008- 2013, the German taxpayers provided the German financial sector with an assistance, in the form recapitalizations and relief measures for assets (SoFFin), to the tune of close to €144 billion (Financial Market Stabilization Agency, 2014). The SoFFin program granted assistance to the following credit institutions in Germany: Aareal Bank AG, Bayerische Landesbank, Commerzbank AG, CorealCredit Bank AG, Dósseldorfer Hypothekenbank AG, Hypo Real Estate, HSH, Nordbank, AG, IKB Deutsche Industriebank, AG, Sicherungseinrichtungsgesellschaft deutscher Banken mbH, Westdeutsche Landesbank.

Most German savings banks and credit cooperatives, as well as plentiful regional banks, employed the model of “traditional banking” (Deutsche Bundesbank, 2015). The immediate consequence was that savings banks and credit cooperatives profitability sustained during the crisis, taking on incremented interest rate risks.

### **3. LITERATURE REVIEW**

#### **3.1 THEORETICAL FRAMEWORK**

Literature presumes banking institutions as maximum-profit seekers. Shareholders are closely monitoring the returns on their investments. There is a wide range of profitability ratios to assess the return on their investments. Profit maximization derives from effective management of inputs and outputs. The optimal relationship between inputs and outputs is a matter of key importance for bank managers, affecting seriously bank profitability. Market power also enables banks to increase output pricing or / and decrease the cost of acquiring inputs. Nevertheless, maximum profits are not always attained. Potential causes are related to risk tolerance and differentiation, agency cost issues between management and shareholders, imperfect market competition conditions and managerial inefficiency when handling inputs and outputs.

Vital concepts closely associated with maximum bank profitability, are risk and diversification. Shareholders must consider the trade-off between return and risk, in their investment strategies. It is generally accepted that when it comes to profit distribution, shareholders are indifferent between dividends and capital gains on their shares. This norm has the following prerequisites; homogeneous risk preferences for all banks, or alternatively risk and return figures are explained through a simple homothetic function. This is not the case in the German banking system, where an important segment of banking entities –e.g. cooperative banks- is extremely risk averse and does not comply with the standard profit maximization model. Additionally, this segment owns less diversified asset portfolios with prevailing local virtues. There is a growing literature on modeling the risk and return trade-off in banking environments. For example, Hughes et al (2000) and DeYoung et al (2001) incorporated risk in their study of bank performance. Koetter (2004) applied this model to the German banking system. This project does not look at profit maximization from this respect.

Incentives constitute the second parameter in bank's profit maximization. Contradicting pursuits may occur between shareholders and management. The first group,

known as principal, requires all company's actions to be taken for the sake of incremented profits, whereas the latter group, known as agents, adds a personal agenda to company's actions, neglecting optimal income enhancement, or / and cost minimization strategies. This lack of shareholder control is routed in information asymmetries between the two groups of interest. This may be the case even for risk-neutral and well-differentiated bank shareholders. These asymmetries impede effective management control and allow decisions with negative impact, in the form of incremented costs or reduced profits. Diamond (1984) argues that asymmetric information between principals and agents, justifies moral hazard and other incentive problems for banks. There is a growing literature on agency cost theory and possible manners to combat the contradicting pursuits of principals and agents. These include pecuniary as well as non-pecuniary incentives and competition criteria. The objective is dual; diminish the negative effects of agency cost without undermining management's administrative power. The latter is affected, for example, by external control mechanisms, external supervisory boards, or by secured debts and acquisition proposals.

Bank performance is also affected by competitor's actions, macroeconomic variables and regulation adopted by national and supranational organizations. Hence, bank profitability is also depended on bank's market power. Theoretically speaking, profit maximization is equal to cost minimization under perfect competition market conditions. Nevertheless, external factors such as regulations and adverse market conditions seriously question optimal performance. These factors may have asymmetric effects on profit maximization and cost minimization, which ultimately leads to a gap between the two objectives. When profits are maximized at a certain level which does not correspond to minimum average cost, imperfect competition market conditions prevail. These conditions and their implications to bank performance explain, to a great extent, the time variation of individual bank's financial performance, as well as the performance discrepancies among competitors.

Eventually, this project focuses on models that use the bank's market power to account for profitability.

### **3.2 STRUCTURAL APPROACH IN MEASURING BANK PERFORMANCE**

The Structure Conduct Performance (SCP) approach presumes the structure of the banking system. According to this approach, better performance for banks occurs when an incremented level of concentration is observed in the industry. This increased concentration is translated into high interest rates charged on credit, attached to low interest rates applied on deposits (banks are enabled by market conditions to adopt a collusive behavior). Consequently, banks witness enhanced net interest margins and profitability figures (Bikker, 2004).

The empirical testing of this hypothesis, undertaken by many researchers, involves the formulation of an equation where the dependent variable is any measure of bank profitability and the independent variable is a metric of bank concentration. Simultaneously, the model incorporates variables to control for alternative factors, different from the banking system concentration, that affect bank profitability. The importance of the bank concentration variable is validated via a statistically significant coefficient, implying a positive relationship between concentration level and bank profitability.

### **3.3 THE NON-STRUCTURAL APPROACH IN MEASURING BANKING PERFORMANCE**

New Industrial Organization Theory is a contemporary methodology, applied when assessing bank competition. The theory examines profit maximization based on static market conditions. Key characteristic of the method is that unobservable marginal costs can either be estimated via bank performance, or they cannot be estimated altogether. It is crucial to depict all inherent traits of the industry under testing. The nature of market power is determined within a set of alternative assumptions and the assumption of perfect competition is an alternative that can be chosen (Bresnahan, 1989:1012).

The previously described methodology involves two alternatives when it comes to assess bank competition. The first uses the Panzar-Rosse H-statistic as proposed by Rosse and Panzar (1982,1987) (see Eq. (3.1)). Within this alternative, a specific revenue function is utilized to distinguish between different market structures. Bresnahan - Lau (1982, 1989) suggested another alternative which uses an index of market power of the banks, resulting

from the estimation of a system simultaneous equation. A third approach, this of Hall-Roeger (1988, 1995), is also commonly used in the literature.

In an early study, Bikker and Groeneveld (2000) employed the Panzar-Rosse model to evaluate the competitiveness of 15 European Union countries' banking system, over the period 1986 -1992. Their empirical results suggested that in most countries monopolistic competition market conditions prevailed, whereas levels of competition remained stable throughout time, a conclusion confirmed for every individual country. Only two countries, Greece and Belgium, experienced perfect competition conditions, based on the value of the H- statistic (Greece  $H = 0.92$ ).

The Panzar – Rosse model was used by Gibson and Demenagas (2002) in an effort to investigate the prevailing market conditions in the Greek banking system, over the period 1993 – 1999. Two explanatory variables were employed, namely the changes in market shares of the financial institutions and the spread evolution between lending and deposit rates. The empirical results suggested incremented competition among banks, especially in the household deposit and lending (consumer and mortgage loans) segment. Despite the intense competition levels, Greek bank's net interest margin is sustained in high levels, implying incomplete competition for some banking products.

In a similar study, Rezitis (2006) investigated the Greek banking system, over the period 1995 to 2004. At that time domestic banks controlled 85% of the national banking system, while the remainder was under the control of insurers and foreign banks. The largest banks were the National Bank of Greece, Emporiki Bank, Agricultural Bank of Greece, Alpha Bank, Piraeus Bank and Eurobank. The first three were state - controlled, while the others were privately owned. The Panzar - Rosse model revealed perfect competition conditions prevailing in the sector, for the aforementioned period.

Nevertheless, when the author split the time period in two segments, the empirical results suggested that the banking sector was initially (during the first sub-period) operating in perfect competition conditions, whereas the second sub-period is characterized by monopolistic ones. Additionally, the the Bresnahan - Lau and Hall-Roeger model empirical results implied a non-competitive structure of the Greek banking system throughout the whole reporting period, and a shift from a competitive to a non-competitive structure, from the first to the second period.

