Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies

RIGOROUS THESIS

The importance of banking fee income in the EU banking industry - does market concentration matter?

Author: **Mgr. Karolína Růžičková**

Supervisor: **PhDr. Petr Teplý, Ph.D.**

Academic Year: **2014/2015**

Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, September 6, 2014

Signature

Acknowledgments

I would like to thank my supervisor PhDr. Petr Teplý, Ph.D. for leading me through the entire work with friendly attitude and unflagging patience. I am very grateful for his priceless comments and support. My sincere gratitude belongs also to PhDr. Jozef Baruník, Ph.D. for valuable suggestions concerning the applied methodology. I am grateful to Matěj Kuc for his recommendations and mainly for provided mental support.

Last but not least, I thank my mom for continuous encouragement during my studies.

Abstract

This thesis deals with both theoretical and practical aspects of banking fee and commission income in the European Union. Since fee income represents the largest part of non-interest income earned by banks, it remains a major challenge for bank management to set and maintain an appropriate fee policy. Nevertheless, solving for the optimal fee structure has not yet been accomplished either on a theoretical level, or in actual practice. In the thesis, we analyse fee income in EU banking sectors. Our results show that the Czech banking sector was not abnormally dependent on fee income compared to other EU countries in the period 2007–2012. As a result, we argue that the high profitability of Czech banks cannot be attributed to abnormal banking fee and commission income, but rather other factors should be considered. Moreover, we study the determinants of fee income share in individual banks and discuss the impact of market concentration on the magnitude of banking fees. We conclude that banks facing higher competition tend to expand more aggressively into non-traditional activities and therefore they report higher fee income shares. We also study the relationship between banking fees and banks' performance in terms of profit and risk. The results on profitability are mixed depending on applied profitability measure, but in general, banks with high shares of fee income exhibit lower risk-adjusted profitability. Furthermore, higher shares of fee income are connected with higher probability of insolvency. Increased reliance on fee income tends to raise both, the leverage as well as portfolio risk.

JEL Classification	C23, G21, L25
Keywords	Banking fee and commission income, market concentration, bank performance, system GMM

Author's e-mail	karolinaruzickova90@gmail.com
Supervisor's e-mail	teply@fsv.cuni.cz

Abstrakt

Práce se zabývá teoretickými a praktickými aspekty výnosů z bankovních poplatků a provizí v Evropské unii. Vzhledem k tomu, že příjmy z poplatků představují největší část neúrokových příjmů bank, stanovení a dodržování odpovídající poplatkové politiky představuje pro vedení bankovních domů důležitý úkol. Optimální struktura poplatků však zatím nebyla stanovena, a to ani v teoretické rovině ani v praxi. V předložené práci analyzujeme příjmy z poplatků v bankovním sektoru EU. Naše výsledky ukazují, že v období 2007–2012 nebyl český bankovní sektor ve srovnání s ostatními zeměmi EU abnormálně závislý na příjmu z poplatků. V důsledku toho tvrdíme, že vysokou ziskovost českých bank nelze přičítat vysokým bankovním poplatkům a provizím, ale je třeba zvážit spíše jiné faktory. Dále studujeme determinanty podílu výnosů z poplatků v jednotlivých bankách. Zaměřujeme se především na to, jak je výše poplatků ovlivňována koncentrací bankovního sektoru. Došli jsme k závěru, že banky, které čelí vysoké konkurenci, mají větší tendenci expandovat do netradičních aktivit, a proto mívají vyšší podíl příjmů z poplatků. V neposlední řadě studujeme vztah mezi bankovními poplatky a výkonností bank se zaměřením na zisk a riziko. Výsledky vzhledem k ziskovosti se různí v závislosti na použitém ukazateli ziskovosti, ale obecně lze říci, že banky s vysokým podílem příjmů z poplatků vykazují nižší výnosnost upravenou o rizika. Navíc vyšší podíl příjmů z poplatků bývá spojen s vyšší pravděpodobností insolvence. Zvýšená závislost na příjmech z poplatků má tendencí zvyšovat riziko pákového efektu stejně jako riziko portfolia.

Klasifikace	C23, G21, L25
Klíčová slova	Bankovní příjmy z poplatků a provizí, koncentrace trhu, ziskovost bank, system GMM

E-mail autora	karolinaruzickova90@gmail.com
E-mail vedoucího práce	teply@fsv.cuni.cz

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Acronyms

ATM	Automated Teller Machine
CEE	Central and Eastern Europe
EU-17	Eurozone
EU-27	European Union, excluding Croatia
FE	Fixed Effect
GDP	Gross Domestic Product
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
HI	Herfindahl Index
IV	Instrumental Variable
LSDV	Least Squares Dummy Variable
NFCI	Net Fee and Commission Income
NFCI/GDP	Net Fee and Commission Income to Gross Domestic Product Ratio
NFCI/TA	Net Fee and Commission Income to Total Assets Ratio
NFCI/TI	Net Fee and Commission Income to Total Income Ratio
NII	Non-interest Income
NIM	Net Interest Margin
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PIIGS	Portugal, Ireland, Italy, Greece, Spain
RAEAR	Risk-adjusted Equity to Assets Ratio
RANIM	Risk-adjusted NIM
RAROAA	Risk-adjusted ROAA
RAROAE	Risk-adjusted ROAE
RE	Random Effect
ROAA	Return on Average Assets
ROAE	Return on Average Equity
SUR	Seemingly Unrelated Regression
TA	Total Assets
TI	Total Income
WLS	Weighted Least Squares

Rigorous Thesis Proposal

Institute of Economic Studies
Faculty of Social Sciences
Charles University in Prague

Author:	**Mgr. Karolína Růžičková**	Supervisor:	PhDr. Petr Teplý, Ph.D.
E-mail:	karolinaruzickova90@gmail.com	E-mail:	teply@fsv.cuni.cz
Phone:	604 580 462	Phone:	724 020 385
Specialization:	Finance, Financial Markets and Banking	Defense Planned:	October 2014

Proposed Topic:

The importance of banking fee income in the EU banking industry - does market concentration matter?

Topic Characteristics:

Banking models have widely changed over last few decades. The technological development and widespread deregulation increased the competition among financial institutions which in turn led to decreased cost advantages of banks. As a result, the profitability of traditional activities of banks dropped which consequently led to an expansion of banking activities into non-traditional fee and commission bearing services. This has attracted the interest of academic sphere and the literature examining the effects of growing non-interest income on the economy is sharply rising. The academicians as well as bank managers are mainly concerned by the impact of non-interest income on the risk-return tradeoff, i.e. how the income diversification affects the magnitude and the volatility of bank earnings.

We compare the magnitude of fee income across EU-27 countries and study its determinants. Moreover, we deal with the link between net fee and commission income and bank performance in terms of risk and return. (The rigorous thesis will be based on the results of author's master thesis. The referee's comments and revealed further research opportunities will be elaborated.)

Aim of the thesis and hypotheses:

This thesis should extend and improve the analysis performed in the master thesis. The aim of the thesis is to compare fee income magnitude across EU-27 and to study empirically the determinants of fee and commission income with special emphasis on market concentration. Moreover, we analyse the link between banking fees and

bank's performance in terms of profit and risk. We control for different bank types facing dissimilar macroeconomic and banking sector conditions. We consider to construct two datasets, one including banks facing low concentration and one bank facing high concentration and to estimate the links between fee income magnitude and bank performance separately for these two datasets.

Hypotheses:

High profitability of Czech banking sector can be attributed to high fee income share.

Banks facing high competition tend to have higher shares of income represented by fee.

Higher shares of fee income are connected with better financial performance of banks in the European banking sector.

Methodology:

The analysis is based on balanced panel data from EU-27 countries (185 banks) spanning the period from 2007 to 2012. The panel will be constructed primarily based on BankScope database. Macroeconomic data as well as banking sector specific data are taken from ECB database, Eurostat, The World Bank DataBank and HelgiLibrary database.

For the comparison of fee income magnitude in different EU countries we apply simple descriptive statistics. For the research on bank level we use dynamic panel data models that are estimated by System GMM. In this way we are able to treat endogeneity, heteroscedasticity and autocorrelation that are present in our data adequately. Furthermore, the estimation method allows for fixed effects and at the same time is able to estimate time invariant variables. More standard estimation methods for panel data, namely fixed effects, random effects and pooled OLS, are used for robustness check.

Outline:

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Author **Supervisor**

Rigorous Thesis Introduction

The rigorous thesis underwent some significant changes compared to the original diploma thesis. Firstly, the Referee's comments and suggestions were incorporated, the thesis was largely shortened and some parts were reformulated or made more specific. We added the missing citations and restructured the literature review in Section 4.1.1, such that the most relevant paper will be at the beginning of the section. Some charts and tables, including those suggested by the Referee, were excluded from the thesis or moved to the Appendix. We added the definition of non-traditional banking activity (firstly in footnote 1 and in more detail in Section 2.2). In Section 4.1.5, we discuss what makes the conclusion that in highly concentrated markets, banks tend to rely more on non-traditional banking activities possible.

The Referee also asked about the inclusion of only 3 banks operating in the Czech banking sector in the data set. It should be noted that in the analysis on macro level, all banks operating in banking sector in the given year are included. The inclusion of more banks in the analysis on micro level was not possible due to high number of missing data in the Bankscope database. Strongly unbalanced panel could make the estimation inaccurate.

Last suggestion from the Referee was to consolidate Section 4.1 and Section 4.2 into one. We do not believe that this approach will be suitable, because in these sections fee income share figures firstly as dependent variable and secondly as explanatory variable. We needed to separate the literature review, results as well as variables description. Some variables overlap, but they were included twice because we describe the importance of the variable as well as the expected sign of the related coefficient for each model separately (we needed to justify the choice of variables set for both models – one examining net fee and commission income determinants and the other the banking performance – separately). Still, we agree that there were some unnecessary parts repeating and Section 4.2.2 and Section 4.2.3 were therefore shortened.

Besides the changes mentioned above, new parts examining the link between fee income share and bank's risk were added. More specifically, we analyze how is the fee income share connected to insolvency, leverage and portfolio risk. The new parts are included in Section 4.2. Sections 4.2.1, 4.2.2, 4.2.3, 4.2.4 and 4.2.5 were adequately extended, while Sections 4.2.4.3, 4.2.5.5 and 4.2.5.6 are completely new.

1 Introduction

Banking models have widely changed over last few decades. The technological development and widespread deregulation increased the competition among financial institutions which in turn led to decreased cost advantages of banks. As a result, the profitability of traditional activities of banks dropped which consequently led to an expansion of banking activities into non-traditional fee and commission bearing services (Edwards and Mishkin, 1995, Rogers and Sinkey, 1999, Davis and Tuori, 2000).[1] In Europe, non-interest income (NII) (which main part is represented by fee and commission income) has increased from 26% to 41% of total income between 1989 and 1998 (Lepetit et al., 2005). This has attracted the interest of academic sphere and the number of papers examining the effects of growing non-interest income on the economy is sharply rising. The academicians as well as bank managers are mainly concerned by the impact of non-interest income on the risk-return tradeoff, i.e. how does the income diversification affect the magnitude and the volatility of bank earnings. An overall effort to find the optimal banking strategy and to identify the most appropriate level of banking fees can be observed.

The main aim of this thesis is to analyse banking fee and commission income across EU countries both on macro (country) as well as on micro (bank) level. The goal is to find the links between fee income magnitude, market concentration and bank performance. In the theoretical part, we discuss the fee puzzle regarding the optimal fee structure in theory and we deal with the rationality of imposed fees in different banking business models with their positive and negative aspects.

The empirical research is divided into two parts, the fee income on country level is studied in the first one and on bank level in the second one. In the first part, we investigate and compare banking fee income across EU banking sectors with a special emphasis on the Czech Republic in 2007–2012 period. We examine whether the level of bank net fee and commission income (NFCI) is higher in the Czech Republic than in the European Union. We also focus on the development of banking

[1] In the thesis we refer to traditional activities if we are speaking about activities such as deposit taking and loan providing (in general core businesses of commercial banking). Non-traditional activities are for example retail brokerage, insurance sales, securities issuance (in general core businesses of investment banking). See also discussion in Section 2.2.

fee income in the Czech Republic and pose a question how new entrants influenced the overall level of NFCI in the Czech banking sector in last years. Moreover, we study the impact of market concentration on the magnitude of average banking fees in a given country and we examine the relation between NFCI and average banks' profitability.

In the second part of the empirical analysis, a set of European banks' data is used to analyse the links between bank fee and commission income, business strategies, market and macroeconomic conditions, and financial performance between 2007 and 2012. We analyse the determinants of fee income share with a special emphasis on market concentration. Furthermore, we study how the share of NFCI influences the bank's financial profitability, risk as well as risk-adjusted performance.

Altogether, we examine mainly the following four hypotheses:

- First hypothesis: High profitability of Czech banking sector can be attributed to high fee income share.
- Second hypothesis: Banks facing high competition tend to have higher shares of income represented by fee.
- Third hypothesis: Higher shares of fee income are connected with higher profitability and risk-adjusted profitability of banks in the European banking sector.
- Fourth hypothesis: Higher shares of fee income are connected with lower probability of insolvency and lower leverage risk in banks in the European banking sector.

The rest of the study is structured as follows. Section 2 describes the theoretical background where philosophy of a fee is described and the optimal level of fees in different banking businesses is discussed. In Section 3, we provide empirical research on country level in which we study banking fees in the EU-27 based on three different indicators. Besides basic descriptive statistics, we also analyse the relation between NFCI and banks' profitability, as well as the influence of banking, sector concentration on the magnitude of banking fees. In the second part of the section we examine banking fee income in the Czech Republic in more detail. In Section 4, we analyse NFCI on bank level. We study the determinants of fee income magnitude, especially the impact of market concentration on NFCI. In the second part we examine the relationship between banking fees and the banks' performance in terms of profitability, risk and risk-adjusted profitability. Section 5 summarizes the thesis and states final remarks.

2 Theoretical background

This chapter deals with theoretical background of banking fee and commission income. First, we define the fee income and describe how it differs from commission. We also describe the role of fees in banking industry. Then we discuss whether a level of banking fees that lead to optimal risk-return tradeoff exists.

2.1 Philosophy of a fee

Fees accompany people all around the world for very long time. Dictionary of Banking; a concise encyclopaedia of banking law and practice defines fee as "*the sum of money which is to be paid for a service rendered*" (Thomson, 1911). The difference between fee and charge is the professionalism of the service provided. Whereas charge is simply a price demanded for a thing or service, fee requires the service to be from a professional provider. In most cases we deal with lump sum fees that are usually paid as remuneration for services which are used just by a given number of customers or which exact price would be difficult or inefficient to quantify. One can distinguish many different categories of fees that can be paid either to public or private entities such as governmental fees for public services or licences and permits, fees for telecommunication services, fees for above-standard medical care or banking fees.

Clients do not perceive some fees anymore. However, some other fees, such as banking fees, are from the customers' point of view very difficult to accept. Still, banks provide services with added value and therefore they charge a fee for it. Banking fees are used not only as a price for services but also as a penalty. For instance, when the account balance is under a required amount, the client may be asked to pay a fee as a compensation for non-fulfilment of the demanded limit. There are also fees encouraging bank's customers to use automated services.