## 4. METHODOLOGY AND DATA

### 4.1 THE ECONOMETRIC MODEL

In line with the literature, and specifically within the structural-approach framework, the following model shall be tested:

$$\Pi_{i,t} = X'_t\beta + C'_t\gamma + \varepsilon_t \quad (4.1)$$

Where  $\Pi_t$  the performance of bank the banking sector at time  $t$ ,  $X$  is a column-vector of bank-specific variables,  $C$  is a column-vector of control, macroeconomic, variables and  $\varepsilon$  is the disturbance term of the model.

#### 4.1.1 The Dependent Variable

The model as presented in the (4.1) formula attempts to model bank performance based on bank profitability metrics, such as the bank's Return on Assets (ROA), or the bank's Return on Equity (ROE). The advantages of immediate and easy calculus, since all primary data are available in the annual accounts, may be outweighed by endogenous disadvantages. For example, if a banking institution is not operating efficiently this is not necessarily have an impact on its profitability (Vesala, 1995). In econometric terms, in such a case the model above may suffer from omitted-variable bias.

#### 4.1.2 The Explanatory Variables

The explanatory variables used in the study include both bank-specific variables and macroeconomic variables. The latter type of variables normally includes the country's economic growth performance and its inflation rate.

In what follows, there is a brief discussion of the bank-specific variables and the macroeconomic variable that will be used in the study.

### *Liquidity risk*

Liquidity and profitability are two conflicting goals for a banking institution. On the one hand, the more liquid the banking institution, i.e. the more cash reserves it holds on its books, the safer the bank is deemed by depositors, in case they decide to engage in extraordinary withdrawals of their deposited funds. However, since holding cash does not earn the bank an interest, the bank's profitability takes a hit from the high liquidity. On the other hand, a bank's profitability is naturally enhanced whenever they extend loans into the economy. However, since loans involve highly illiquid assets, the bank cannot meet any emergency demand for cash, which depositors may need, and hence the bank's liquidity is dented.

We proxy bank liquidity with the variables 'Credit' and 'Lrisk'; these are defined as follows

1. Credit: Domestic credit extended to private sector, as a percentage of GDP. Since loans represent the most (or one of the most) profitable banking assets, we expect a positive relationship between bank profitability and credit, that is, as credit rises, so does the bank's profitability.
2. Lrisk: The ratio of loans to bank deposits. Whenever a banking institution holds a higher percentage of its deposit as loans, it should boost its profitability. Thus, the higher the Lrisk ratio the higher the bank's profitability and hence a positive relationship is expected between bank profitability and Lrisk.

### *Bank efficiency*

There are many ways to measure a bank's operational efficiency. ECB (2010) propounds cost-to-income ratio (CIR), as a proper bank efficiency measurement. Cost to Income Ratio is a ratio of operating expenses to operating revenues and is considered to unveil the ability of a bank to generate returns for a given amount of revenues. Hence, CIR assesses managerial ability pertaining to income and cost figures. These two variables are quite contradicting, since incremented revenues, resulting from high volumes of banking activity, require more costs whereas, at the same time, effective bank management is associated with lowering cost activities.

For this study the variable efficiency, which is the reciprocal of CIR, is used so that an increase in the new ratio should point to an improvement in banking efficiency. Hence, we expect a positive relationship between bank profitability and efficiency (Akbas, 2012).

### *Capital Adequacy*

An internal factor influencing a bank's profitability is its capital structure, which states the way the bank's assets are financed (Hassan and Bashir, 2003); in other word it presents the proportion of assets backed by liabilities and equities respectively. Capital adequacy is presented by the bank equity to total assets ratio. Theoretically speaking, high ratio figures classify the institution as risk averse; simultaneously such figures are associated with lower returns. Increased equity to total assets ratio adds up to bank's solvency and moderates leverage effect. Nevertheless, financing costs augment, since equity financing is relatively more expensive compared to the liability counterpart (Akbas, 2012), and as a result, bank profitability depresses. Another perspective to higher solvency is proposed by Athanasoglou et al. (2006) who argues that it substantially reduces the risks undertaken by the bank and has a positive effect on its performance. Thus, it is not clear, a priori, the expected relationship between bank profitability and capital adequacy.

### *Bank Concentration*

Several measures of bank concentration are suggested (see Bikker and Haaf (2002)). Concentration ratios incorporate two vital elements; (a) the number of banks (fewness) and (b) the distribution of bank sizes (inequality) in each market. Concentration Indices (CI) are derived from the following general formula:

$$CI = \sum_{i=1}^n s_i w_i$$

where  $s_i$  is the market share of bank  $i$ ,  $w_i$  is the weight attached to the market share and  $n$  is the number of banks in the market. Bikker and Haaf (2002) considered ten concentration ratios – the  $k$  bank Concentration Ratio ( $CR_k$ ); the Herfindahl-Hirschman Index (HHI); the Hall-Tideman Index (HTI); the Rosenbluth Index (RI); the Comprehensive Industrial Concentration Index (CCI); the Hannah and Kay Index (HKI); the U Index (U); The

multiplicative Huse Index ( $H_m$ ); the additive Huse Index ( $H_a$ ); and the Entropy measure ( $E$ )  
 The most popular indices from the above, namely  $CR_k$  and HHI, are presented below.

The  $k$ - bank Concentration Ratio ( $CR_k$ ) can be easily derived by adding up the market shares of the  $k$  largest banks in the market, that is,

$$CI_k = \sum_{i=1}^k s_i$$

The  $k$  variable, which encompasses the number of banks included in the concentration index, is arbitrarily determined and does not follow any justification rule. It is obvious that a high index figure indicates that the  $k$  largest banks incorporated in the index prevail in the banking market of the specific country.

The Herfindahl-Hirschman Index (HHI) is derived from the sum of the squared bank market share, of each bank operating in the sector. The algebraic form is presented below:

$$HHI = \sum_{i=1}^n s_i^2$$

The Herfindahl-Hirschman Index has two distinctive characteristics, as opposed to the previous index. Firstly, it incorporates all banks operating in the industry and secondly, attaches a greater weight to larger banks by squaring their market share.

The HHI index ranges between a minimum of  $1/n$ , when all banks in the market are of equal size, and a maximum of unity 1 in the case of monopoly. The more banks operating in the banking sector, the less sensitive the HHI index becomes to changes in the number of market participants (Davies, 1979).

A positive coefficient on the concentration explanatory variable validates the argument that bank performance is determined by the level of concentration. A non-significant value actually will imply that the efficiency hypothesis stands.

Increased market concentration has positive effects on bank performance, in the form of enhanced net interest margin (Hannan, 1989; Hannan and Berger, 1991; employing US data). In such an environment, banking institutions are induced to (a) pay a lower interest on deposits; additionally, these rates are not quickly adjusted to changes in interbank rates, and (b) charge high-particular interest rates on loans.

Sufian and Chong (2008) also apply the Herfindhal-Hirschman Index (HHI) as a proxy of market concentration. However, the hypothetical existence of a causal relationship between market concentration and profitability is still inconclusive. There is an abundance of studies that tests market structure and its effect on bank performance, especially in terms of ROA

and ROE (Rhoades, 1995; Moore, 1998; Berger, 1995; Pilloff and Rhoades, 2002). As already pointed out, empirical evidence does not agree on a relationship pattern, between the level of concentration and profitability.

### *Economic Growth*

Economic growth is captured by the variable 'gdppc', which represents per capital growth of GDP. A positive relationship is expected between economic growth and bank profitability. Bullish market conditions encourage loan-financed capital budgeting projects whereas they offer incremented chances of business prosperity.

## 4.2 DATA SOURCES

All data on the German Banking system included in this study have been derived from Deutsche Bundesbank and the World-Bank database. Table 4-1 presents some details on the variables used and their data source.