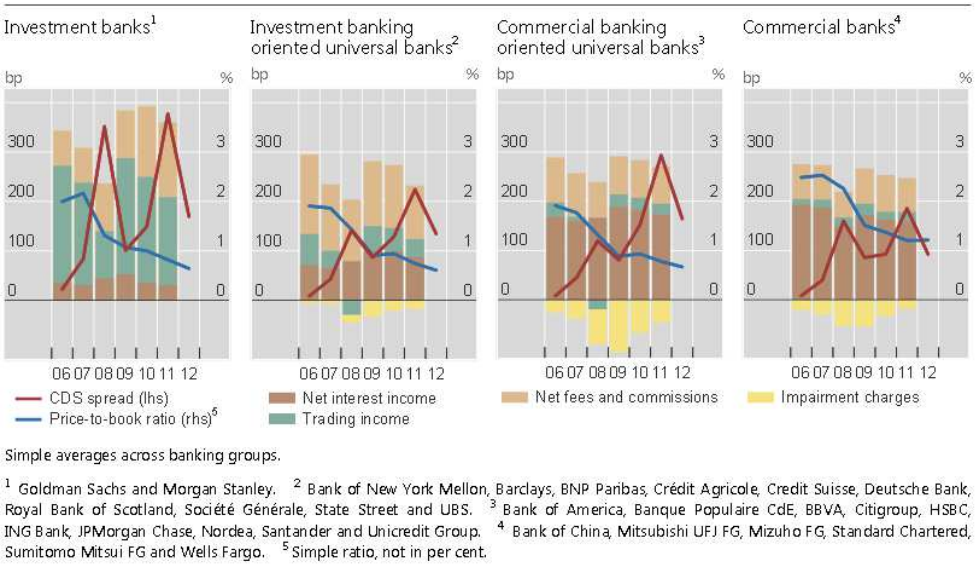
Banks report in their financial statements NFCI as part of operating income. It should be noted that fee and commission are not the same. Whereas a fee refers to a fixed payment, commission is mostly calculated as a percentage of the value of each transaction that the client orders. Fees are mainly applied in valuation of those products whose nature is not transferring a certain risk on a bank including non-sufficient funds fees, overdraft charges, late fees, monthly service charges, account research fees, payment cards-related fees (Půlpán, 1998). On the other hand,

commission applies to products by which the bank accepts certain level of risk including commissions from insurance activities, commission for agency service regarding selling products of external financial entities, commission due to guarantees granted, commission on trust and fiduciary activities.

2.2 Optimal level of banking fees: Does any optimal share of net fee and commission income exist?

When studying the optimal level of NFCI from bank's point of view, it is important to look which structure of income leads to highest financial stability of a bank. Three main business strategies can be identified: i) commercial banks, ii) investment banks and iii) universal banks. Commercial banks provide the most important financial services such as deposit taking and loan providing (i.e. traditional activities). They make money mainly on charging higher interest on loans than what they are paying on clients' deposits. Investment banking is the part of banking activities that are potentially more risky and generally not as important as activities of commercial banks. This includes services and financial advisory to corporations as well as for example securities issuance (i.e. non-traditional activities). Investment banks make their money mainly on trading, fee and commission income (with an approx. >40% NFCI/total income ratio). Universal banks combine commercial and investment banking within one group. The income composition of those banks reflects the combined structure of the business. Investment oriented universal banks have higher net fee and commission income than interest income, commercial banking oriented universal banks have higher interest income than net fee and commission income. Income structures of different banking business strategies can be seen in Figure 2.1.

The universal banking offers many advantages; primarily, universal banks are able to provide a broad range of services, due to economies of scale and scope they are able to reduce their costs and because of higher level of diversification they offer greater financial stability (Schildbach, 2012). Financial crisis has shown that besides those benefits there are also issues connected to the new trend of universal banking, mainly complexity and intransparency. Moreover, large interconnectedness increases the systematic risk. In response to the financial crisis, the economic costs and benefits of universal banks were reassessed and several alternative models that should separate certain banking activities were considered. Generally, 'commercial' and 'investment' banking businesses should be separated. The main tree alternatives of such separation are the Volcker rule in the United States, the Liikanen Report suggested by the European Commission and the Vickers Commission proposed in the United Kingdom.



Simple averages across banking groups.

[1] Goldman Sachs and Morgan Stanley. [2] Bank of New York Mellon, Barclays, BNP Paribas, Crédit Agricole, Credit Suisse, Deutsche Bank, Royal Bank of Scotland, Société Générale, State Street and UBS. [3] Bank of America, Banque Populaire CdE, BBVA, Citigroup, HSBC, ING Bank, JPMorgan Chase, Nordea, Santander and Unicredit Group. [4] Bank of China, Mitsubishi UFJ FG, Mizuho FG, Standard Chartered, Sumitomo Mitsui FG and Wells Fargo. [5] Simple ratio, not in per cent.

Figure 2.1: Main income components as percentage of total assets

Source: Gambacorta and van Rixtel (2013) based on Bankscope, Datastream and BIS estimates

The Volcker rule forbids deposit taking institutions proprietary trading. The restriction is quite strict, because the trading activities are allowed to exist neither in different subsidiaries within the same group. The Liikanen Report restricts besides the proprietary trading also market-making. But the activities are allowed to be executed within the same group as long as they are in separate subsidiaries. The Vickers Commission's approach excludes a large set of banking activities from the protected entity. The activities can exist in different subsidiaries within the group but subject to intragroup constraints (Gambacorta and van Rixtel, 2013).

One can argue whether the separation of commercial and investment banking would really improve the financial stability or whether the less diversified entities would be more volatile. In other words, a question remains whether including non-interest income – a very rough proxy for more investment banking-like activities – increases or decreases the riskiness of a bank.[2] Lepetit et al. (2007) claim "*banks expanding into non-interest income activities present higher risk and higher insolvency risk than banks which mainly supply loans*". Higher non-interest income may also lead to increased earnings volatility. Moreover, they claim that the positive link with risk is more accurate for small banks and essentially driven by commission and fee activities. This is also supported by Köhler (2013) who provides evidence that only commission and fee income influences the bank stability; trading income has no

[2] More detailed literature review regarding the impact of income diversification on bank profitability and stability can be found in Section 4.2.1.

impact on the riskiness of a bank. Both articles also agree that non-interest income is usually more volatile than interest income, which is probably due to the fact that switching of lending relationships would be very difficult for borrowers because of information costs.

On the other hand, Köhler (2012) argues that banks will become more stable if they increase their non-interest income and that the effect decreases with the bank size. In his later article, Köhler (2013) does a more detailed research and finds substantial benefits from income diversification for smaller and more retail-oriented banks. Those banks can become more stable by increasing their share of non-interest income. On the contrary, larger and more investment-oriented banks should increase their share of interest income to become more stable. Smith et al. (2003) state in their article that income diversification can reduce the risk and stabilize the profitability of banks only if the different earnings are independent. They found a negative correlation between interest and non-interest income in several countries and non-interest income therefore seems to stabilize total operating income. But the evolution of non-interest income, which is more volatile, does not fully offset the reduction in interest margin.

Some of the above claims are supported by the past U.S. empirical evidence. DeYoung and Rice (2004b) conclude that reliance on fee-based activities tends to increase the volatility of banks earnings streams. Moreover, traditional banking services remain the single largest source of non-interest income. DeYoung and Rice (2004a) also found that well managed commercial banks expand more slowly into non-interest activities. On a related note, Stiroh (2002) says that greater reliance on non-interest income is more risky. He claims that the declining volatility of net operating income did not reflect the diversification benefits from non-interest income (which are quite volatile and increasingly correlated with net interest income), but rather reduced volatility of net interest income.

Thus we can say that the non-interest income and especially NFCI seems to influence the bank's stability and riskiness. The exact impact of the level of non-interest income is dependent on the business model and size of the bank, however. Whereas commercial banks, mainly dependent on interest income, can gain by increasing their fees and commission income, investment banks should rather rely more on the interest income to stabilize their profits. Therefore, the regulation will reduce the risk only by certain banks while by other the risk may increase. All in all, the question which business model and which level of non-interest income is optimal has not been solved yet.

3 Empirical analysis on macro level

The shape of banking industry has been dramatically changing during last years. Technological development, deregulation, financial liberalization, increased competition as well as establishment of European Economic and Monetary Union were characteristic for European banking system. One of the most pronounced changes was an increased activity of EU banks in non-traditional activities. This has caused that NII accounted for most dynamic component in bank income structure during the turn of the 21st century. NII is composed of heterogeneous components which have different relative importance. The most pronounced part of NII is net fee and commission income that accounted on average for 58% of all NII between 1993 and 1998 in EU countries. Nevertheless, it is important to note that the composition of non-interest income differs across European countries significantly. Whereas in the United Kingdom NFCI represented more than 70% of NII in 1998, it was only 35% in Portugal and Sweden (ECB, 2000). Moreover, fee structure in different EU-27 countries is also discrepant. While some countries charge high fees for payments, others depend rather on account management and cash utilization fees (Capgemini at al., 2008).

We can observe efforts to compare individual components of banking fees across different EU countries, but very poor transparency makes such comparison extremely difficult. The European Commission (2009) compared the prices of current accounts across EU-27 countries. They divided the users according to their activity into four groups and compared the average costs of current accounts of those profile customers. The overall price differences were very large and ranged from maximum of EUR 831 in Italy to a minimum of EUR 28 in Bulgaria. In most of the examined cases, the Czech Republic reported lower than average current account fees. Only the active users (comprising the top 1/3 users when individuals are ordered according to their usage intensities) paid in the Czech Republic higher fees compared to EU-27.

Capgemini at al. (2008) claim that it is important to compare the fee magnitude not only between different countries but also within country, because retail banking is mainly a national business. Moreover, most EU consumers do not show high intention to switch bank providers (TNS, 2012). Relatively high differences between national banks' prices are usually associated with quickly changing markets. Decreasing discrepancies between 2005 and 2008 could be observed in all examined

regions. Moreover, in the Czech Republic the discrepancies were permanently below the EU-27 average.

Despite the findings of the European Commission (2009) and Capgemini et al. (2008), Czech clients are increasingly unsatisfied with the credit institutions that are, from their point of view, imposing excessively high fees on their products and services (bankovnipoplatky.com, poplatkyzpet.cz). This intolerance of banking fees led to a boom in low-cost banks that are providing their services without fee and who are making their profit mainly on interest income or trading income. The problem of such banks is that they are much more risky and often unable to keep up with the competition in the long run.[3]

It is very important to study the overall development of NFCI as well as the development of NFCI on individual country levels in order to be able to identify the impacts of the increasing NFCI on the profitability and riskiness of banks. In this section, we provide an analysis of banking fees based on data taken from the European Central Bank (ECB) and the Czech National Bank (CNB). The study includes the EU-27 data from 2007 to 2012.[4] For better transparency, we divided the EU in five different groups (PIIGS, CEE, EU-17, EU-27 and CZ[5]) that are compared to each other. Firstly, we compare fee income of EU-27 banking sectors based on different ratios and indicators.[6] Besides the basic ratios we also discuss the relation between fee and commission income magnitude and return on average equity (ROAE) and the influence of the market concentration on the NFCI magnitude. Thirdly, we take a narrow view on banks' fee income in the Czech Republic. We start

[3] This follows from reliance on funding from savings accounts, limited and undiversified product portfolio, reliance solely on interest income, and losses reported in most of the low-cost banks in the Czech banking sector. See also discussion on in Section 3.2.1.

[4] The yearly total operating income for Denmark was not available in the ECB database. We took the semi-annual data from 2010 to 2012 (which were the only data available) and approximated them to yearly data by multiplying by two. The 2008 and 2009 yearly total operating income was approximated by the averages obtained from 2010 and 2012 entries.

[5] The exact composition of each group can be found in Appendix A.

[6] The data for some countries were available starting from year 2008 and not already from 2007. Starting from 2007 we got data for – BE, BG, CZ, FI, FR, IT, LT, MT, PL, PT, RO, SK, SI, starting from 2008 we got data for – AT, CY, DE, DK, EE, EL, ES, HU, IE, LU, LV, NL, SW, UK. The descriptive statistic and all other analyses were adequately adjusted to take into account this fact.

by looking at the development of the fee income in the Czech banking sector as a whole in the 2007–2012 period and then we compare the fee income strategies of different Czech banks. This section includes only very simple and general models that are not necessary robust to failures. The rigorous regression models are provided in Section 4.

3.1 Banking fees in the EU

This part analyses the NFCI of different groups of EU countries.[7] Total banking income is split up into 3 categories: i) net interest income, which represents the major part of total operating income in banks in all European countries, ii) NFCI, which is the most important part of non-interest income in the examined countries and iii) other net income that stands for all income of a bank that is different from the previous two.[8]

3.1.1 Comparison of fee income magnitude in EU banking sectors

When assessing banking fee income in the EU, we investigate three indicators: net fee and commission income to total income ratio (NFCI/TI), net fee and commission income to total assets ratio (NFCI/TA) and net fee and commission income to gross domestic product ratio (NFCI/GDP).

Figure 3.1 shows that in 2007–2012 the average NFCI/TI ratio amounted to 23.9% in the Czech Republic. It means that it was lower than in most of other countries included in the EU-27 where the average level reached 24.6%. Only CEE countries posted lower average NFCI/TI ratio (22.5%). The difference seems to come rather from the earlier years, because in 2012 the Czech Republic reported lower NFCI/TI ratio than other CEE countries.[9]

[7] The exact countries included in individual groups can be found in Appendix A.

[8] See Appendix B.1 for the decomposition of income of the European banking sector.

[9] See Figure B.3 in Appendix B.2, where we display the evolution of NFCI ratios over time for each group of countries.

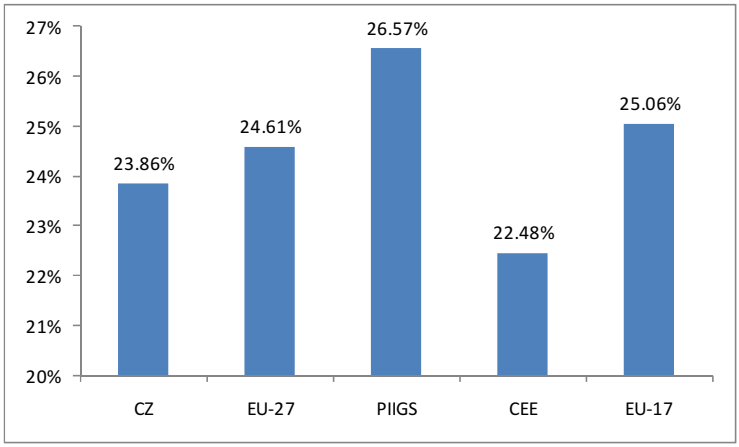


Figure 3.1: Net fee and commission income/Total income – averages for 2007–2012

Source: Author using data from the ECB

On the other hand, the Czech Republic reported the NFCI/TA higher than most of other EU-27 countries, what can be explained by a lower size of banks in the Czech Republic measured by total assets. This can be illustrated when comparing the Czech Republic and Finland. Both countries post nearly the same NCFI and NFCI/TI remained at approximately 24% on average in both of them in 2007–2012, but the NFCI/TA was in Finland almost three times lower than in the Czech Republic. So we conclude that the primary reason for different NFCI/TA ratios stems in a relative smaller bank intermediation in the Czech Republic compared to EU-17 countries. On the other hand, when comparing the Czech Republic with other CEE countries, the Czech Republic does not report an extraordinarily high NFCI/TA ratio (Figure 3.2).

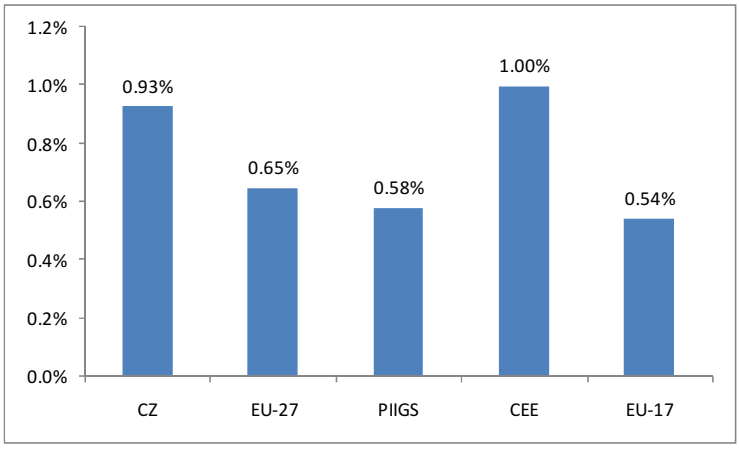


Figure 3.2: Net fee and commission income/Total assets – averages for 2007–2012

Source: Author using data from the ECB

The third indicator we are using to analyse net fee and commission income in EU countries is NFCI/GDP. In the 2007–2012 period, the Czech Republic together with Finland, Poland, Romania and Slovakia reported the lowest NFCI/GDP ratios of all EU-27 countries. The Czech Republic and CEE are the only countries that reported NFCI/GDP ratios below 1.0%, whereas the other groups' ratios exceeded 1.5% as documented in Figure 3.3. This figure indicates that banks resided in the Czech Republic do not report a higher-than-average NFCI/GDP ratio.

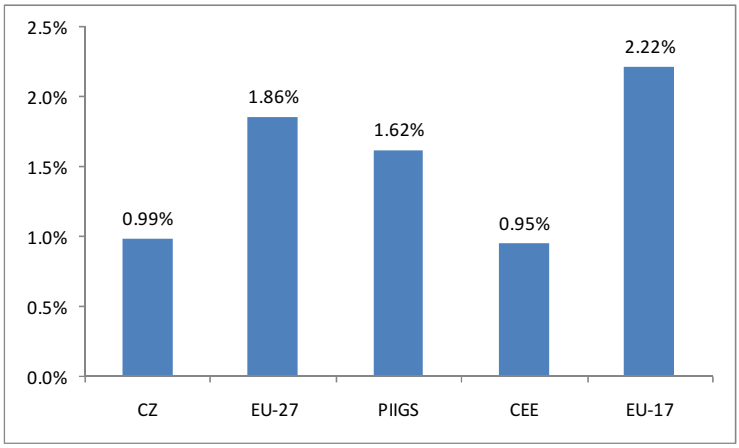


Figure 3.3: Net fee and commission income/GDP – averages for 2007–2012

Source: Author using data from the ECB

Table 3.1 summarizes results of the above-mentioned indicators and provides evidence that the Czech banking sector does not rely on NFCI more than the other EU banking sectors measured by the NFCI/TI, which is probably the most important indicator in context of banking fees, and the NFCI/GDP. Nevertheless, the Czech banking sector reported a higher-than-average NFCI/TA what is caused chiefly by a relatively lower size of Czech banks compared to their EU peers.

Table 3.1: Average net fee and commission income ratios of different groups of EU countries compared to EU-27 averages (years 2007–2012)

	NFCI/TI	NFCI/TA	NFCI/GDP
CZ	-	+	-
PIIGS	-	-	-
CEE	+	+	-
EU-17	+	-	+

Source: Author's computations

3.1.2 Influence of the market concentration on the magnitude of fee income

The relationship between the competition and the magnitude of NFCI may be analysed by several ways. For instance, the ECB provides the Herfindahl index (HI) as a measure of market concentration through assessing the size of firms in relation to the industry. The HI's values range between 0–10,000 (0%–100%). Values below 1,000 indicate low concentration, values of 1,000 to 1,800 correspond to moderate concentration, and a HI over 1,800 indicates high concentration (Neven and von Ungern-Sternberg, 1998).

Figure 3.4 displays that – on average – there is a moderate market concentration in the European Union (EU-27 HI averages around 1,100). The Czech Republic lies with the HI of 1,030 slightly below the average which means that the Czech banking sector is more competitive than banking sectors of other EU countries, but still it belongs to the group with moderate concentration. PIIGS and CEE report the HI even lower than the Czech Republic. On the other hand, EU-17 countries post average HI of nearly 1,200 but they still count to moderate concentration group. The relatively high HI is caused mainly by Finland, Estonia and Netherlands with HIs above 2,000.

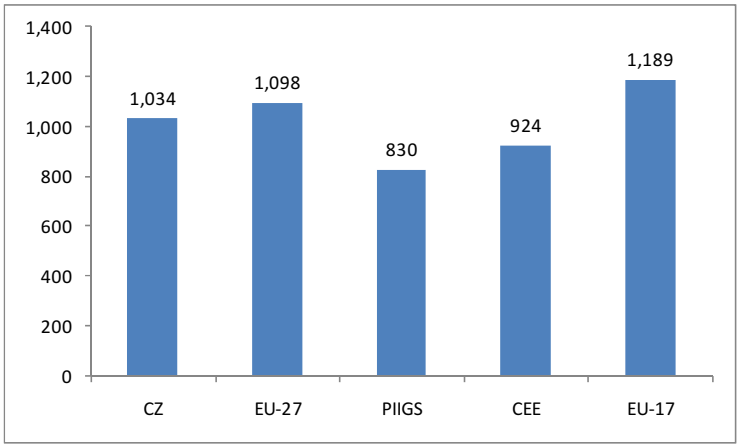


Figure 3.4: Average Herfindahl index from 2007 to 2012[10]

Source: Author using data from the ECB

Increasing competition is assumed to be one of the main reasons forcing banks to switch to non-traditional fee bearing activities. Therefore, we hypothesize that higher competition is connected with higher level of fee income in the banking sector. Still,

[10] A comparison of HI in 2007 and 2012 in different groups of EU countries is displayed in Appendix B.3.

the relationship between NFCI and HI need not to be necessarily the one stated in the hypothesis. The explanation is intuitive. The lack of competition may enable to charge high banking fees. On highly concentrated markets cartels may prohibit the players to reduce their prices; therefore, a possibility to switch to a cheaper provider of banking services remains limited. We also assume that most clients are conservative and not enough flexible to deposit their money or take a loan from abroad because of financial fragmentation in EU markets. Moreover, in case of high concentration the bank will take the advantage of its market power not only by charging higher fees but it will most probably exhibit also higher interest margins. Therefore, the share of fee income does not need to increase. Consequently, we expect to find a negative relation between NFCI and HI.

Figure 3.5 demonstrates empirical results. We regressed the average HI on the average NFCI/TA ratio. In order to obtain convenient results, we have chosen a NFCI/TA ratio as an indicator of the magnitude of net fee and commission income because the Herfindahl index is constructed by the ECB for credit institutions in terms of total assets. At the first sight, it can be seen that the relation between HI and NFCI/TA ratio, if there is any, is not statistically strong (the points on the Figure 3.5 are distributed very randomly). For example, the most concentrated banking sectors (such as Estonia and Finland both with the HI approximately 3,000) do not have higher NFCI/TA than the EU-27 average.

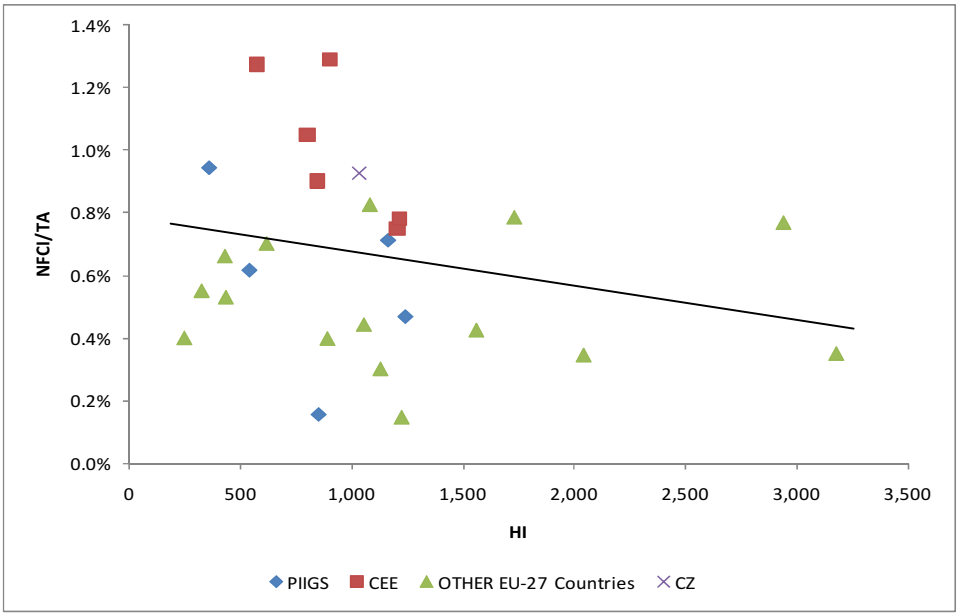


Figure 3.5: EU-27 – Relation between Net fee and commission income/Total assets and the Herfindahl index based on average data from 2007 to 2012

Source: Author using data from the ECB

Figure 3.5 plots the following regression line:

$$NFCI/TA = -0.9E-07\ HI + 0.007 + e, \text{ where } e \text{ is the disturbance.}$$

The relation between NFCI/TA and HI seems to be the in line with what we have expected. Anyhow, the regression results are not convenient because its R^2 amounts only 0.0405 meaning that approximately 4% of total variation in the dependent variable is explained by the variation in independent variable.[11] Moreover, the coefficient of HI is very low in absolute terms and insignificant (the p-value is 0.314). This implies that the HI influences the NFCI/TA ratio only marginally, if at all. There are other factors that are omitted in our regression that could explain the magnitude of fee and commission income much better.[12] To conclude, when examining the impact of the market competition on the magnitude of NFCI on international level, the obtained results show no real dependency between those two variables. This surprising result implicates that even concentrated markets in terms of assets might be competitive in terms of NFCI.

3.1.3 Relation between banking fee income and ROAE

This section deals with the relation between net fee and commission income and return on average equity. We have regressed ROAE on NFCI/TA in Figure 3.6. The regression line[13]

$$NFCI/TA = 0.012\ ROAE + 0.006 + e, \text{ where } e \text{ is the disturbance,}$$

indicates that NFCI/TA and ROAE are positively correlated. R^2 for this regression line reaches 0.175 meaning that about 17.5% of total variation in the dependent variable is explained by the variation in independent variable. (In our model the dependent variable is NFCI/TA and independent ROAE, but the model can be defined also in a reverse way, the regression line will then be

$$ROAE = 14.624\ NFCI/TA - 0.089 + e, \text{ where } e \text{ is the disturbance,}$$

R^2 remains for this reversed regression the same.)

[11] Adjusted R^2 is 0.0021.

[12] A more detailed analysis of factors influencing NFCI can be found in Section 4.1.

[13] Intercept and slope coefficient are both significant.

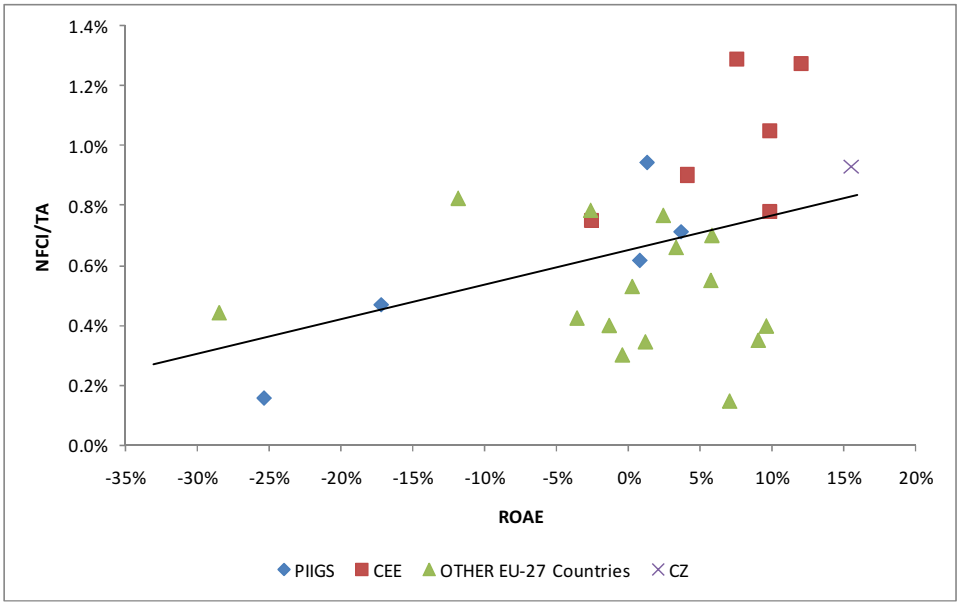


Figure 3.6: EU-27 – Relation between Net fee and commission income/Total assets and ROAE based on average data from 2007 to 2012

Source: Author using data from the ECB

It can be concluded that the higher the NFCI/TA ratio, the higher the expected ROAE is. This positive correlation is present mainly in CEE and PIIGS countries (if we do the regression separately for those countries R^2 increases significantly), but in other EU countries this relation does not seem to be present at all. The reason is mainly that we measure the magnitude of net fee and commission income based on NFCI/TA ratio which reflects heavily besides the magnitude of banking fees also the size of the banking sector in a given economy. This means that our results need not show just the impact of fee income on the profitability (measured by ROAE) but also the impact of bank size on the profitability. The three countries with the most negative average ROAE Ireland, Cyprus and Greece have all relatively low average NFCI/TA ratios but based on other indicators it can be seen that their net fee and commission income is not as low as suggested by NFCI/TA ratio. Together we can say that fee income has probably some impact on ROAE, but the profitability of a bank is dependent on many other factors and therefore it is not possible to say how large role the fee income plays based on this very limited model.[14]

[14] A more detailed analyse of the factors that influence ROAE on individual bank level can be found in Section 4.2.

3.1.4 Comparison of profitability of EU banking sectors

Figure 3.7 depicts the change in ROAE between 2007 and 2012 in different groups of EU countries. In 2007, the differences in ROAE in the individual countries were not so strong. Moreover, in 2007 all examined banking sectors were in black numbers and ROAE of the Czech Republic was just slightly above the EU-27 average (18.4% vs. 16.8%). This changed heavily during the global crisis. In 2012, nine of the twenty-seven EU countries reported a negative ROAE. Furthermore, the losses of those countries were so huge that the overall average ROAE for EU-27 resulted negatively (especially in PIIGS countries with average ROAE at -24.2%). On the other hand, CEE countries remained in black numbers in 2012, but also their average ROAE dropped heavily by more than 16% to a mere 1%. In 2012, the Czech Republic reported the second largest ROAE in the European Union after Estonia (14.1% vs. 14.2%).

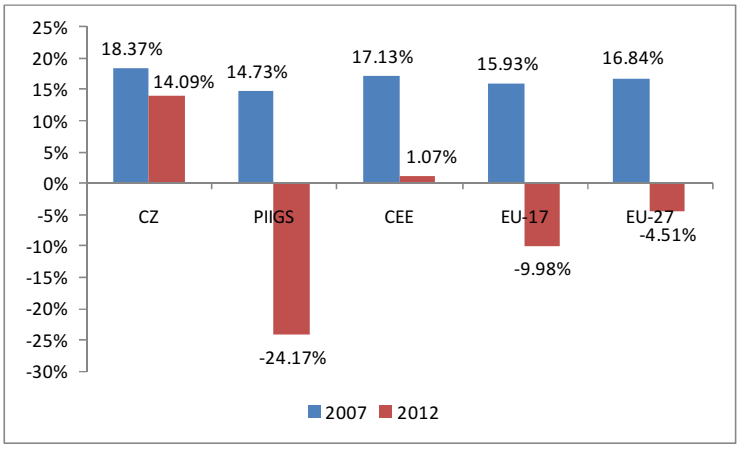


Figure 3.7: ROAE in different groups of European countries in 2007 and 2012

Source: Author using data from the ECB and the IMF

The pending soundness of the Czech banking sector can be attributed mainly to banks' proper risk management and high cost efficiency (EBF, 2012). This has also prevented the Czech banking market from large losses during the global financial crisis. In this aspect, the following reasons played a significant role: i) a relatively small exposure to toxic assets and PIIGS countries, ii) traditional conservative commercial banking concentrated on domestic market and related low exchange rate risk, iii) centralized 'under-one-roof' and conservative supervision, iv) conservative clients and high liquidity surplus (with a low dependency on inter-bank market or central bank, loan-to-deposit ratio is constantly under 80%), v) sufficient capital buffers (the capital adequacy ratio is higher than 15% in the Czech Republic) and a high quality of capital (EBF, 2012). All in all, we can say that the high profitability of

the Czech banking sector may be attributed to proper risk management rather than to a high level of banking fees as will be discussed also below.