**Table 4-1: Data and Source**

<b>Variable</b>	<b>Code/ Name</b>	<b>Source</b>
Return on Equity (%)	Return on equity of individual categories of banks	Deutsche Bundesbank
Cost-to-Income Ratio (%)	GFDD.EI.07	World Bank
Bank Credit to Bank Deposits (%)	GFDD.SI.04	World Bank
Bank Capital to Total Assets (%)	GFDD.SI.03	World Bank
Domestic Credit to GDP (%)	GFDD.DI.14	World Bank
GDP per Capita (constant LCU)	NY.GDP.PCAP.KN	World Bank

## 5. EMPIRICAL RESULTS

This chapter contains the empirical findings of the study, which are presented in three sections. Specifically, Section 5-1 presents the results of the financial ratio analysis for the German banking sector, Section 5-2 touches on the descriptive statistics of certain variables, related to the statistical and regression analysis on the determinants of profitability of the German banking system, which is presented in Section 5-3.

In conducting financial ratio analysis of the German Banking sector, in line with the ECB (2010), we examine the sector's profitability, efficiency, capital adequacy, and liquidity, to gain an in-depth insight into bank performance. Bank profitability is captured by the banks' Return on Equity (ROE) or Return on Assets (ROA); efficiency is measured by the ratio of bank costs to income; capital adequacy is measured by the ratio of equity capital to total assets, while liquidity is proxied by the ratio of bank loans to deposits.

Literature research classifies the influencing factors of bank profitability in two broad categories, namely internal (bank specific) and external (relating to industry and macro economy). The first category of influential factors includes banks' market share and capitalization, balance sheet structure, risk pertaining to lending, liquidity risk, business model adopted, management of financial inputs and outputs and capital reserves. The second category includes –but is not limited to- market concentration and macroeconomic figures such as price level changes and economic conditions (upward or downward trends).

Conditions prevailing in the economy have direct effects on bank profitability. Economy slowdown or growth, usually expressed via the per capita GDP changes, affects both lending and borrowing business. Whenever we experience positive changes in GDP, banks exhibit increased operations deriving from the credit expansion, as well as increased deposits. This intense activity usually results in enhanced profitability for banking institutions. In contrast, economy downturn affects negatively lending and depositor base with analogous results in profitability (Sufian and Chong, 2008). Researchers also suggest that price level changes are positively related to bank profitability, since they affect interest rates in the same direction.

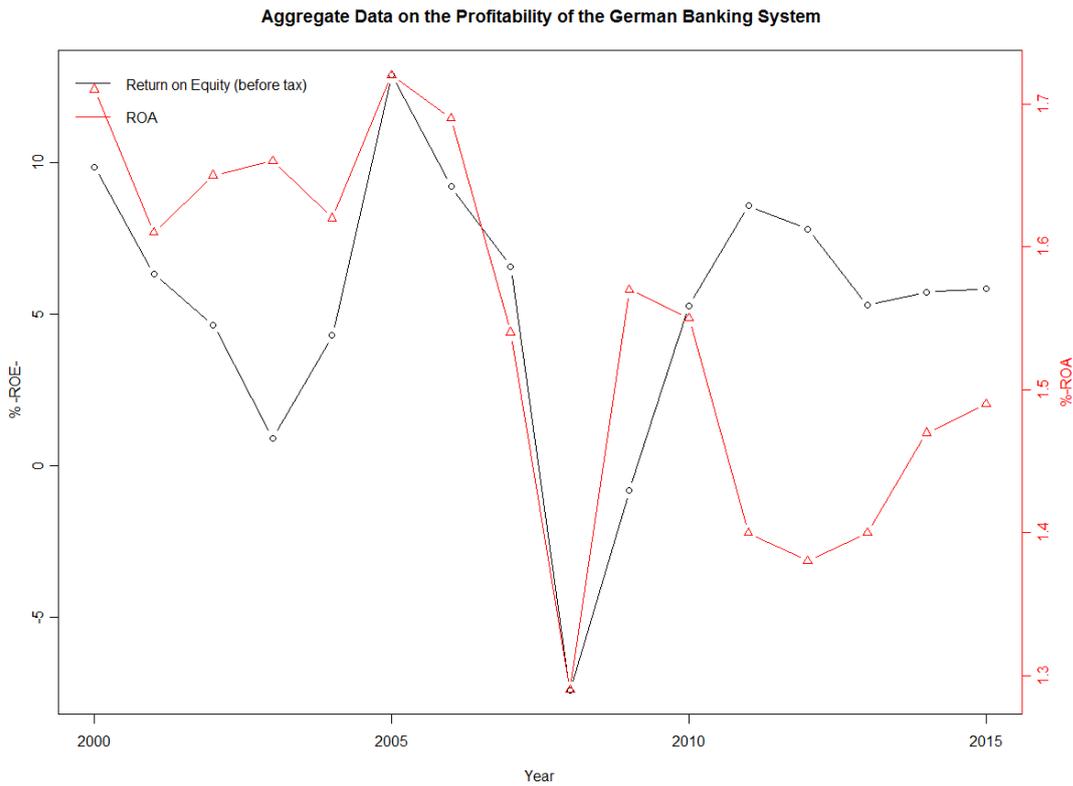
## 5.1 FINANCIAL RATIO ANALYSIS

### 5.1.1 Profitability Analysis

This study adopts the Eichengreen and Gibson (2001) research pattern, utilizing Return on Average Equity (ROAE) and Return on Average Assets (ROAA) to evaluate bank profitability. These financial ratios are extremely popular among management executives and are commonly used in special reports addressed to business analysts and investors. ROAE is derived by dividing after tax profit or loss to average equity. It divulges the yield on shareholders' funds. On the other hand, ROAA is derived by dividing after tax profit or loss to average total assets value. This metric divulges the yield accomplished for all investors (equity and external borrowers). Both metrics use average figures for either equity or assets in an effort to obtain more accurate results, in contradiction to absolute end of year values.

Compared to the initial ratio of ROE, ROA depicts all risks resulting from leverage and is considered to be a vital bank profitability ratio (Athanasoglou et al., 2005). Researchers note that ROA pitfall may be its inability to capture off balance-sheet assets, widely employed by European banks. Hence, Goddard et al (2004) suggests ROE superiority when evaluating bank profitability. In this study, both metrics, return on average assets (ROAA) and return on average equity (ROAE), are presented as appropriate performance appraisals.

Fig. 5.1 shows the profitability of the German Banking sector over the period 2000-2015. The before-tax return on equity of German Banks dropped from 9.84% in 2000 to 5.82% in 2015, that is, the average annual decline of profitability was 3.44%. When it comes to ROA, for all types of German Banks, dropped from 1.71% in 2000 to 1.49% in 2015, that is, the average annual decline of profitability was 0.91%.