3.2 Banking fees in the Czech Republic

In this section, we describe the NFCI in the Czech Republic based on data provided by the CNB. As in previous sections, total operating income is split up into three groups: i) net interest income, ii) net fee and commission income and iii) other income. Figure 3.8 depicts that – as in other EU countries – interest income forms the largest part of total income in the Czech banking sector, what corresponds to the applied commercial banking model in these countries. The second greatest part of income is acquired from banking fees that account for the most important non-interest income of banks. The figure illustrates that the NFCI increased slightly in the 2007–2012 period by from CZK 35.8 billion to CZK 37.3 billion, what implies a mere CZK 1.4 billion rise or a 0.8% compound annual growth rate.

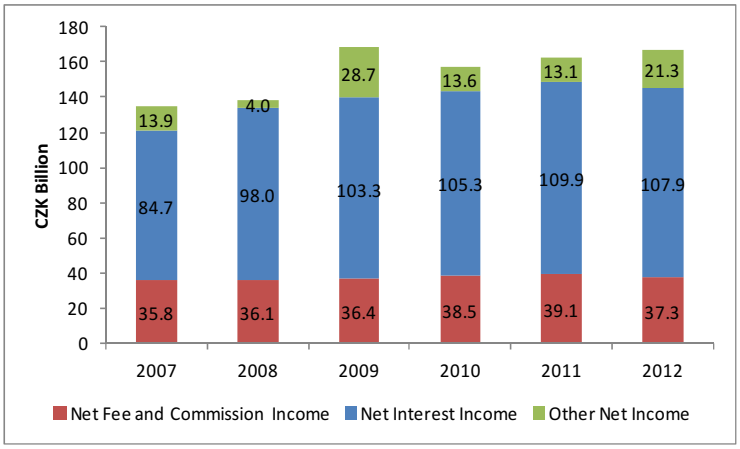


Figure 3.8: Czech banking sector – Total operating income decomposition 2007–2012

Source: Author using data from the CNB

It is worthwhile to note that despite the fact that the NFCI increased in absolute values between 2007 and 2012, in relative values its share on the total income fell by 4.3% (from 26.7% in 2007 to 22.4% in 2012). This decline can be seen in Figure 3.9 and Figure B.3. On a related note, interest income share went up by 1.8% during the same time period. From this we can conclude that the NFCI/TI has been decreasing in the Czech banking sector, which has been caused by higher competition as analysed below.

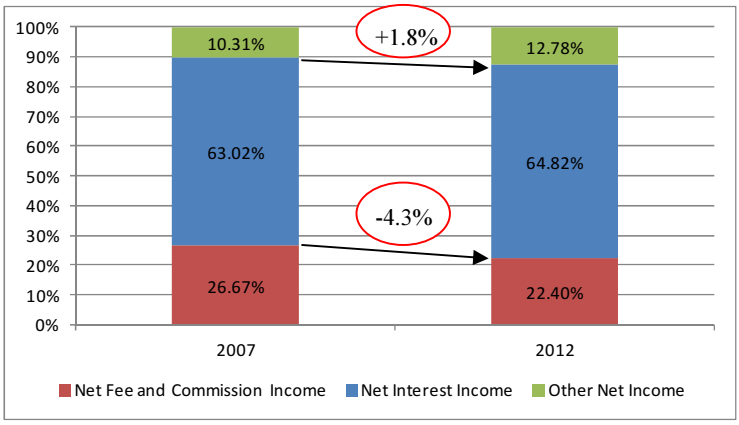


Figure 3.9: Czech Republic – Total operating income decomposition 2007 and 2012 in Percent

Source: Author using data from the CNB

3.2.1 Different banking models in the Czech Republic

As of December 31th 2012, the Czech banking sector consisted of 43 bank institutions, there of 18 banks, 20 foreign bank branches and 5 building societies. The CNB recognizes five banking types in the Czech Republic: i) large banks, ii) medium-sized banks, iii) small banks, iv) foreign bank branches and v) building societies.[15] About 80% of the capital in the Czech banks originates in foreign countries. The TOP 4 banks dominated the market with almost 60% share. However, their share was steadily declining over the last few years due to relatively strong competition from medium and small sized banks (CNB, 2012).

Figure 3.10 shows the development of HI in the Czech Republic from 2007 to 2012. In all considered years, there was moderately high market concentration in the Czech banking sector since HI fluctuated from 999 to 1,100. The decrease in HI between 2007 and 2012 can be attributed mainly new market entrants which we call low cost-banks,[16] i.e. the banks offering a limited product portfolio and providing a large part of their services without fees. The first low-cost bank – mBank – came to the Czech Republic in 2007 and filled the gap on the Czech market; nowadays there are about five low-cost players in the Czech banking market. To attract new clients, these banks often offer high interest on saving accounts. Therefore, these excessive rates might be perceived as acquisition costs rather than a money making business.

[15] For a complete list see CNB (2013, p. 105). Financial Market Supervision Report 2012

[16] Sometimes called as 'electro' or 'internet' banks.

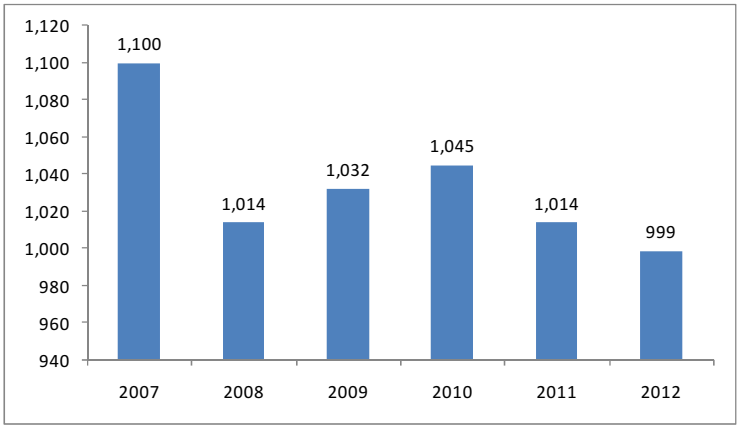


Figure 3.10: Development of the Herfindahl index in the Czech Republic between 2007 and 2012

Source: Author using data from the ECB

Not surprisingly, the low-cost banks and other banks differ in their income structures. Due to their basic 'zero-fee policy' strategy, the low-cost banks' NFCI is marginal or even negative. Figure 3.11 shows that 'traditional' banks (Česká spořitelna, ČSOB, Raiffeisenbank, Komerční banka, UniCredit Bank, GE Money Bank) reported in 2012 positive NFCI/TI in a range from 16.3% (ČSOB) to 29.5% (ČS). On the other hand, low-cost banks Equa Bank (EQ) and Air Bank (AIR) reported negative net fee and commission income in the same year. ZUNO Bank (ZUNO), with NFCI/TI of 26% seems to be rather one of the 'traditional' banks that rely heavily on non-interest income. In reality, the high ratio is only due to the fact that ZUNO Bank was in red numbers in 2012. It had net fee and commission expense of CZK 6 million but due to the operating loss the ratio resulted positive.

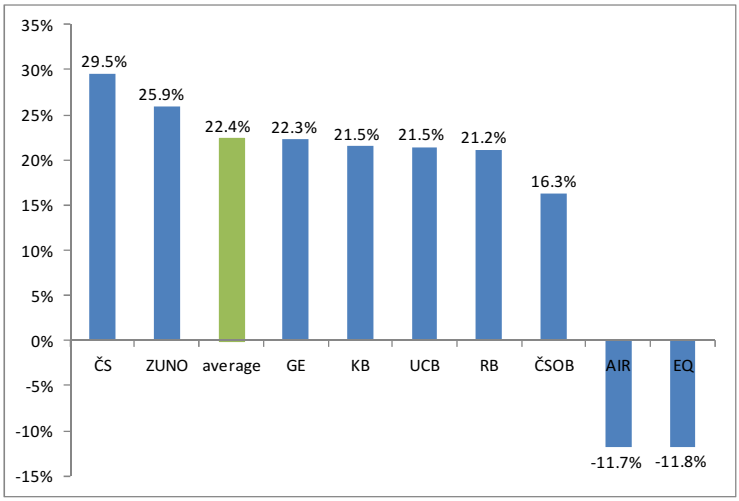


Figure 3.11: Net Fee and Commission Income/Total Operating Income in Czech Banks in 2012

Source: Author using data from individual banks and the CNB

The future development of low-cost banks remains a big question mark, however. First, they often rely on funding from savings accounts, i.e. risky instruments that cannot be hedged by standard risk mitigation techniques (Džmuráňová and Teplý, 2013). Second, low-cost banks offer a limited product portfolio (e.g. savings and current accounts, consumer loans, mortgages) what makes them vulnerable to competition and low prices. Sometimes this is called 'commoditization' defined as a lack of meaningful differentiation in these products, i.e. a client focuses on product price rather than product quality. Last but not least, some low cost banks report risky portfolios since they rely solely on interest income and most likely lend money to risky borrowers (often rejected by traditional banks). We argue that many low-cost banks in the Czech Republic serve as special purpose vehicles within their financial groups rather than banks maximizing their profits.[17]

3.3 Further research opportunities

During the research, we have identified the following further research opportunities: the comparison of fee income in different countries could be done based on larger number of countries, mainly those in Europe but outside the European Union because of clear similarities among their financial markets. Inclusion of banks across different continents would need more sophisticated analytical methods in order to capture the differences among the banking sectors adequately.

We also propose to compare the fee and commission income based on the bank type, since from the literature follows that the business strategy of a bank tends to influence the NFCI magnitude heavily.

Regarding the examination of Czech banking sector, we suggest to perform a similar analysis in few years. This is because the low-cost banking represents quite new but at the same time rapidly growing business strategy and currently it is not possible to make any final conclusions about the stability and performance of this type of banks.

As already mentioned, this part of the thesis does not use any advanced analytical methods, it shows only very simple relationships. Robust methods will be needed to examine the links between market concentration, fee income magnitude and profitability more consistently. Some of them are provided in the following empirical analysis.

[17] For more details about the income structure of traditional and low-cost banks see Case study: Income structure of Česká spořitelna vs. Equa bank and Air Bank in Růžičková (2014).

4 Empirical analysis on micro level

In this section, we provide an empirical analysis on bank level based on EU-27 data from 2007 to 2012. The data were taken from Bankscope database, ECB database, Eurostat, The World Bank DataBank and HelgiLibrary database. We are mainly interested in the relationship between market concentration (measured by Herfindahl index) and the magnitude of NFCI in European banks. Moreover, we study the determinants of bank performance with a special emphasis on NFCI/TI.

4.1 Relation between market concentration and banking fees

In this section, we examine what determines the magnitude of NFCI of banks. Besides commonly used bank interior and exterior factors, we include market concentration as a determinant of NFCI. Increased competition is considered to be one of the main causes for switching from traditional deposit-lending strategy to non-traditional activities. In our work, we analyse whether the level of competition influences the share of NFCI, knowing that the expansion in NFCI bearing activities is considered to be connected with market concentration. Therefore, we test the hypothesis that banks in countries with low concentration display higher shares of fee and commission income.[18]

4.1.1 Literature review

As banks have become more involved in non-traditional activities that generate fee and commission income, the number of literature examining the common features of banks expanding into non-traditional areas has grown. While there are more studies trying to document the determinants of NII share at the bank level, the literature studying the relation between market concentration and the magnitude of NFCI is limited. The first paper examining the correlation between HI and NII was Moshirian

[18] As in Section 3.1.2, we are aware of the fact that high concentration may allow the bank to charge higher fees, suggesting that the relation between NFCI share and HI should be the opposite one. But since banks in highly concentrated markets may take advantage of their market power to charge also higher interest, the effect on NFCI/TI ratio will be probably limited.

et al. (2011). Based on data from 20 developed countries (109 banks), they found that banks facing high concentration have lower levels of non-interest income activity. Moreover, they included a variable measuring the change in market competition which turned out to be significantly negative. This means that even though the concentration is slowly moving variable, also small changes influence the income composition of banks significantly. This indicates that banks in highly competitive markets are more likely to engage in risky behaviour including expansion in non-traditional activities. Similarly as the U.S. studies Moshirian et al. (2011) conclude that large banks with smaller net interest margin (NIM) exhibit higher non-interest income.

The following papers deal with the determinants of NII in general, none of them specialized on the market concentration.

Rogers and Sinkey (1999) found that banks with high non-interest income tend to be larger, have smaller NIM, have relatively fewer core deposits and exhibit less risk. Banks with low net interest margin and few core deposits earn less revenue from traditional activities and must therefore engage in non-interest bearing services in order to remain profitable.

DeYoung and Hunter (2003), DeYoung et al. (2004) and DeYoung and Rice (2004a) also concluded that non-interest income is positively correlated with bank size. They argue that large banks take advantage of economies of scale and operate with very low unit costs. Despite this fact, they tend to earn very low interest margins because of large competitiveness of this market. Thus large banks need to rely heavily on NII in order to be profitable. On the other hand, small banks operating in local markets develop relationships with their customers. Although they have high unit costs, they are able to remain profitable because of high interest margins. NII is less important to those banks. They also found that well managed banks generate less NII, because they do not tend to expand into activities that have poor risk-return tradeoff.[19]

In comparison to Rogers' and Sinkey's study DeYoung and Rice (2004a) included to the model also bank external factors that may influence choice of the proportion of NII. They claim that banks located in states with strong economies and banks with high market power are able to generate more NII. Moreover, they find that banks

[19] DeYoung and Rice (2004) found that non-interest income has negative effect on risk-adjusted performance of banks (measured by Sharpe ratio).

with more developed payment technologies such as credit cards, debit cards or electronic checks generate increased fee income.

Most of the later research is based on the previous ones. The hypotheses that were tested in the above mentioned papers based on U.S. commercial banks' data are examined on data from other countries. Shahida et al. (2006) applied the Rogers' and Sinkey's model on panel of Malaysian Islamic commercial banks. They concluded that banks with higher levels of fee-generating activities tend to have higher assets and core deposits as well as exhibit less risk. Compared to Rogers and Sinkey (1999), they found no significant relationship between fee income and NIM. The fee income and core deposits turned out to be positively correlated. This indicates that Islamic banks with traditional sources of funds are associated with more non-traditional activities as sources of income.

Craigwell and Maxwell (2005), Bailey-Tapper (2010) and Kim and Kim (2010) followed the framework from DeYoung and Rice (2004a). Craigwell and Maxwell (2005) investigate the determinants of NII and its impact on financial performance of commercial banks in Barbados between 1985 and 2001. The results show that contrary to other Caribbean countries and developed world, NII in Barbados decreased over the examined period. This could be caused by the absence of deregulation and technological change mainly in loan securitization and credit scoring. The results support the importance of bank specific and market development factors by determining the non-interest income share, although the found coefficient signs or their significances are not always in line with the findings of DeYoung and Rice (2004a). Contrary to findings in the United States the job growth in the economy has no significant impact on NII. Furthermore, larger banks are associated with lower NII than smaller banks which also deviates from the U.S. empirical results.

Bailey-Tapper (2010) investigates NII based on Jamaican panel data. In contrast with the U.S. evidence, well managed banks in Jamaica tend to generate more NII than other banks. Another result that is in contrast with a priori expectations is that core deposits decrease NII. This suggests that banks do not generate higher fee income in a context where customers' demand is inelastic. This paper also concluded that some macroeconomic conditions, especially exchange rate and interest rate volatility, have significant impact on income diversification of bank.

Kim and Kim (2010) document the long-run trends in the amount and composition of NII at South Korea banks. Most of the coefficients in this study resulted insignificant. Loans to assets ratio as well as core deposits to total assets ratio are negatively

correlated with NII share. Besides those two indicators, only technology variables[20] turned out to influence the NII of Korean banks significantly.

Hahm (2008) based his study on data from 29 OECD countries and he analysed both bank specific as well as macroeconomic factors. He found that large and more profitable banks with relatively low NIM and low loans to assets ratio tend to exhibit higher NII ratio which is consistent with conclusions of Rogers and Sinkey (1999), DeYoung and Hunter (2003) and DeYoung et al. (2004). He also claims that risk-taking banks and less cost efficient banks are diversifying their revenue more aggressively by increasing their NII. Among macroeconomic factors, GDP growth, inflation and market capitalization seem to be important determinants of NII.

We conclude that common factors determining the income diversification can be found but their impact on NII varies across countries. The largest differences can be identified when analysing the developed and developing economies separately. Moreover, there are factors influencing the composition of bank income that need to be studied more deeply. Table 4.1 provides a summary of the literature review.

Table 4.1: Overview of the key empirical works on determinants of NII magnitude in banks

Authors	Short description	Methodology and data used	Determinants of NII
Rogers and Sinkey (1999)	Examination of features common to banks that are heavily engaged in non-traditional activities	Fixed effect (FE) and random effect (RE) models estimated by Generalised Least Squares (GLS) method applied on data from 8 931 U.S. commercial banks in 1989–1993	Bank size (assets), bank profits (NIM), core deposits, bank risk (equity capital, liquid assets, interest rate gap, provision for loan losses)
DeYoung and Rice (2004a)	Analysis of empirical links between bank NII, business strategies, market conditions, technological change, and financial performance	3 equations model (dependent variables: NII ratio, ROAE and standard deviation of ROAE) estimated by GLS, based on data from U.S. commercial banks in 1989–2001	ROAE, loans and its structure, core deposits, full-time-employees, assets and its growth, dummy for credit card banks, organizational form, ownership, market power, growth in state employment, technology variables

[20] Variables used to proxy development and application of new technologies in the banking sector.

Craigwell and Maxwell (2005)	Studies the determinants of non-interest income and its impact on commercial bank financial performance in Barbados	Seemingly Unrelated Regression (SUR) using the same models as in DeYoung and Rice (2004a) and applied on data from commercial banks in Barbados in 1985–2001	DeYoung's and Rice's (2004a) model with following modifications performance (ROAA), loan concentration
Shahida, Abd. Ghafar, Sanep (2006)	Investigation of Islamic banks' involvement in various fee income activities	Cross-section FE and RE models applied on Malaysian Islamic banks' panel data in 1994–2004	See Rogers, Sinkley (1999)
Hahm (2008)	Investigation of determinants and consequences of NII diversification in commercial banks	Pooled ordinary least squared (OLS) and RE model applied on commercial banks in 29 OECD countries	Assets, ROAA, NIM, equity, loan and impaired loan ratio, cost-income ratio, GNI per capita, real GDP growth, real interest rate, inflation rate, market capitalization
Bailey-Tapper (2010)	Demonstration of empirical linkages between NII, financial performance and macroeconomics	DeYoung's and Rice's (2004a) models estimated by SUR and applied on Jamaican panel data in 1999–2010	Craigwell's and Maxwell's (2005) model with following extension – GDP growth, exchange rate volatility, variability in Treasury bill rates
Kim and Kim (2010)	Discussion of trends in NII at South Korea banks and its impact on the financial performance of those banks	OLS applied on DeYoung's and Rice's (2004a) models and data from South Korean banks in 1999–2009	See DeYoung and Rice (2004a)
Moshirian, Sahgal and Zhang (2011)	Examination of the correlation of concentration with NII	OLS regression with country and year FE based on data from 20 developed countries in 1996–2010	Assets and assets growth, HI and difference in HI, interest rate spread, equity, GDP growth, GDP per capita, inflation, country specific regulation, current account

Source: Author based on individual papers

4.1.2 Data and methodology

The data set is a balanced panel covering six years period between 2007 and 2012. Our study is based on data from 185 European banks (112 commercial banks, 14 savings banks, 17 cooperative banks, 15 real estate and mortgage banks, 10 investment banks, and 17 bank holdings and holding companies), i.e. on average we have data for almost 7 banks in each country available. The exact number of banks included in the study for each country can be seen in Table 4.2.[21]

Table 4.2: Number of banks included in the study by country

Austria	:	7	Germany	:	10	Netherlands	:	7
Belgium	:	3	Greece	:	4	Poland	:	7
Bulgaria	:	5	Hungary	:	3	Portugal	:	7
Cyprus	:	3	Ireland	:	2	Romania	:	2
Czech Republic	:	3	Italy	:	32[22]	Slovakia	:	3
Denmark	:	9	Latvia	:	1	Slovenia	:	6
Estonia	:	2	Lithuania	:	1	Spain	:	9
Finland	:	3	Luxemburg	:	1	Sweden	:	9
France	:	14	Malta	:	1	United Kingdom	:	31

Source: Author's computations

It can be seen from the literature review and Table 4.1 that most of the authors used FE, RE or pooled OLS estimation method for the analysis of NFCI (NII) magnitude determinants. We claim that those approaches can be outperformed by System Generalized Method of Moments (GMM) which we will apply. This is because we expect persistence in NFCI magnitude and the inclusion of lagged dependent variable

[21] The inclusion of more banks was not possible due to high number of missing data in the Bankscope database. Strongly unbalanced panel could make the estimation inaccurate. Moreover, we excluded all banks with negative operating income from the final data set, because their NFCI/TI ratio would be misleading.

[22] We had to adjust the number of Italian banks that was considerably higher than in other countries. This was caused mainly by the fact that in Italy, the same banks operating in different regions stand as separate legal entities (i.e. we had in our data for example more than twenty Cassa di Risparmio). Due to the regional separation, the Italian banks resulted to be much smaller than other European banks. In order to have a representative data set, we kept just 32 biggest Italian banks. (We considered also to merge and/or average the data for individual Italian bank types, but since we were not sure about the used accounting standards and consolidation, we decided rather to drop the small banks.)

leads to inconsistency of the previous methods. System GMM is appropriate for our data set with large number of banks and small number of time periods and is able to correctly deal with explanatory variables that are not strictly exogenous. In the following paragraphs we describe the System GMM theoretically and we justify our choice of the estimation method.

We deal with autoregressive-distributed lag model that uses large set of cross-section data and small number of time periods. The general model of the data-generating process is as follows:

$$y_{i,t} = \alpha y_{i,t-1} + X'_{i,t}\beta + \varepsilon_{i,t} \qquad 4.1$$

$$\varepsilon_{i,t} = \mu_i + v_{i,t}$$

$$E[\mu_i] = E[v_{i,t}] = E[\mu_i v_{i,t}] = 0$$

where $|\alpha| < 1$, $i = 1, \dots, N$ is the individual's index and $t = 1, \dots, T$ is a time index. The disturbance term has two orthogonal components: an unobserved individual-specific time-invariant effect, i.e. the fixed effects, μ_i, and the idiosyncratic shocks, $v_{i,t}$. While the number of individuals (N) is assumed to be large, the number of time periods (T) is assumed to be small. The exogeneity assumption required for consistency of pooled OLS estimation model (explanatory variables need to be uncorrelated with the disturbance term) is violated since $y_{i,t-1}$ and μ_i are necessarily correlated. This gives rise to so called dynamic panel bias. It followes that pooled OLS is inappropriate in case of dynamic panel data models (Wooldridge, 2002). Particularly, pooled OLS attributes more predictive power to the lagged dependent variable than it should have (Roodman, 2006).

As shown in Nickell (1981) and Bond (2002) also Least Squares Dummy Variable (LSDV) or Within Groups estimator that can be used to address the fixed effect are not able to eliminate the dynamic panel bias. The latter estimator is constructed as deviations of the original observations from its individual means, which removes the time-invariant individual effects. However, when number of periods is small, the transformed lagged dependent variable $(y_{i,t-1} - \frac{1}{T-1}(y_{i,1} + \cdots + y_{i,T-1}))$ and the transformed error term $(v_{i,t} - \frac{1}{T-1}(v_{i,2} + \cdots + v_{i,T}))$ are correlated. This leads to inconsistency of Within Groups estimator that is contrary to pooled OLS biased downwards. This means that the true estimate should lie between the pooled OLS and Within Group estimates. Therefore, we will use these two methods for robustness check as suggested also in Bond (2002).

Kiviet (1995) suggests to use LSDV corrected for the bias. He shows that such procedure yields often more efficient estimates than consistent GMM approach. Anyway, this type of model is appropriate only for balanced panel and is not able to solve the potential endogeneity of other variables (Roodman, 2006).

Two transformations are commonly used for dynamic panel data. The first method is so called Difference GMM. This estimator was originally developed by Holtz-Eakin et al. (1988) and by Arellano and Bond (1991) and it uses the first-difference transformation applied on the original model. This yields the following equation:

$$\Delta y_{i,t} = \alpha_1 \Delta y_{i,t-1} + \Delta X'_{i,t} \beta_1 + \Delta v_{i,t} \qquad 4.2$$

As by Within Group transformation, the fixed effects are no more present, but the new lagged dependent variable ($\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$) is still endogeneous, i.e. correlated with the new error term ($\Delta v_{i,t} = v_{i,t} - v_{i,t-1}$). This can be addressed by assuming that $v_{i,t}$ are serially uncorrelated. Another drawback of this transformation is that it prolongs gaps in unbalanced panel data. This motivated another transformation called forward orthogonal deviations that subtracts the mean of all available remaining future observations of a variable from the contemporaneous one (Arellano and Bover, 1995). This framework minimizes the data loss.

Moreover, Differenced GMM estimator is poorly behaved when the time series are persistent and the number of time series observations is small, because in this case, the lagged levels of the series provide only weak instruments for subsequent first-differences (Blundell and Bond, 1998, Bond et al., 2001, Odesanmi and Wolfe, 2007). This gives rise to the System GMM developed in Blundell and Bond (1998) that is able to address the persistence of the endogeneity bias. This method combines the differences equation (4.2) with the level equation (4.1). As long as $v_{i,t}$ are serially uncorrelated, we do not need to have strict exogeneity of the explanatory variables. Moreover, in this framework the fixed effects are not removed by the differencing of regressors, System GMM differences the instruments to make them uncorrelated with the fixed effects (Sanya and Wolfe, 2011). This means that the variables in level equation are instrumented with their own differences, which increases the efficiency of the estimation (Gürbüz et al., 2013).

This type of model is the most suitable for our data because past changes in the explanatory variables can better predict the current levels than the current changes (Sanya and Wolfe, 2011). Moreover, when applying the Difference GMM all time-invariant regressors would disappear, which is not the case for System GMM (Roodman, 2006). Finally, it is more robust to missing data, because the lagged

observations are used as instruments and not as explicit regressors (Sanya and Wolfe, 2011). Furthermore, we include time dummies in the regressions,[23] because they make the assumption of no correlation between idiosyncratic shocks more likely to hold (Roodman, 2006, Sanya and Wolfe, 2011).

The estimation equation representing our model for each of the net fee and commission magnitude measure is as follows:

$$Y_{i,c,t} = \alpha + \beta Y_{i,c,t-1} + \gamma X_{i,c,t} + \delta Z_{c,t-1} + \epsilon W_{c,t} + \theta D_i + \vartheta T_t + (\mu_i + v_{i,c,t})$$

where:

$Y_{i,c,t}$ ..... net fee and commission income share of bank i in country c at time t (dependent variable), namely NFCI/TI and NFCI/TA,
$Y_{i,c,t-1}$ .. NFCI share of bank i in country c at time $t-1$, measured as above,
$X_{i,c,t}$ ..... vector of bank-specific variables for bank i in country c at time t,
$Z_{c,t-1}$ ... vector of country-specific variables for country c at time t,
$W_{c,t}$ ..... vector of banking sector-specific variables for country c at time t,
D_i ..... bank type dummy,
T_t ..... time dummy,
μ_i ..... unobserved bank-specific time-invariant effect,
$v_{i,c,t}$ ..... disturbance term which is independent across banks.

4.1.3 Variables

By choosing the proper variables, we follow the papers by DeYoung and Rice (2004a), Shahida et al. (2006), Moshirian et al. (2011) and ECB FSR (2013).

The dependent variable captures the net fee and commission income magnitude that is measured by NFCI/TI ratio (*nfci_ti*) and NFCI/TA ratio (*nfci_ta*).

The explanatory (independent) variables are classified as bank-specific, country-specific, and banking sector-specific variables. As already mentioned, besides the variables listed below, we include also lagged dependent variable (*lag_DV*).

[23] The time dummies are not reported in the tables.

1) Bank-specific explanatory variables

The bank-specific variables are mainly supposed to capture the business model of a given bank to which the magnitude of NFCI is clearly linked. We define factors that measure the involvement in traditional retail customer business as well as non-traditional investment banking and asset management activities of a given bank.

Natural logarithm of total assets (ln_ass) measures the size of a bank. It is hypothesized that larger banks are on average more involved in non-traditional activities than smaller banks. This is because investment banking requires a certain level of specialization and technology which is present mainly in larger banks.

Net interest margin (nim) is a ratio of the difference between income from investment of depositors' fund and income attributable to depositors to total assets. It is used to measure the profits of traditional activities. In case the banks with large amounts of non-traditional activities have lower profits from traditional businesses, we would find a negative relation between NFCI and NIM, and vice versa.

Total customer deposits to asset ratio (depos_ass) is also used as a proxy for traditional relationship banking. The higher the *depos_ass* the more is the bank using traditional activities and the lower NFCI should be.

Total equity to total assets ratio (eq_ass) is a measure of capital risk (from accounting perspective), the ability of a bank to meet its obligations and absorb potential losses. If we assume that the bank needs capital in order to prevent excessive risk by entering new (non-traditional) activities, we would expect to find a positive relationship between NFCI and *eq_ass*.

Common equity Tier 1 capital ratio (tier1) is a measure of capital risk (from regulatory perspective). We assume that Tier1 is highly correlated to *eq_ass* and therefore, we would probably need to drop one of them in the final analysis.

Non-performing loans to gross loans ratio (npl_loans) measures the credit risk as well as loan quality. A negative relationship between *npl_loans* ratio and NFCI would imply that banks involved in non-traditional activities are less risky.

Loans to assets ratio (loans_ass) represents the loan volume and the lending strategy of a given bank. High *loans_ass* means that the bank is mostly oriented towards core banking businesses and interest income.

ROAE (roae) is a proxy for management quality. It captures the bank's profitability.

Cost to income ratio (cost_inc) reflects the efficiency in expenses management.

Bank-type dummy variables: *dcom*: 1 = commercial bank, *dcoop*: 1 = cooperative bank, *dsav*: 1 = savings bank, *dinv*: 1 = investment bank, *dhold*: 1 = bank holdings and holding companies, 0 = real estate and mortgage banks. The time invariance of bank type dummy variables means that they can be tested only in models that do not remove fixed effects, i.e. they will be included in System GMM models, but not in FE models.

2) Banking sector-specific explanatory variables

Herfindahl index (hi) approximates the banking sector concentration. It is based on banks' individual total assets market share. The sign of the coefficient is ambiguous, because high competition can be a reason to switch to non-traditional activities, which would lead to increased NFCI share. On the other hand, in highly competitive markets there is a pressure on prices and the fees charged cannot be so high.

Number of automated teller machines per 100,000 adults (atms), *Number of all cards transactions (except e-money function) per capita (cashless)* capture the development and application of new technology in a given banking sector.

3) Country-specific explanatory variables[24]

Real annual GDP growth rate (gdp) measures the economic activity in the country.

Annual inflation rate (inf) measured as percentage increase in consumer price index.

Annual unemployment rate (unem) affects besides other the decisions of customers about their use of certain banking services.

Long-term annual interest rate (int) is approximated by ten year government bond yield in the given country.[25]

There is a high probability that some of the chosen explanatory variables will have to be dropped from the final model because of their correlation with other variables.

[24] Country specific variables are included with lagged values and labelled by *lag_dependent variable*. I.e. in the table with results we include *lag_GDP* instead of *GDP*.