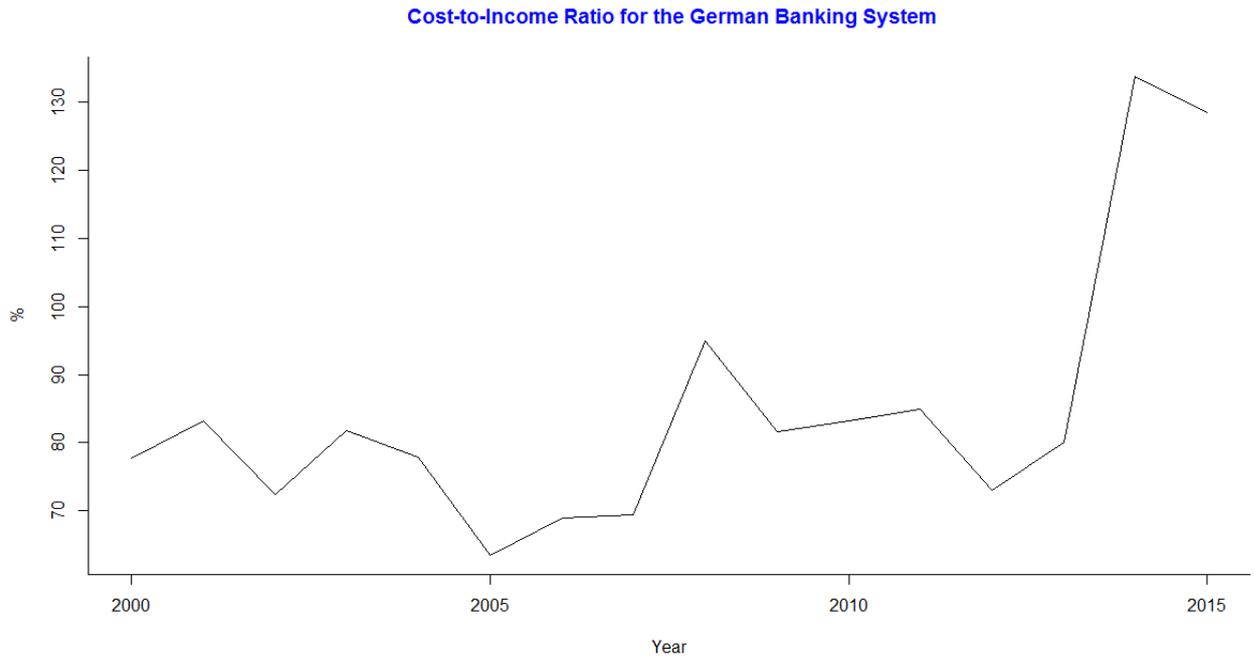


**Figure 5-1:** Profitability Ratios for the German Banking Sector, 2000- 2015

Source: Deutsche Bundesbank (for the data on ROE) and author’s calculations

### 5.1.2 Efficiency Analysis

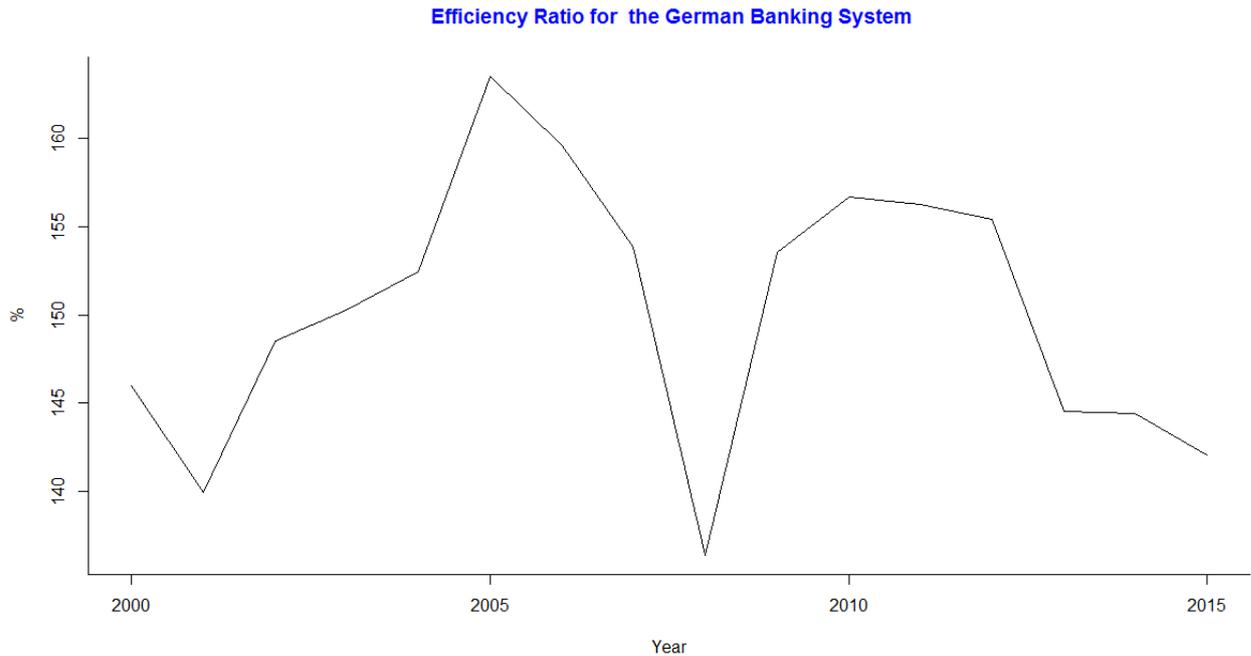
Fig. 5.2 shows the efficiency of the German Banking sector over the period 2000-2015. Specifically, the Operating-Income-to-Cost (OIC) ratio for all types of German Banks remained roughly the same over the aforementioned period, slightly declining from 146% in 2000 to 142% in 2015.



**Figure 5-2:** Cost-to-Income Ratio for the German Banking Sector, 2000- 2015

Source: World Bank

In order however to come up with an “efficiency ratio”, which signifies an “improvement” in banking efficiency whenever its value increases, we have constructed such a ratio by dividing the banks’ operating income by their general administrative spending and multiplied the result by 100. Fig. 5.3 shows the evolution of this new measure of efficiency of the German Banking sector over the period 2000-2015.



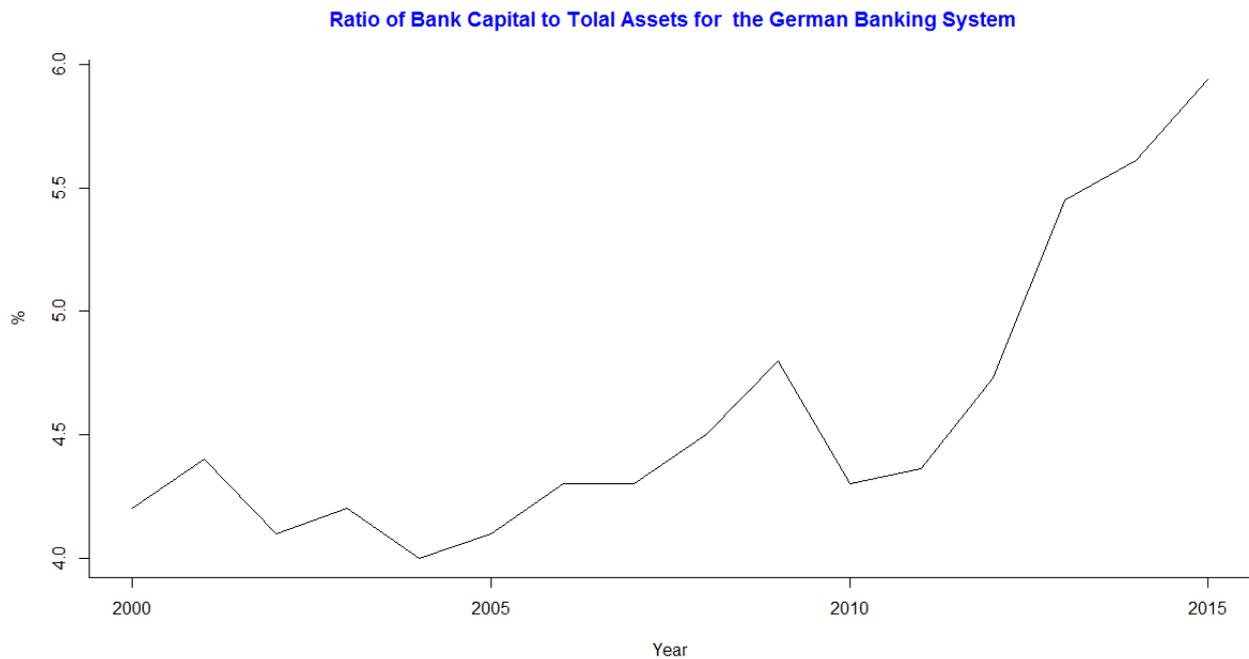
**Figure 5-3:** Efficiency Ratio for the German Banking Sector, 2000- 2015

Source: Deutsche Bundesbank (for the data) and author’s estimations

### 5.1.3 Capital-Adequacy Analysis

The most prominent metric to assess capital adequacy is Capital Adequacy Ratio (CAR), an internationally accepted standard. This ratio is widely employed by banks’ management teams to decision making and constitutes a risk restrictive factor (Christopoulos et al., 2011). The term ‘capital adequacy’ is directly related to the existence of sufficient equity funds to confront economy turbulence. The availability of sufficient equity funds diminishes the probability of bankruptcy, since it enables bank institutions to depress the cost of funding (Kosmidou, 2008). CAR is calculated by dividing the total amount of bank’s equity to total assets.

Fig. 5.4 presents the capital adequacy ratio of the German Banking sector over the period 2000-2015. Specifically, the ratio of bank capital to total assets, for all types of German Banks, increased from almost 4.2% in 2000 to 5.94% in 2015, thus, increasing an average annual rate of 2.34%.



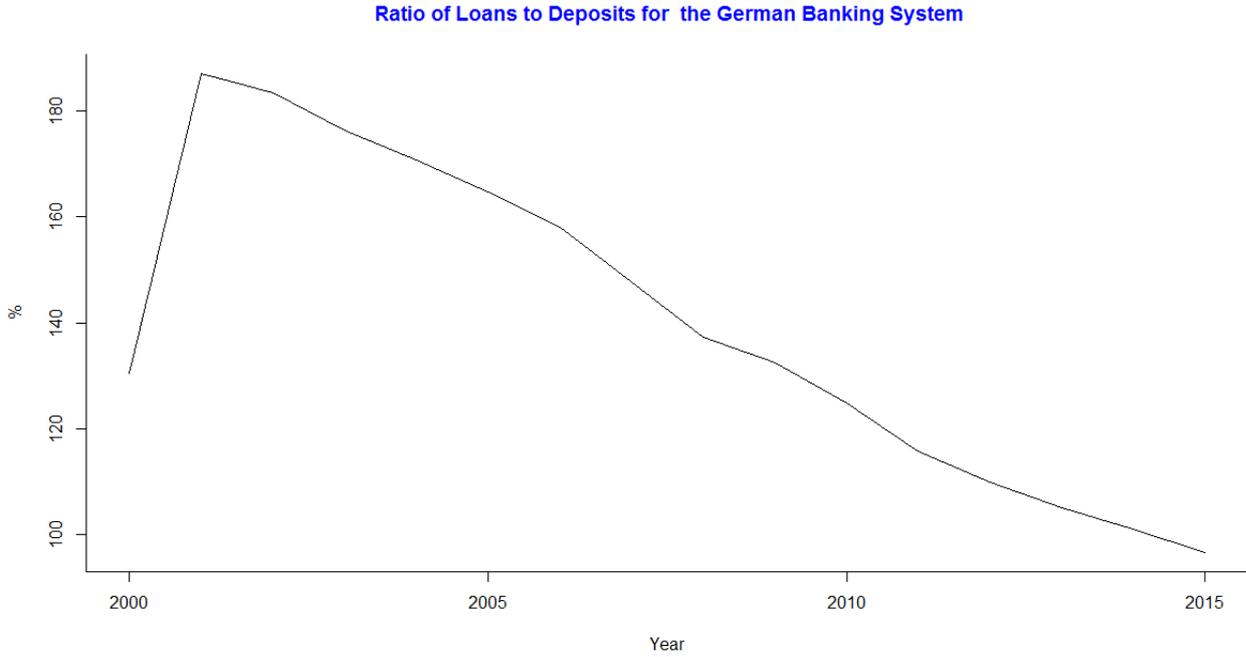
**Figure 5-4:** Capital Adequacy for the German Banking Sector, 2000- 2015

Source: World Bank

#### 5.1.4 Liquidity Risk Analysis

Bank liquidity is usually measured by the Loans-to -Deposits ratio (LDR), a ratio which indicates liquidity risk (Alexiou and Sofoklis, 2009). This ratio captures the retention of deposits made by the managing authorities in order to grant loans, and indirectly the bank's dependence on interbank markets. It is considered to be an appropriate indicator of the bank's adaptability to changes in funding. The lower the ratio is, the higher the accomplished liquidity. Increased liquidity is positively related to enhanced profitability, when risk features are taken into consideration. Nevertheless, the relationship is not analogous. As in all enterprises, increased liquidity levels deduct valuable funds that could be used to finance profitable investments. Usually liquid funds gain low rates of return and as liquidity requirements increase, bank profitability is challenged (Kosmidou, 2008).

Fig. 5.5 shows the liquidity ratio of the German Banking sector over the period 2000-2015. Specifically, the ratio of bank credit to bank deposits, for all types of German Banks, dropped from 130% in 2000 to close to 97% in 2015, thus, dropping an average annual rate of close to 2%.



**Figure 5-5:** Liquidity Ratio for the German Banking Sector, 2000- 2015

Source: World Bank

**5.2 BASIC STATISTICAL ANALYSIS**

**5.2.1 Descriptive Statistics**

Table 5-1 presents some basic descriptive statistics for the time-series variables under consideration. The results are presented over the whole period, 2000-2015, and over the two sub-periods 2000-2008 and 2009-2015

**Table 5-1: Basic Descriptive Statistics**

	n	mean	s.d.	min	max
ROE after Tax	16	3.32	4.14	-7.89	9.04
ROE before Tax	16	5.30	4.71	-7.40	12.87
ROA	16	1.55	0.13	1.29	1.72
Credit	16	96.69	12.70	77.95	115.72
Adequacy	16	4.58	0.59	4.00	5.94
Efficiency	16	150.22	7.52	136.39	163.50
Concentration	16	85.66	1.26	83.22	88.47
Liquidity Risk	16	140.11	30.38	96.69	187.01
Inflation Rate	16	1.49	0.66	0.23	2.63
GDP Growth Rate	16	1.30	2.50	-5.38	5.60
PERIOD: 2009-2015					
ROE after Tax	7	3.63	2.75	-2.02	6.68
ROE before Tax	7	5.38	3.02	-0.81	8.57
ROA	7	1.47	0.08	1.38	1.57
Credit	7	84.74	6.79	77.95	98.19
Adequacy	7	5.03	0.64	4.30	5.94
Efficiency	7	150.42	6.44	142.05	156.66
Concentration	7	85.19	1.25	83.22	86.65
Liquidity Risk	7	112.26	12.94	96.69	132.51
Inflation Rate	7	1.16	0.75	0.23	2.08
GDP Growth Rate	7	1.00	3.50	-5.38	5.60
PERIOD: 2000-2008					
ROE after Tax	9	3.08	5.13	-7.89	9.04
ROE before Tax	9	5.25	5.89	-7.40	12.87
ROA	9	1.61	0.13	1.29	1.72
Credit	9	105.98	6.77	96.43	115.72
Adequacy	9	4.23	0.16	4.00	4.50
Efficiency	9	150.06	8.65	136.39	163.50
Concentration	9	86.02	1.21	84.19	88.47
Liquidity Risk	9	161.78	19.96	130.53	187.01
Inflation Rate	9	1.74	0.49	1.03	2.63
GDP Growth Rate	9	1.54	1.55	-0.76	3.82

Source: World Bank and author's calculations

So, for example, over the whole period, the ROE for the all categories of banks was on average 5.3%, with a standard deviation of 4.71, while it was roughly the same over the

eight-year period 2000-2008 (5.25%) and over the subsequent period 2009-2015 (5.38%). When it comes to ROA, over the whole period, the ROA for the all categories of banks was on average 1.46%, with a standard deviation of 0.37. Looking at the two sub-periods, we see that over the eight-year period 2000-2008, the average ROA was 1.61%, while over the subsequent period ROA dropped to 1.27%

The Operating-Income-to-Cost (OIC) ratio for all the categories of German banks was on average 150%, with a standard deviation of 7.5%, over the whole 2000-2015 period. Looking at the two sub-periods, we see that over the eight-year period 2000-2008 and the subsequent period 2009-2015 period the average OIC ratio was 150%.