[25] According to ECB and Eurostat there are no Estonian sovereign debt securities that comply with the definition of long-term interest rates for convergence purposes. We use data from HelgiLibrary as a proxy for long-term interest rate in Estonia.

4.1.4 Descriptive analysis

4.1.4.1 Descriptive analysis of dependent variables – NFCI/TI and NFCI/TA and its relation to HI

In this section, we provide descriptive analysis of variables entering the model. Firstly, we analyse the dependent variables, namely NFCI/TI and NFCI/TA. Figure 4.1 displays the mean NFCI/TI and NFCI/TA by bank type computed over the period 2007 to 2012.[26] The lowest share of NFCI can be observed in real estate and mortgage banks which have NFCI/TI below 17% and NFCI/TA less than 0.4%. On the other hand, highest share of NFCI was reported in cooperative banks with average NFCI/TI of 30.6% and average NFCI/TA of almost 0.8% (measured by average, cooperative banks displayed the fourth highest NFCI/TA among the considered groups, but when median was applied their NFCI/TA was above all other groups).

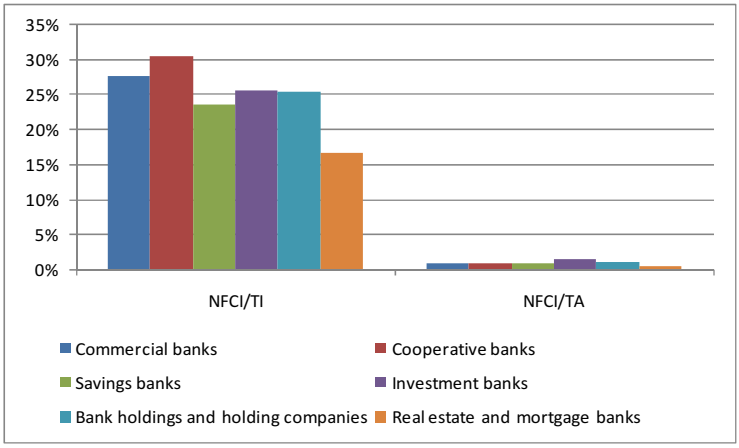


Figure 4.1: Average Net fee and commission income/Total income and Net fee and commission income/Total assets by bank type

Source: Author using data from Bankscope

Interestingly, investment banks do not display an average NFCI/TI ratio around 40% as suggested by Gambacorta and van Rixtel (2013). This is caused mainly by the fact that we have only 10 investment banks in our sample and therefore the special features of each bank affect the overall result heavily. The greatest share of this result can be attributed to 3 Italian banks with average NFCI/TI of less than 10%. Furthermore, Bank of Cyprus Public Company Limited-Bank of Cyprus Group and Bank of Valletta Plc combine investment banking with commercial banking (in Bankscope they are classified as investment banks) and have NFCI/TI around 20%. Banks in PIIGS countries were heavily affected by the crisis. In a Portuguese Banco

[26] For each figure we provide its counterpart depicting the median value in Appendix C.1.1.

de Investimento Global SA – BIG we can observe a drop in NFCI/TI from more than 50% in 2008 to less than 9% in 2012. Similarly in Investment Bank of Greece NFCI/TI declined from 81% in 2008 to 38% in 2012. In Spanish Aresbank SA the trend was opposite. In 2008 it had NFCI/TI of 21% while in 2012 it was 53%. All these made the average NFCI/TI ratio in investment banks lower than expected. Still, we believe that in general, higher share of NFCI can be attributed to more non-traditionally oriented banking strategy as reported in many previous researches. Our results reflect rather the special features of most of the included investment banks.

Figure 4.2 shows the development of average NFCI/TI by bank type for the period from 2007 to 2012. It can be seen that real estate and mortgage banks as well as savings banks display low levels of NFCI share compared to other type of banks over the whole examined period, while cooperative banks and commercial banks have NFCI share consistently above the average.

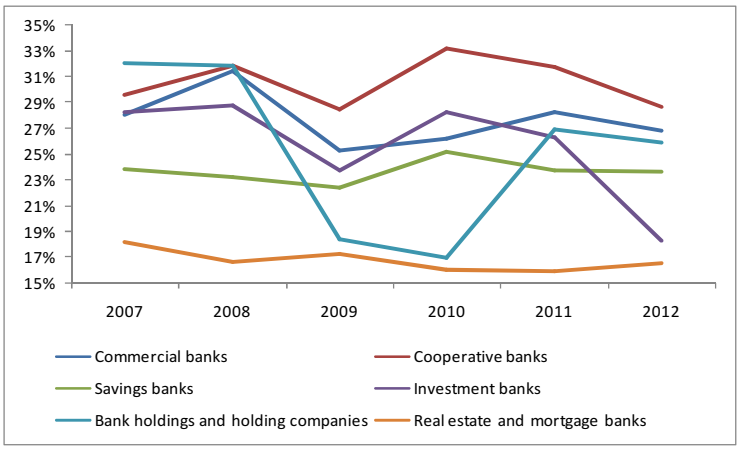


Figure 4.2: Development of average Net fee and commission income/Total income by bank type between 2007 and 2012

Source: Author using data from Bankscope

The crisis had different impact on individual bank types. By many of the examined banks we can observe a drop in average NFCI/TI in 2009. In bank holdings and holding companies the decrease accounted for more than 10%. Furthermore, while in other bank types the fee income share began to recover already in the following year, in bank holdings it remained low until 2010. This sharp fall can be attributed mainly to Hypo Real Estate Holding AG that reported NFCI/TI of -132% in 2009 and -160% in 2010 (see also outliers in Figure 4.3). Moreover, we support this by Figure C.2 in Appendix C.1.1 where the development of median NFCI/TI by bank type can be found and where no extraordinary decline in NFCI/TI by bank holdings and holding companies can be seen. In 2012, the fee income shares returned back to their pre-crisis levels, only by investment banks a further decline in NFCI/TI can be seen in

that year. In real estate and mortgage banks and savings banks, the NFCI/TI seems to be more or less constant. Over the analysed period, average NFCI/TI in those banks varied within 3%. Therefore, as concluded also in the previous parts of the study, the NFCI share is highly dependent on the banking strategy.

In Figure 4.3 and in Figure 4.4, two scatter plots depicting the relationship between NFCI/TI and NFCI/TA with HI can be seen. The left-hand-side outliers in Figure 4.3 stand for Hypo Real Estate Holding AG in 2009 and 2010. In those years, its NFCI was negative and operating income declined by half compared to 2008 value. All banks with NFCI/TI over 100% are commercial banks. These extremely high values were reported mostly in years around the crisis, especially in year 2008, and were caused by drop of total operating income rather than by increase in NFCI.[27] High values of NFCI/TA were reported in some investment banks as well as in bank holdings and holding companies.

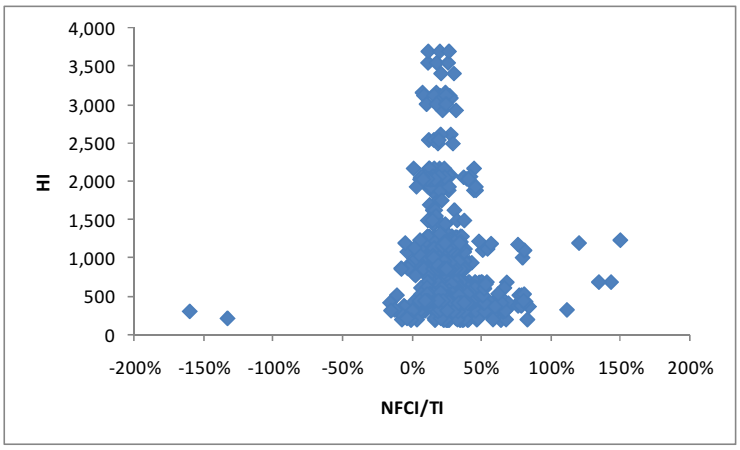


Figure 4.3: Net fee and commission income/Total income and Herfindahl index

Source: Author using data from Bankscope and the ECB

[27] For example the highest value among all observations, almost 150%, was reported in Bankaktieselskabet Alm. Brand Bank in 2008. In 2007 this bank had NFCI/TI of less than 29% and in 2009 of less than 35%. Furthermore, the levels of NFCI remained stable in those years and the increase in NFCI/TI was caused by a sharp drop in operating income from EUR 89,239 thousands in 2007 to EUR 16,370 thousands, i.e. drop of almost 82%.

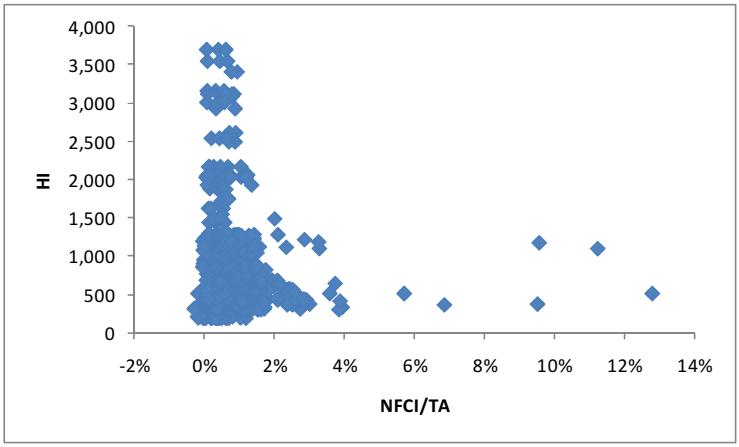


Figure 4.4: Net fee and commission income/Total assets and Herfindahl index

Source: Author using data from Bankscope and the ECB

Figure 4.5 shows the evolution of average NFCI share between 2007 and 2012 by market concentration. The low concentration group includes the banks in countries with levels of assets HI below 1,000. The moderate concentration group includes banks in countries with HI between 1,000 and 1,800. The high concentration group stands for the banks in countries with HI over 1,800. As can be seen, the highest NFCI shares are reported in banks in countries with low concentration over the whole considered period. On the other hand, the lowest shares of fee income display banks that are facing low competition. A similar picture provides also Figure C.3 in Appendix C.1.1 that displays the median NFCI/TI by concentration. In this figure, we can observe even larger differences between individual concentration groups in terms of fee income share. These findings support the hypothesis that increased competition forces banks to switch to non-traditional activities that bear high fee income.

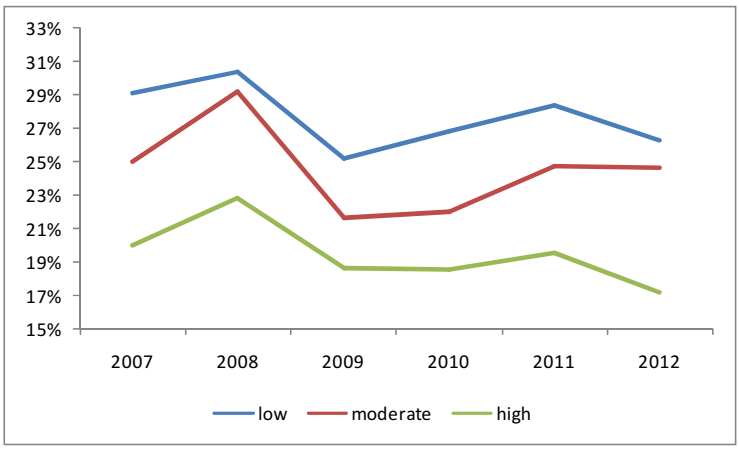


Figure 4.5: Development of average Net fee and commission income/Total income by market concentration

Source: Author using data from Bankscope and the ECB

4.1.4.2 Descriptive analysis of banking sector-specific variables

In this section, we do not provide any further descriptive analysis of HI. The basic analysis can be found in Section 3.1.2. Figure 3.4 depicts the average HI between 2007 and 2012 by different groups of countries. Furthermore, Figure B.6 in Appendix B.3 compares HI in 2007 and 2012 for the same groups of countries. Description of market concentration in the Czech Republic can be found in Section 3.2.1.

Figure 4.6 captures the development and application of new technologies that is measured by ATMs per 100,000 adults and number of cashless transactions per capita. It can be seen that those two measures are not necessarily correlated, in some countries there might be positive relation but in other there is negative one, therefore no conclusion about the correlation between these two variables can be done.

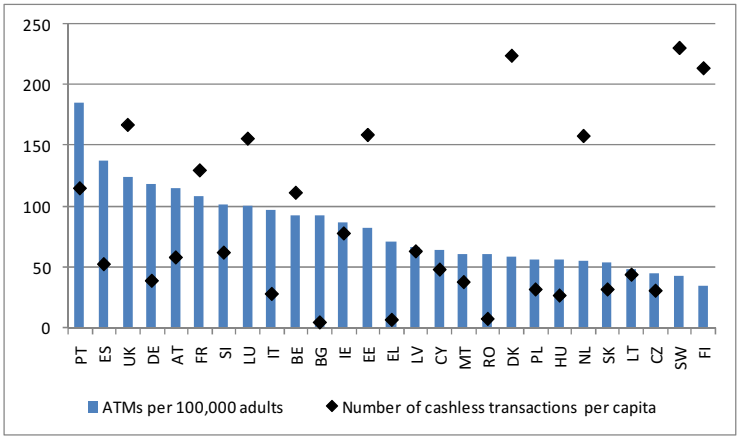


Figure 4.6: The development of banking sector in 2012 by country[28]

Source: Author using data from the World Bank and the ECB

4.1.4.3 Descriptive analysis of country-specific variables

Figure 4.7 and Figure 4.8 show country-specific macroeconomic indicators in year 2011.[29] In 2011, the country with the most negative real annual GDP growth was Greece, followed by Portugal and Spain with just positive value. Those countries displayed also very high unemployment rates, mainly speaking about Spain and Greece which both had unemployment rate of more than 17%. On the other hand, lowest unemployment rate (below 5%) was reported in Austria, Netherlands and

[28] For Belgium, Germany and United Kingdom the data of ATMs per 100 000 adults were not available in 2012 and therefore they were approximated by 2011 values.

[29] In the model we are using lagged country-specific dependent variables and therefore the last observations entering the model are from year 2011.

Luxembourg. The most rapid growth among EU-27 countries experienced Estonia with real annual GDP growth of nearly 10%.

The poor macroeconomic conditions of PIIGS countries are reflected also by the high government bond yields displayed in Figure 4.8. While in the sound countries the 10-year government bond paid around 3% per annum in 2011, in Greece the yield was more than five times as high. Also other PIIGS countries displayed long term interest rates, higher than average EU-27 country. The differences in annual inflation rate among the European countries were not as significant as by the interest rates, but still they should be considered as a factor that can influence the banking sector decisions. In 2011, the highest inflation rate was reported in Romania, Estonia and in United Kingdom, while the lowest values were in Ireland and Sweden.