Over the whole period, 2000-2015, the capital-adequacy ratio for the all categories of German banks was on average 4.58%, with a standard deviation of 0.59%. Then, over the eight-year period 2000-2008, the average capital-adequacy ratio was 4.23%, while over the subsequent period the ratio rose to 5.03%. Over the whole period, 2000-2015, the ratio of bank credit to deposits for the all categories of German banks was on average 140%, with a standard deviation of 30%. Then, over the eight-year period 2000-2008, the average ratio was 162%, while over the subsequent period the ratio dropped to 113%

### 5.2.2 Correlation Analysis

Table 5-2 presents the correlation coefficient for the variables included in the formula. Looking at the data in this table there seems to be no multicollinearity problem, as the most problematic result is just the correlation between adequacy and efficiency at 0.78 (relatively high). Economic theory does not suggest any relationship between these variables. Inevitably, we decided to maintain them in the analysis.

**Table 5-2: Correlation Matrix for the Data**

	ROA	ROEbt	ROE	Credit	Adequacy	Efficiency	Concentration	Inflation	GDP Growth
ROA	1.0000	0.1619	0.1183	0.4338	-0.0589	-0.1238	-0.0704	0.0423	-0.3140
ROEbt	0.1619	1.0000	0.9929	0.0145	-0.0955	-0.2460	0.0433	-0.0176	0.4415
ROE	0.1183	0.9929	1.0000	-0.0482	-0.0540	-0.2165	0.0317	-0.0110	0.4745
Credit	0.4338	0.0145	-0.0482	1.0000	-0.7644	-0.5676	0.5356	0.1875	-0.1159
Adequacy	-0.0589	-0.0955	-0.0540	-0.7644	1.0000	0.7875	-0.6057	-0.4916	-0.2358
Efficiency	-0.1238	-0.2460	-0.2165	-0.5676	0.7875	1.0000	-0.3314	-0.4546	-0.0528
Concentration	-0.0704	0.0433	0.0317	0.5356	-0.6057	-0.3314	1.0000	0.1515	0.0420
Inflation	0.0423	-0.0176	-0.0110	0.1875	-0.4916	-0.4546	0.1515	1.0000	0.4987
GDP Growth	-0.3140	0.4415	0.4745	-0.1159	-0.2358	-0.0528	0.0420	0.4987	1.0000

Notes: The estimation period is 2000-2015. ROEbt: return on equity before taxes.

### 5.2.3 Stationarity Tests

In this section we test the stationary character of several time series that are used in the econometric modelling, the results of which are presented in Section 5.3. The stationarity test involves the Augmented Dickey Fuller (ADF) test.

Table 5-3 reports the results from performing this stationarity tests on several time series. Consider for example, the case of ROE before taxes. Fig. 5-1 showed that the time series for ROE before tax follows a stochastic model with no drift, and hence the standard Dickey-Fuller test will involve testing the following model

$$\Delta ROE_t = \varphi ROE_{t-1} + \varepsilon_t$$

In the above model the errors  $\varepsilon_t$  are assumed independently and identically distributed. The null hypothesis that is being tested is that  $H_0: \varphi = (\rho - 1) = 0$  against the alternative hypothesis  $H_1: \varphi = (\rho - 1) < 0$ . Note  $\varphi = 0$ , then  $\rho = 1$ , that is we have a unit root, meaning the time series under consideration is nonstationary, since in that case we will have

$$ROE_t = ROE_{t-1} + \varepsilon_t$$

The estimation of the first model is simple enough as it involves regressing the first differences of  $ROE_t$  on  $ROE_{t-1}$  and examine if the estimated slope coefficient  $\hat{\varphi}$  is statistically different from zero or not. If it is zero, we conclude that  $ROE_t$  is nonstationary,

but if it is negative “enough”, i.e. its absolute value is greater than the absolute value of the critical value, then we conclude that the time  $ROE_t$  is stationary. Under the null hypothesis that  $H_0: \varphi = 0$ , the value of the t-statistic on the estimated coefficient of  $ROE_{t-1}$  does not follow the t distribution even in large samples<sup>3</sup>. Dickey and Fuller have shown that under the null hypothesis that  $H_0: \varphi = 0$ , the estimated t value of  $\hat{\varphi}$  follows the  $\tau$ (tau) statistic where

$$\tau = \frac{\hat{\varphi}}{\text{s.e.}(\hat{\varphi})}$$

For example, in the case of ROE, we see that the tau test statistic is higher in absolute value than the critical value ( $|-2.34| > |-1.95|$ ), hence we reject the unit-root null hypothesis thus concluding that the ROE of the German Banking is a stationary time series. Note, the estimated model<sup>4</sup> involves on lag, and it has as follows

$$\Delta ROE_t = -0.5820 ROE_{t-1} + 0.3345 \Delta ROE_{t-1}$$

(-2.34)

**Table 5-3: Stationarity Tests Results**

Variable	Tau-Statistic	Critical Value†	Lags	Drift	Trend	Conclusion
ROE before Tax	-2.34*	-1.95	1	None	None	Stationary
credit	-3.55**	-3.00	1	Yes	Yes	Trend Stationary
lrisk	-0.439	-3.60	1			Non-Stationary
adequacy	-1.26	-3.60	1			Non-Stationary
efficiency	-0.30	-1.95	1			Non-Stationary
concentration	-0.613	-1.95	1	None	None	Non-Stationary
gdppcgr						

Notes: The ADF test is used to test for stationarity of the time series. \*(\*\*)Statistically significant estimate at the 5%(10%) level of significance. † the reported critical value at the 5% level of significance.

Variable definition *credit*: bank credit extended to private sector as percentage of GDP; *gdpcgr*: growth rate in per capita GDP

<sup>3</sup>That is, it does not have an asymptotic normal distribution

<sup>4</sup>Not reported in table

Fig. A-2(Appendix A) presents the evolution of the time series credit, which clearly seems to fit the pattern of a stochastic model with a trend, and hence the standard Dickey-Fuller test will involve testing the following model

$$\Delta\text{credit}_t = a + \beta t + \varphi\text{credit}_{t-1} + \varepsilon_t$$

In the above model the errors  $\varepsilon_t$  are assumed independently and identically distributed. Again, the null hypothesis being tested is that  $H_0: \varphi = (\rho - 1) = 0$  against the alternative hypothesis  $H_1: \varphi = (\rho - 1) < 0$ . The estimated  $\tau$  statistic is  $\tau = \frac{\hat{\varphi}}{\text{s.e.}(\hat{\varphi})} = \frac{-1.3184}{0.3708} = -3.55$ , while the critical value is -3.60. So, it is trend stationary.

### 5.3 REGRESSION RESULTS

Table 5-4 presents the regression results for various model specifications, depending on the banking variable used as a regressor.

In all models, i.e. model 1 through 10, the dependent variable is the natural logarithm of the ROE before tax for all German banking institutions. For models 1-5, the estimation period runs from 2000 to 2015, while for models 6-10 the corresponding period is 2001-2015. Models 1-5 use as regressors non-stationary banking time series, while Models 6-10 use as regressors non-stationary lagged banking time series and stationary time-series.

**Table 5-4:** Regression Results for the Determinant of ROE before Tax

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
log(credit)	0.3241*				
log(lrisk)		0.2973*			
log(adequacy)			0.9641*		
log(efficiency)				0.2979*	
log(concentration)					0.3346*
gdppc.gr	0.1594**	0.1649**	0.1712*	0.1521**	0.1548**
$\bar{R}^2$	0.9048	.9000	0.9091	0.9075	0.9069
Variable	Model 6	Model 7	Model 8	Model 9	Model 10
credit <sub>t-1</sub>	0.0156*				
credit.gr <sub>t</sub>	0.0926				
lrisk <sub>t-1</sub>		0.0090*			
lrisk.gr <sub>t</sub>		0.0059			
adequacy <sub>t-1</sub>			0.2973*		
adequacy.gr <sub>t</sub>			0.0266		
efficiency <sub>t-1</sub>				0.0099*	
efficiency.gr <sub>t</sub>				0.0178	
concentration <sub>t-1</sub>					0.0177*
concentration.gr <sub>t</sub>					0.1299
gdppc.gr	0.2571**	0.2123**	0.1865**	0.1313	0.1360
$\bar{R}^2$	0.8671	0.8266	0.8922	0.8918	0.9047

Notes: (\*\*) statistically significant estimate at the 5% (10%) level of significance. The estimation period for models 1-5 is 2000-2015. The estimation period for models 6-10 is 2001-2015. lrisk: the ratio of loans to bank deposits (%); efficiency: the ratio of operating income to operating expenses (%); adequacy: the ratio of bank capital to total assets (%); credit: domestic credit to private sector (% of GDP); credit.gr: growth rate in domestic credit to private sector (% of GDP); gdppc.gr: growth rate in per capita GDP;

Then Table 5-5 presents the results for stepwise regression. Backward stepwise regression omits gradually statistically insignificant variables, delivering ultimately a reduced

model. The output from step shows the sequence of models processed. In this case, step removed x2 and x4 and left only x1 and x3 in the final (reduced) model. The summary of the reduced model shows that it contains only significant predictors. The backward methodology is manageable, albeit not appropriate if many variables are incorporated in the equation. In such a case, the opposite direction methodology is proposed, namely forward stepwise regression, which gradually inserts only statistically significant variables in the tested equation.

**Table 5-5: Stepwise Regression Results for the Determinant of ROE**

Variable	Full Model 1	Variable	Full Model 2
log(credit)	0.3241*	credit <sub>t-1</sub>	0.0563*
gdppc.gr	0.1594**	credit.gr <sub>t</sub>	0.3138**
		lrisk <sub>t-1</sub>	-0.0423*
		adequacy.gr <sub>t</sub>	-0.1114
		efficiency <sub>t-1</sub>	0.1243*
		efficiency.gr <sub>t</sub>	0.0601
		concentration <sub>t-1</sub>	-0.1794*
$\bar{R}^2$	0.9048	$\bar{R}^2$	0.9485

Notes: statistically significant estimate at the 5% level of significance. The estimation period is 2000-2015. credit: domestic credit to private sector (% of GDP) \_; gdppgr: growth rate in per capita GDP; infl: inflation rate; gdppgr: growth rate in per capita GDP; infl: inflation rate; gdppgr: growth rate in per capita GDP

5.3.1 The Effect of Domestic Credit

The credit granted from the German banking system to the private sector, is referred as domestic credit. The most common unit of measurement is as the percentage of GDP. In theory, credit expansion has a positive relationship with bank profitability.

Indeed, as Table 5-4 shows, the estimated slope coefficient for the (natural logarithm of) variable credit is 0.3241, hence the effect of bank credit on German banks’ profitability is positive. Both dependent and explanatory variables (ROA and Credit respectively) are expressed in terms of natural logarithm. Hence, the change in the value of the Return on Assets (dependent variable - ΔROA) is expected to be (approximately) equal to the product

of the aforementioned slope estimate ( $\hat{\beta}_{\text{credit}} = 0.3241$ ), the ratio of the banks' ROA to domestic credit ( $\frac{\text{ROA}}{\text{credit}}$ ), and the change in the domestic credit ( $\Delta\text{credit}$ ).

As it was shown in Table 5-1, over the whole period, 2000-2015, the average bank ROA for all categories of German banks was 1.55%, while the ratio of bank credit extended to whole economy by all categories of German banks averaged 97%, with a standard deviation of 12.7%. So, we may take the ratio of the banks' ROA to domestic credit to be  $\frac{\text{ROA}}{\text{credit}} = \frac{1.55}{97} = 0.0160$ , and the change in the domestic credit to be equal to one standard deviation, i.e.  $\Delta\text{credit} = 13$ . Hence, if credit to the private sector extended by the German banking system increases by 13 percentage points then, the sector's ROE (on a before-tax basis) is expected to increase by just 0.07 ( $= \hat{\beta}_{\text{credit}} \frac{\text{ROA}}{\text{credit}} \Delta\text{credit} = 0.3241 \times \frac{1.55}{97} \times 12$ ) percentage points, of just 7 basis points. In other words, the average bank ROA for all categories of German banks will increase from 1.55% to 1.62%.

This finding is in line with those of Goddard et.al (2004), who found, using panel consisting of 6 European countries observed over the period 1992- 1998, that domestic credit positively affects banks' profitability.

### 5.3.2 The Effect of Liquidity Risk

A measurement applied to assess an important variable for banking operations, namely liquidity risk, is the ratio of credit to deposits. This ratio exhibits a negative relationship when discussed in relation to bank performance. Additionally, the higher the ratio the riskier bank management occurs.

Table 5-4 (model 2) shows, the estimated slope coefficient for the natural logarithm of *lrisk* is 0.2973. Then, as it was shown in Table 5-1, over the whole period, 2000-2015, the ratio of bank credit to deposits for the all categories of German banks stood on average at 140%, with a standard deviation of 30%. Then, over the eight-year period 2000-2008, the corresponding ratio was 162%, while over the subsequent period the liquidity risk ratio dropped to 113%. Given the average bank ROA for all categories of German banks to the tune of 1.55%, we may take the ratio of the banks' ROA to liquidity risk to be  $\frac{\text{ROA}}{\text{lrisk}} = \frac{1.55}{140} = 0.0111$ , and the change in liquidity risk to be equal to one standard deviation, i.e.  $\Delta\text{lrisk} = 30$ .

Hence, if the ratio of bank loans to demand deposits of all German banks increases by 13 percentage points then, the sector's ROE (on a before-tax basis) is expected to increase by 0.1  $\left( = \hat{\beta}_{\text{risk}} \frac{ROA}{\text{credit}} \Delta \text{risk} = 0.2973 \times \frac{1.55}{140} \times 30 \right)$  percentage points, of 10 basis points. In other words, the average bank ROA for all categories of German banks will increase from 1.55% to 1.65%. Similar effects (on banks' profitability) were also documented in the studies of Horvath (2009) and Kundid et al., (2011), albeit of different magnitudes.

### 5.3.3 The Effect of Capital Adequacy

Our empirical results in Table 5-4 below indicate a statistically significant positive relationship between capital adequacy ratio and equity return. The higher the ratio, the lower the implied banking risk, as perceived by shareholders. However, in such a case equity holder do not benefit from positive leverage effects. The figures in the relevant Table indicate that if the capital-equity ratio of the German banking system increases by 1 % then, the sector's ROE is expected to increase by 96 basis points. This empirical result agrees with those reported by Kosmidou et al., (2005), concerning the positive effect of bank capital reserves on bank profitability, but they are opposite to what was found by Athanasoglou et al., (2006), who established an inverse relationship between bank equity capital and bank profitability.

### 5.3.4 The Effect of Bank Concentration

The empirical results presented in Table 5-4, unveil another statistically significant variable that determines bank profitability. This variable is the market concentration ratio, which has a positive impact on Return on Equity. Specifically, for every one percent increase in the aforementioned concentration ratio, the German banking system's ROE is expected to increase by 33 basis points.

### 5.3.5 The Effect of Efficiency

Management efficiency is approximated via the cost-to-income ratio, as already presented in the literature review. As it was pointed out in section (5.1.2), an improvement in bank efficiency occurs when income from operations increases or / and the reciprocal costs deteriorate.

Table 5-4 (model 4) shows, the estimated slope coefficient for the natural logarithm of efficiency is 0.2979. Then, as it was shown in Table 5-1, over the whole period, 2000-2015, the ratio of bank's operating income to their admin spending for the all categories of German banks averaged 150%, with a standard deviation of 7.5%. Given the an average bank ROA for all categories of German banks to the tune of 1.55%, we may take the ratio of the banks' ROA to efficient to be  $\frac{ROA}{\text{efficiency}} = \frac{1.55}{150} = 0.103$ , and the change in efficiency to be equal to one standard deviation, i.e.  $\Delta\text{efficiency} = 7.5$

Hence, if the ratio of banks' institution revenue to aggregate administrative expenses increases by 7.5 percentage points then, the sector's ROE is expected to increase by 0.02  $\left(= 0.2979 \times \frac{1.55}{150} \times 7.5\right)$ percentage points, of just 2 basis points. In other words, the average bank ROA for all categories of German banks will increase from 1.55% to 1.57%. This result concerning the positive relationship between bank profitability and bank efficiency is consistent to the findings reported by Akbas (2012) in his study.