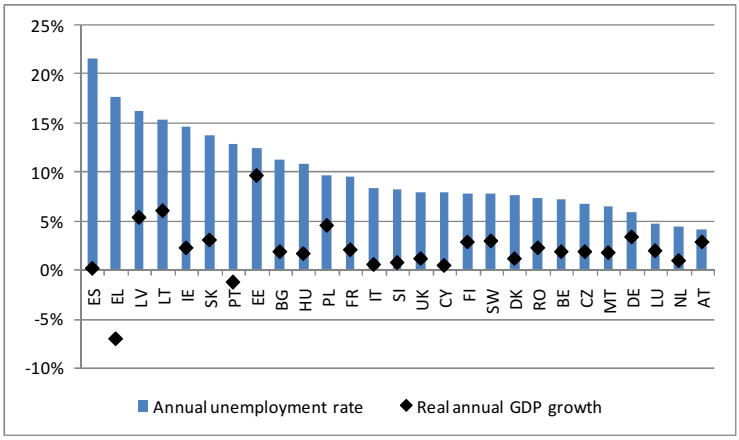


Figure 4.7: Macroeconomic conditions in 2011 – Annual unemployment rate and real annual GDP growth

Source: Author using data from Eurostat

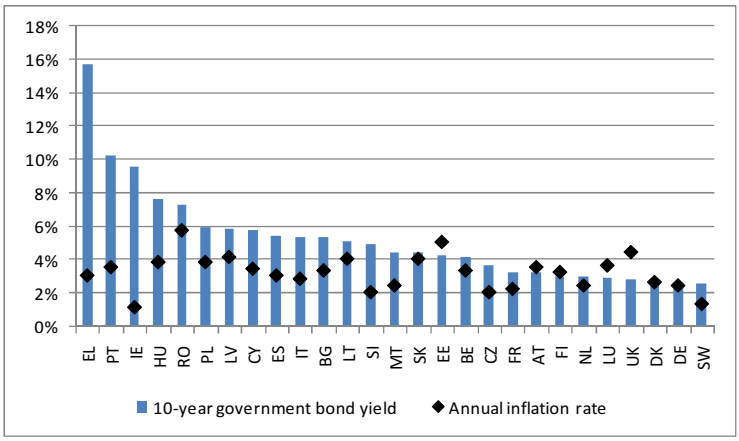


Figure 4.8: Macroeconomic conditions in 2011 – Long term interest rate and annual inflation rate

Source: Author using data from Eurostat, the ECB and HelgiLibrary

Summary statistics of used variables reporting the mean, median, standard deviation, minimum, maximum and 1st and 3rd quartiles of each variable can be found in Appendix C.1.2.

4.1.5 Results and findings

Because there is no real theory supporting our assumption about the autoregressive process in NFCI share, we performed the Wooldridge test for autocorrelation in paned data. The results can be found in Table 4.3. The null hypothesis of no first-order autocorrelation was rejected for both dependent variables NFCI/TI and NFCI/TA. Therefore System GMM will be used as the main estimation method. Other methods will be applied only for robustness check because in some cases System GMM may yield unstable results.

Table 4.3: Wooldridge test for autocorrelation in panel data – NFCI/TI, NFCI/TA

	nfci_ti	nfci_ta
F statistics	2.831	67.424
	(d.f. 1, 184)	(d.f. 1, 184)
p-value	0.0941	0.0000

H0: no first-order autocorrelation, d.f. = degrees of freedom
Source: Author using data from Bankscope

Table 4.4 shows the model that investigates the relationship between market concentration and fee income share in European banks. We report the estimation results based on one-step and two-step System GMM, both with clustered standard errors robust to heteroscedasticity and autocorrelation within individuals and with small sample corrections to the covariance matrix. Moreover, in order to prevent the downward bias of standard errors in two-step estimation that may arise when the number of instrument is large (Arellano and Bond, 1991) we apply Windmeijer correction in two-step estimation. After this correction, two-step efficient GMM should be modestly superior to one-step in estimating coefficients with lower bias and standard errors (Windmeijer, 2005).

System GMM yields the best estimation results, because for both dependent variables and with both estimation methods the lagged dependent variable is significant with a 99% confidence level (p-value is below 0.01). Moreover, the null hypothesis of no first-order autocorrelation in residuals is rejected in Arellano-Bond AR (1) for NFCI/TI models. For NFCI/TA, the test does not suggests any first-order autocorrelation, but the p-value reached 0.131 in the two-step model and 0.115 in

one-step model, which is very close to the critical value at which the null hypothesis would be rejected. We assume that the test did not performed well in this model, because the previously mentioned Wooldridge test and significant lagged dependent variable both suggest that the NFCI/TA is persistent in time. Arellano-Bond AR (2) with null hypothesis of no second-order autocorrelation is not rejected. These results were expected and are important for the consistency of GMM estimator.

We suppose that some of the explanatory variables such as *nim*, *cost_inc* or *eq_ass* are predetermined or endogenous and therefore we instrument them adequately. Hansen test for overidentification with null hypothesis of exogenous instruments was not rejected. The rule of thumb implying that instruments should not exceed the number of groups is not violated. Therefore, our model is unlikely to suffer from overidentification. F-test indicates the joint significance of explanatory variables.

The reported outcome does not include all explanatory variables specified in Section 4.1.3. In order to obtain valid estimates, we excluded those variables that were insignificant in the initial estimation that included all defined independent variables and significantly correlated with other independent variables.[30] In Appendix C.3 (Table C.5 columns 1–2 and 4–5), regression results with more extended model specification can be found. It can be seen that both models – the full model as well as the restricted one – performed similarly according to the tests. Also the coefficients and their significance did not change dramatically with the restricted specification.[31] Therefore, the results seem to be robust to exclusion of correlated variables.

The coefficients of lagged dependent variables are positive (0.44 for NFCI/TI and 0.67 for NFCI/TA) and significant in estimated models implying strong time persistency of NFCI share. Also *eq_ass* coefficients are positive and significant meaning that banks with lower capital risk are better able to expand into non-traditional banking activities and to collect more money on fee income. Contrary to our expectation, we found that *depos_ass* which is a proxy of traditional banking activities is positively related with NFCI/TI as well as with NFCI/TA. This suggests that the European banks are able to exploit the close relationships with depositors to encourage them to undertake additional fee-based services and/or given the inelastic demand to charge more by selling those services at higher prices.

[30] See Table C.2, Table C.3 and Table C.4 in Appendix C.2 for the correlation matrix.

[31] Only *lag_gdp* was significant in the extended model and turned out to be insignificant after exclusion of correlated variables.

Table 4.4: Relationship between NFCI share and HI – System GMM regression results

	Dependent variable			
	nfci_ti		nfci_ta	
Independent variables	two-step	one-step	two-step	one-step
lag_DV	0.4385***	0.4352***	0.6655***	0.6657***
	(0.1097)	(0.1109)	(0.0235)	(0.0236)
nim	-1.3637	-1.3603	0.0074	0.0110
	(1.6469)	(2.1642)	(0.0175)	(0.0188)
eq_ass	0.4006***	0.3912**	0.0094***	0.0097***
	(0.1414)	(0.1519)	(0.0036)	(0.0035)
npl_loans	-0.1700	-0.1868	-0.0024	-0.0020
	(0.1990)	(0.2115)	(0.0020)	(0.0021)
cost_inc	0.0809	0.0763	-0.0001	-0.0001
	(0.1084)	(0.1121)	(0.0002)	(0.0002)
depos_ass	9.4005*	8.3168**	0.3025***	0.2746***
	(4.8345)	(4.0162)	(0.1042)	(0.0890)
hi	-0.0025***	-0.0027***	-0.0000***	-0.0001***
	(0.0006)	(0.0007)	(0.0000)	(0.0000)
lag_gdp	-0.2604	-0.3461	-0.0009	0.0009
	(0.1913)	(0.2216)	(0.0031)	(0.0035)
lag_inf	-0.0547	-0.0543	0.0001	0.0002
	(0.3032)	(0.4224)	(0.0046)	(0.0052)
dcom	7.9208***	8.6518***	0.1486**	0.1292**
	(3.0088)	(3.1380)	(0.0606)	(0.0601)
dcoop	9.7720***	9.8077***	0.16223**	0.1361**
	(3.0231)	(3.2270)	(0.0641)	(0.0605)
dsav	3.7773	4.8735	0.0927	0.0585
	(3.4364)	(3.7366)	(0.0705)	(0.0703)
dinv	6.2117*	5.7484	0.0766	0.0539
	(3.5689)	(3.6997)	(0.0677)	(0.0712)
dhold	5.9203	5.5092	0.1378**	0.1151*
	(3.8191)	(4.1139)	(0.0640)	(0.0654)
_cons	3.2414	5.5322	-0.1204	-0.0912
	-7.6472	(8.2772)	-0.0878	(0.0765)
Estimation diagnostics				
Number of observations	925	925	925	925
Number of groups	185	185	185	185
Observations per group	5	5	5	5
Number of instruments	107	107	122	122
F-test	43.94***	50.83***	361.13***	539.75***
Arellano-Bond AR (1)	-1.79*	-1.64*	-1.51	-1.57

Arellano-Bond AR (2)	-1.53	-1.41	0.07	0.07
Hansen test	99.13	99.13	121.44	121.44

Robust standard errors adjusted for 185 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, p-value of Arellano-Bond AR (1) in nfci_ta models is 0.131 in two-step model and 0.115 in one-step model, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

The coefficients of *dcom* and *dcoop* are significantly positive. This suggests that commercial banks and cooperative banks display on average higher NFCI shares than other bank types. Moreover, *dhold* is positively related with NFCI/TA and *dinv* has significant positive relationship with NFCI/TI in two-step estimation. These findings are in line with Figure 4.1, Figure C.1 and with the expectation that the type of bank and its business strategy are important determinants of fee income share. All other bank-specific variables are insignificant in these models.[32]

As suggested by Figure 4.5 and the correlation between NFCI/TI, NFCI/TA and *hi*, we have found significantly negative coefficient for *hi*. More precisely, for two-step estimator the coefficient of *hi* in NFCI/TI and NFCI/TA regression was -0.0025 and -0.000041, respectively. Therefore, the more competitive is the market in which the bank operates, the higher the average NFCI share is. From this we can conclude that the competition pushes the banks to offer more non-traditional fee income bearing banking services which are potentially more risky than the traditional ones.

This conclusion may be done since we are using NFCI/TI ratio. NFCI per se includes both, fee income from traditional as well as fee income from non-traditional banking activities and alone cannot be used to measure the extent of non-traditional activities in a given bank. On the other hand, NFCI/TI is commonly used as a proxy for non-traditional banking activities.[33] In this context for example Czech Republic, which fee income is created to a large extent from the fee from payments, displays NFCI/TI below the average of EU, which is in line with our reasoning.[34]

[32] *Tier1* is significant in NFCI/TI models under the extended specification reported in Appendix C.3. Nevertheless, it was excluded in the restricted specification because of its correlation with *eq_ass*.

[33] See Section 2.2 in which we clearly show that for example commercial banks have much lower NFCI/TI than investment banks, see also Gambacorta and van Rixtel (2013) and DeYoung and Rice (2004b).

[34] In the Czech Republic there are mainly traditionally oriented banks with NFCI/TI around 24% - see Figure 3.1, while for example investment banks have in most cases NFCI/TI > 40% - see p.5.

Other bank sector-specific variables were excluded, because they were insignificant and highly correlated with *hi*.

Both country-specific variables are insignificant. For *lag_gdp*, the p-value is close to 0.1 for model with NFCI/TI as dependent variable under one-step as well as two-step estimation. Moreover, in the extended model *lag_gdp* was significantly negatively related with NFCI/TI. Therefore, despite the insignificance of macroeconomic indicators displayed in Table 4.4, we assume that there can exist negative relationship between *lag_gdp* and NFCI/TI.

4.1.5.1 Robustness tests

We have run many regressions using System GMM with different independent variables and sets of instruments. This is necessary since the optimal set of instruments is difficult to determine and too many instruments may hamper the regression results and Hansen test. The results were stable in terms of coefficients that proved to vary very marginally and the signs remained almost always the same. We never observed one coefficient to be significantly positive under one specification and significantly negative under another. Mostly, only the significances have changes. Some of those regressions results can be found in Appendix C.3 Table C.5.

Table 4.5 reports the estimation results of the same model as in Table 4.4 but using linear regression, fixed effects regression and random effects GLS regression.[35] In all models, we used robust and clustered standard errors. Moreover, we included time dummies, which are not reported in the table.

F-test (Wald chi^2 in RE regression) is significant for all regressions meaning that explanatory variables are jointly significant. Furthermore, these methods report goodness of fit measure which is not the case for System GMM. R^2 for NFCI/TI model is almost 20% in FE regression and 60% in pooled OLS. For NFCI/TA model R^2 is even higher 85%–89%. Nevertheless, it should be noted that such a good goodness of fit was obtained mainly thanks to inclusion of *lag_DV*.[36]

[35] It should be noted that RE became pooled OLS in NFCI/TI model suggesting a high ratio of within to between variation, while in NFCI/TA pooled OLS and RE are significantly different (tested after RE estimation using MLE by Likelihood-ratio test that strictly rejected the hypothesis of no standard deviation of residuals within groups).

[36] We have run the regression also without *lag_DV*, R^2 obtained based on pooled OLS dropped in both dependent variables to approximately 25%, while those obtained in FE models were even lower.

Table 4.5: Relationship between NFCI share and HI – OLS, FE and RE regression results

	Dependent variable					
Independent variables	nfci_ti			nfci_ta		
	OLS	FE	RE	OLS	FE	RE
lag_DV	0.6219***	0.1254**	0.6219***	0.6948***	0.6115***	0.6812***
	(0.0866)	(0.0631)	(0.0866)	(0.0331)	(0.0535)	(0.0288)
nim	-0.5451	-2.0278	-0.5451	0.0204	0.0080	0.0186
	(0.3598)	(1.8641)	(0.3598)	(0.0149)	(0.0155)	(0.0145)
eq_ass	0.3165***	0.2222	0.3165***	0.0074**	0.0197***	0.0089***
	(0.0988)	(0.2684)	(0.0988)	(0.0034)	(0.0060)	(0.0030)
npl_loans	-0.1592	-0.2044*	-0.1592	-0.0017	0.0024	-0.0012
	(0.1139)	(0.1227)	(0.1139)	(0.0017)	(0.0030)	(0.0018)
cost_inc	0.1452***	0.1795**	0.1452***	0.0001	0.0001	0.0002
	(0.0516)	(0.0862)	(0.0516)	(0.0002)	(0.0002)	(0.0002)
depos_ass	3.2422	0.0227	3.2422	0.1479***	0.5163**	0.1710***
	(2.4546)	(9.1603)	(2.4546)	(0.0507)	(0.2182)	(0.0544)
hi	-0.0016**	0.0055	-0.0016**	-0.0000***	0.0001**	-0.0001***
	(0.0006)	(0.0038)	(0.0006)	(0.0000)	(0.0001)	(0.0000)
lag_gdp	-0.2627**	0.0800	-0.2627**	-0.0017	0.0022	-0.0013
	(0.1271)	(0.1544)	(0.1271)	(0.0035)	(0.0028)	(0.0032)
lag_inf	0.1939	-0.0115	0.1940	-0.0011	0.0066	-0.0004
	(0.1689)	(0.2156)	(0.1689)	(0.0055)	(0.0048)	(0.0050)
dcom	5.4549**		5.4549**	0.1072**		0.1106**
	(2.2615)		(2.2615)	(0.0487)		(0.0505)
dcoop	6.3215***		6.3215***	0.1062**		0.1121**
	(2.3637)		(2.3637)	(0.0484)		(0.0503)
dsav	3.5120		3.5120	0.0590		0.0571
	(2.2870)		(2.2870)	(0.0527)		(0.0557)
dinv	3.6096		3.6096	0.0141		0.0194
	(2.9089)		(2.9089)	(0.0618)		(0.0642)
dhold	2.8992		2.8992	0.0778		0.0892
	(3.2289)		(3.2289)	(0.0561)		(0.0579)
_cons	-2.5907	12.4721**	-2.5907	-0.0495	-0.2716*	-0.0636
	(2.3870)	(5.8132)	(2.3870)	(0.0453)	(0.1390)	(0.0466)
Estimation diagnostics						
Number of observations	925	925	925	925	925	925
Number of groups		185	185		185	185

Observations per group		5	5		5	5
F-test	100.34***	10.97***		256.64***	89.19***	
Wald chi^2			1806.07***			5846.98***
R^2	0.5862	0.1924	0.5862	0.8940	0.8471	0.8938

Robust standard errors adjusted for 185 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

System GMM suggests that these methods are biased due to inclusion of lagged dependent variables and because of incorrect treatment of endogenous explanatory variables. But as stated in Bond (2002) and Roodman (2006), pooled OLS and FE can be used for robustness check. In particular, pooled OLS inflates the estimated coefficient for lagged dependent variable by attributing predictive power to it that actually belongs to the bank's fixed effect. The opposite holds true for fixed effect regression, where the estimated coefficient for *lag_DV* is biased downwards. The true parameter should therefore lie between these two values (Roodman, 2006), which is satisfied in our models.