## **6. CONCLUSIONS**

This study scrutinized the structure of the German banking system and its performance for a period covering years 2000-2015. Four big banks prevail in the private fragment of the banking sector, namely Deutsche Bank, Commerzbank, UniCredit and Postbank. Big banks were characterized by close ties with the well-established German industrial companies. These close relationships included long-term credit, as well as cross-shareholdings and supervisory board seats. Nevertheless, these ties were radically affected by the changes in the banking business environment in the late 1970s. Big banks were induced to move their business to investment banking and money trading, abandoning simultaneously their close relationships with industrial base. The rest of the private banking sector comprises regionally focused banks or branches of foreign banks. Even though savings banks and credit cooperatives account for about 80% of credit institutions in Germany, in 2014, their combined total assets made up a bit more than 40% of aggregate total assets in the German banking system.

### **6.1 CONCLUSIONS FROM FINANCIAL RATIO ANALYSIS**

The preceded financial ratio analysis focused on the appraisal of the German banking sector's profitability, efficiency, capital adequacy, and liquidity.

Despite the onset of the recent fiscal crisis, and the somewhat significant decline in the banks' efficiency (captured by a rising cost-to-income ratio), the profitability of the German Banking system remained almost intact, as it was reflected by Return on (Average) Assets, ROA, was not severely affected, as the annual average decline over the period under examination was a mere 0.91%. In addition, the German banking system came out of crisis with a larger capital adequacy, as the ratio increased over the period under examination, and a higher liquidity, as this is captured by the ratio of bank credit to total deposits.

## 6.2 CONCLUSIONS ON THE DETERMINANTS OF BANK PROFITABILITY

As already pointed out in the relevant section, literature classifies the banks' profitability influential factors in two groups; the internal (bank-specific) and the external factors (the latter pertaining to banking business sector, as well as macroeconomic variables). Economic activity changes, usually determined by GDP per capita, affect bank profitability. Business related factors, such as depositor base, household and business lending as well as net interest margins, are some of the major bank-specific factors that seriously influence bank returns. Economic slowdown depresses credit volume, the amount of entrepreneurship ventures and consequently financing demand, as well as depositor base. All the above affect negatively banks' profit margins (Sufian and Chong, 2008). Another macroeconomic variable that affects bank profitability in a positive manner is the positive inflation rates, since they cause interest rates and net interest rates margin increase.

Our empirical results, as presented in Chapter 5, suggest that German bank profitability is affected positively by the proxies for liquidity risk, management efficiency, market concentration and general economy performance. The criterion applied to assess bank profitability is ROE. In that case only one insignificant variable was detected, namely bank size.

A policy recommendation, for the supervisors, which can be derived from these empirical findings, is that of a better surveillance for liquidity risk of banks. A policy recommendation for banks' decision makers would be to monitor liquidity risk indicators and cost optimization.

Upcoming research may focus on the extension of the analysis to each type of bank, separately. Further analysis in all types of banks may be based on new data from 2015 and on. Moreover, the regulation and use of IFRS 9 can be used in comparison with the results of the new stress test in the German Banks.

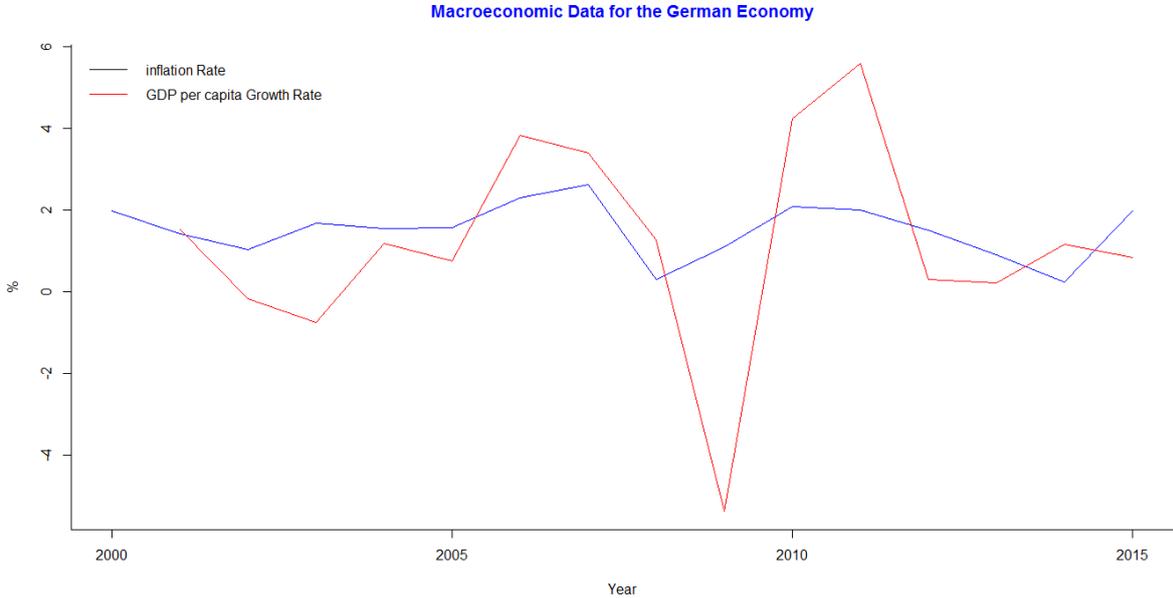
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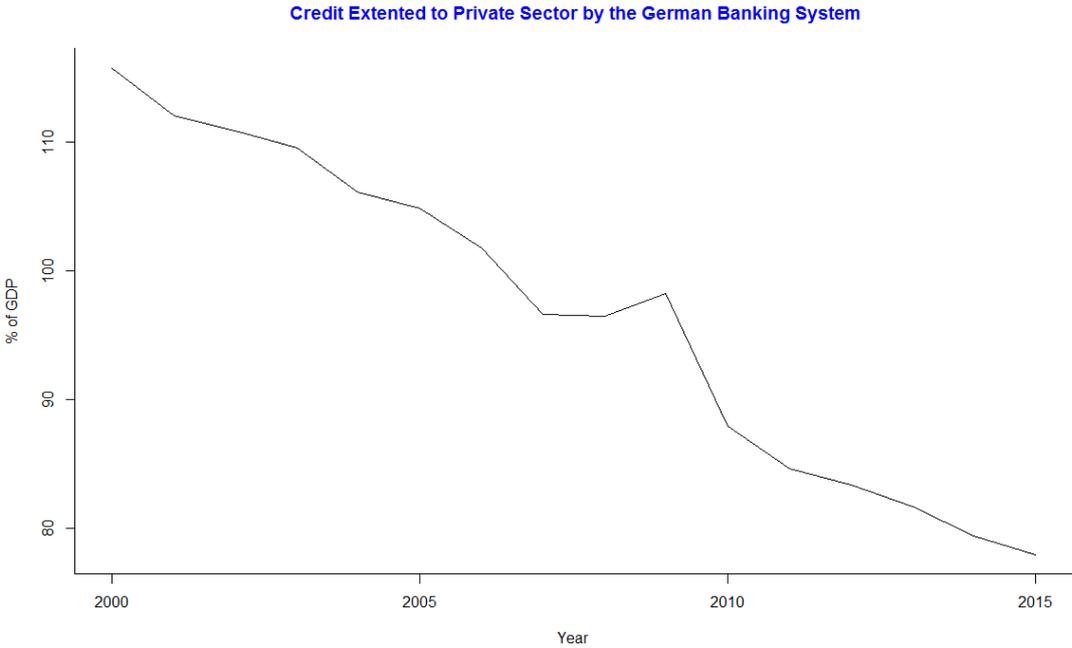
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**APPENDIX A: FIGURES**



**Figure 0-1: Inflation Rate and GDP Per Capita Growth Rate**

Source: World Bank and Author’s Calculations



**Figure 0-2: Credit Extended to the Private Economy by the German Banking System**

Source: World Bank