The results differ mainly in significance. While *cost_inc* and *lag_gdp* were insignificant in System GMM, they turned out to be significant in linear and within regressions of NFCI/TI model. On the other hand, *depos_ass* came out to be insignificant using the standard methods. The coefficients remained mostly similar as in System GMM. Only *hi* turned out to be positively related with NFCI/TA in fixed effect estimation. This is probably caused by the inconsistency of this model, because there is no other evidence that would suggest that the relationship between NFCI/TA and market concentration should be positive.

Together, the results proved to be robust. We can say that besides the bank interior factors such as bank type, the market conditions seem to play an important role for fee income magnitude determination. In this study, we tested only the impact of market concentration on NFCI share because other sector-specific variables were correlated with *hi* and therefore the estimated coefficient would be not necessarily estimated correctly. Still, we think that technologic development and other exterior factors may be relevant.

4.1.5.2 Summary and comparison of results

In Table 4.6, we provide the comparison of results found in our study and the current literature. +/- stands for positive/negative coefficient significant at least at 10% level. 0 indicates that the estimated coefficient is insignificant. Unlike in most of the other

academic papers, we examined the determinants of NFCI and not NII as a whole. Still, we believe that the results may be compared because as already mentioned NFCI represents the greatest part of NII in most of the banks.

It can be seen that in our analysis most of the coefficients turned out to be insignificant which is not the case in other studies. This could be caused by the inclusion of lagged dependent variable that captures a lot of information and was not present in the previous studies. On the other hand, the signs of all significant coefficients in this study are in line with most of the current literature. Higher equity to assets ratio, i.e. low capital risk, is related with higher shares of fee income. The positive coefficient is also in line with our expectation since we believe that banks expanding into non-traditional businesses need more capital to prevent the potential losses and other risks of the new activity.

Table 4.6: Comparison of estimated signs and significance levels for the coefficients on NFCI magnitude

	Coefficients							
Authors	nim	eq_ass	npl_loans	cost_inc	depos_ass	hi	lag_gdp	lag_inf
Rogers and Sinkey (1999)	-	+	+		+			
DeYoung and Rice (2004a)					+			
Craigwell and Maxwell (2005)					0			
Shahida, Abd. Ghafar, Sanep (2006)	0	+	-		+			
Hahm (2008)	-	+	+	+			-	-
Bailey-Tapper (2010)			+		-		0	
Kim and Kim (2010)					-			
Moshirian, Sahgal and Zhang (2011)		+				-	0	0
This study (2014)	0	+	0	0	+	-	0	0

+/- indicates a statistically positive/negative coefficient at the 10% level or better, 0 indicates insignificant coefficients, in case of absence of the variable in the given study the cell is left blank, Hahm (2008) is using lagged independent variables, Rogers and Sinkley (1999) and Bailey-Tapper (2010) are not using *npl_loans* as a measure of loans quality but use provision for loan losses magnitude

Source: Author based on individual papers and own results

Deposits to assets ratio influences the NII share positively in U.S. commercial banks as well as in Malaysian Islamic banks. On the contrary, in Jamaican and Korean banking markets the effect seems to be the opposite. This may be caused primarily by different levels of switching costs and dissimilar attitude of the customers. In the U.S. and Malaysian markets, closer relationship between bank and depositor, based on which the banks can charge higher fees on its services than in Jamaica or Korea, probably exists. Our results suggest that EU-27 banking sector resembles the U.S.

and Malaysian banking market since the coefficient on *depos_ass* is significantly positive in our study.

We have estimated a negative relationship between Herfindahl index and fee income share. This result supports the findings of Moshirian et al. (2011).

Macroeconomic conditions seem to play only limited role in NFCI share determination. Only Hahm (2008) found that higher lagged GDP growth and inflation are connected with lower NII shares.

4.1.6 Further research opportunities

During the analysis, we have revealed further possible areas of research related to magnitude of fee income share. Firstly, the number of studied banks could be increased by adding the data from countries outside EU-27. This would allow drawing more general results from the model. Interesting could be the comparison of the effect of market concentration on NFCI share in differently developed countries. Crucial challenge is the construction of the data set with as low number of missing observations as possible. For some countries, this might be not easy task, but without adequate dataset the proper estimation is impossible.

Secondly, in order to obtain balanced panel data, we comprised only six years period in our analysis. Inclusion of lagged dependent variable in the model removed further year. Therefore, prolonging the data set could lead to more accurate estimates. Sufficiently long period will also allow applying simpler estimation methods such as FE that are biased when the number of periods is small. Moreover, in this way the overall impact of the financial crisis 2008–2009 on the data will be not so distinct.

Thirdly, we have shown that the bank business strategy is an important determinant of fee income magnitude. For this reason, further research may be done for different types of banks separately. We suppose that the market concentration need not to have the same impact on all bank types.

Finally, in order to obtain valid estimates of HI coefficient the technologic development measures that are highly correlated with HI were excluded from our model. Still, we think that those factors are important for a correct determination of fee income. Consequently, other measures capturing the technologic development in a given country that would not be correlated with other regressors should be found and included in the model.

4.2 Impact of magnitude of banking fees on bank's profitability and risk

This section examines the impact of NFCI/TI on bank's profitability, risk and risk-adjusted profitability. The expected sign of the coefficient is though not clear, because as shown in many papers (see Section 4.2.1), high fee income share does not necessarily lead to better performance of a bank. The result is highly dependent on the bank features and the external factors influencing the bank. Therefore, in our analysis, we include besides bank specific variables also variables describing the bank's exterior environment such as competition and macroeconomic conditions and we examine whether the European banks count to those whose profitability is increased and risk decreased by high NFCI/TI. We are dealing with dynamic panel data model, thus, we apply System GMM estimation approach which leads, unlike as other methods such as Pooled OLS and FE, to unbiased estimation.

4.2.1 Literature review

The theory of finance suggests that expanding in non-traditional activities should decrease the risk level of banks via diversification as fee income, trading income and other non-interest income are not perfectly correlated with interest income (DeYoung and Roland, 1999, Smith et al., 2003). Moreover, the diversification should also lead to higher risk-adjusted profits and higher efficiency due to economies of scope (Klein and Seidenberg, 1998, Elsas et al., 2010). However, the empirical evidence is mixed.

Many papers found that expansion in non-traditional activities decreases rather than improves the bank's risk-adjusted performance. This may be caused primarily by higher volatility of NII compared to interest income documented in many studies (DeYoung and Roland, 1999, Stiroh, 2002, Smith et al., 2003) or by increasing correlation of NII with interest income observed in recent years (Stiroh, 2002). Furthermore, the diversification effect depends on the actual portfolio held by the bank (Köhler, 2013) and it affects differently small and large banks (Goddard et al., 2008, Köhler, 2013). Despite the fact that the literature is not unanimous about the income diversification effects, it is very important to study how non-traditional activities affect the risk and performance of banks, because those are crucial indicators for bank managers.

The question of the impact of NFCI on the bank performance is a topic of active research and the literature examining this problem is rapidly increasing. Stiroh and Rumble (2006), Goddard et al. (2008), Sanya and Wolfe (2011) and Gürbüz et al.

(2013) all provide detailed literature reviews on the link between income diversification and bank performance. We discuss just the most important papers. The studies investigating the bank's performance are interested in both, the profits and the risk. In this work, we examine bank profitability (measured by ROAA, ROAE and NIM) and risk-adjusted performance. Furthermore, we estimate the relationship between NFCI/TI and insolvency risk (Z-Score) and leverage risk (risk-adjusted equity to assets ratio (RAEAR)).[37]

Stiroh (2002) concludes based on U.S. data that NII tends to increase the risk and decrease the risk-adjusted profits, while it has no significant impact on ROAE. This is mainly due to high volatility of NII and increased correlation of NII with interest income. Therefore, the diversification benefits seem to be absent. In his later study (Stiroh, 2004) he makes a similar conclusion. NII is related with poorer risk-adjusted performance and it increases insolvency risk. On a related note, DeYoung and Rice (2004a) examined the performance of U.S. commercial banks from 1989 through 2001. They found that well-managed banks expand less aggressively in non-interest income. The correlation between non-interest income share and ROAE is positive and significant, but after controlling for risk the returns (measured by Sharpe ratio) tend to decrease with higher levels of non-interest income.

Similar conclusions were done by Kim and Kim (2010) who followed DeYoung's and Rice's (2004a) model and whose research was based on South Korean banks. In their paper, the effect on ROAE was not significant, but greater level of NII was associated with poorer risk-return tradeoff. Also Craigwell and Maxwell (2005) and Bailey-Tapper (2010) applied similar model on commercial banks in Barbados and in Jamaica, respectively. They concluded that NII affects positively ROAA.

The first studies conducted on U.S. banking data were followed by researchers who examined the income diversification effect on European banks as well as on OECD countries data. Gischer and Jüttner (2003) used 19 OECD countries data for the period 1993–1998 and they discovered that higher fee to income ratio tends to decrease NIM and the profitability. On the other hand, Hahm (2008) used larger data sample from 29 OECD countries in years 1992–2006 and he found an inverse effect of higher NII share. Higher reliance on non-traditional activities seems to increase the bank's profitability, but considering also the macroeconomic factors this relationship

[37] Some of the papers examining the link between NII and bank riskiness and stability are already provided in Section 2.2. Formal definition of dependent variables and their description can be found in Section 4.2.3.

becomes weaker. Therefore, the revenue diversification does not necessarily imply a shift toward superior return-risk frontiers. This is supported by insignificant relationship between NII share and Z-Score.

Baele et al. (2007), Lepetit et al. (2008) and Köhler (2012) tested the correlation between NII and profitability based on European banks data. While Baele et al. (2007) found that higher NII share increases the banks' franchise value, which means that stock market anticipates that expansion into non-traditional activities should increase future profits, Lepetit et al. (2008) claim that higher NFCI/TI decreases the interest margin and loan spreads. According to Köhler (2012), NII tends to improve the risk-adjusted profits and at the same time it decreases the insolvency and leverage risk. Moreover, Chiorazzo et al. (2008), Busch and Kick (2009), Dietrich and Wanzenried (2011), Köhler (2013) studied the same relationship based on individual European countries, more specifically they used data from Italy, Germany, Switzerland and Germany, respectively. The first three papers concluded that higher share of NII increases the bank's profitability measured by ROAE, ROAA and/or NIM. Furthermore, Chiorazzo et al. (2008) found a positive link also between NII share and risk-adjusted performance. Köhler (2013) claims that the link is highly dependent on the bank type. While investment banks with higher NII report lower risk-adjusted profits and increased risk, for other types of banks the link is opposite.

Stiroh and Rumble (2006) included in their model besides NII share also a revenue diversification measure. Based on data from U.S. financial holding companies from 1997 to 2002, they concluded that diversification benefits exist but they are more than offset by the increased exposure to volatile NII bearing activities. Also marginal increases in NII are associated with poorer risk-return tradeoff and higher insolvency risk.

Many other researchers (Mercieca et al., 2007, Odesanmi and Wolfe, 2007, Goddard et al., 2008, Sanya and Wolfe, 2011, Gürbüz et al., 2013) followed this decomposition of the effect of NII into two parts. First, they measure direct exposure effect that is measured by non-interest income to operating income ratio, and second, they define indirect exposure effect as the effect of own income diversification measured by HI. Goddard et al. (2008) investigated the effect of income diversification on bank profits based on U.S. data from 1993 to 2004. The results show that higher non-interest income to operating income ratio increases both the risk-adjusted as well as unadjusted return measures. But for small and medium sized banks the positive direct exposure effect is outweighed by a negative indirect exposure effect. Mercieca et al. (2007) found no direct diversification benefit and

inverse relationship between NII and profitability and bank stability. Besides other factors, this might be caused by the fact that they included in their study only small European banks and as stated above the asset size seems to influence the diversification effect heavily.

Odesanmi and Wolfe (2007), Gürbüz et al. (2013), Sanya and Wolfe (2011) apply System GMM estimator in order to address endogeneity that was identified also in the previous papers but not sufficiently controlled. All these papers report positive diversification effect by decreased insolvency risk and/or enhanced profitability. Odesanmi and Wolfe (2007) found based on data from emerging economies that diversification gains are present even though increased share of NII lowers risk-adjusted profits. On the other hand, Sanya and Wolfe (2011) performed their test also on set of data from emerging economies, but they found that the impact of NII share on the risk-adjusted performance differs across various model specifications. Still, higher share of NII tends to decrease the insolvency risk. Contrary, Gamra and Plihon (2011), who performed their analysis also on emerging countries, found that higher reliance on NII has negative impact on risk-adjusted ROAA (RAROAA) and risk-adjusted ROAE (RAROAE) as well as on Z-Score, i.e. it increases insolvency risk.

Liu and Wilson (2009) have also applied System GMM for their model, but compared to the above mentioned papers, they included in their analysis only NII share and not the HI diversification measure. Moreover, they tested its relation with NIM, ROAA and ROAE and did not adjust the profitability measures for risk. Based on Japanese banks, they found that across all specifications the impact on NIM is negative and significant, while by ROAA and ROAE the significance and coefficient is dependent on the bank type. Only for second association regional banks and for cooperative banks the higher share of NII is associated with higher ROAA and ROAE. Similar study was done by Dumičić and Ridzak (2013). They applied System GMM on CEE countries and found a significantly negative relationship between NII share and NIM.

Also most recent studies are unanimous about the diversification effect on banks' performance. While Yang and Wu (2011), Moshirian et al. (2011) and Karakaya and Er (2013) found positive link between NII share and profitability based on different countries sets, Chunhachinda and Li (2013), who based their study on Asian banks between 2005–2011, report negative correlation between NII share and both ROAA and ROAE. In their paper, a positive effect is found only when taking NFCI separately.

The following table summarizes the literature review.

Table 4.7: Overview of the key empirical works on the relationship between NII, risk and profitability of banks

Authors	Short description	Methodology and data used	NII share-profitability/risk relationship (profitability/risk measure)
Stiroh (2002)	Investigation of potential benefits of increasing reliance on non-traditional activities	Linear regression using U.S. banking industry data in 1984–2001	insignificant (ROAE), negative (RAROAE, Z-Score)
Gischer and Jüttner (2003)	Estimation of the impact of global competition on banks' interest rate margin and profitability	GLS and Two Stage Weighted Least Squares (WLS) using annual cross country panel data from 19 OECD countries in 1993–1998	negative (ROAA, NIM)
DeYoung and Rice (2004a)	Investigation of empirical links between bank NII, business strategies, market conditions, technological change, and financial performance	3 equations model (dependent variables: NII ratio, ROAE and standard deviation of ROAE) estimated by GLS, based on data from U.S. commercial banks in 1989–2001	positive (ROAE), negative (RAROAE)
Stiroh (2004)	Examination of link between diversification and risk adjusted performance for small community banks	OLS applied on small.community bank in 1984–2000	negative (RAROAA, RAROAE, Z-Score), insignificant (RAROAA, Z-Score)
Craigwell and Maxwell (2005)	Studies the determinants of NII and its impact on commercial bank financial performance in Barbados	SUR using the same models as in DeYoung and Rice (2004a) and applied on data from commercial banks in Barbados in 1985–2001	positive (ROAA)

Stiroh and Rumble (2006)	Examination of the shift toward the NII and its impact on performance of U.S. financial holding companies	OLS regression on averaged data including state and time FE applied on U.S. financial holding companies in 1997–2002	insignificant (ROAA, ROAE), negative (RAROAA, RAROAE, Z-Score)
Baele, DeJonghe and Vennet (2007)	Comparison of long-term performance/risk profile of diversified banks and their specialized competitors	OLS regression with country and year dummy variables employed on banking data from 17 European countries in 1989–2004	positive (Tobin's Q)
Mercieca, Schaeck and Wolfe (2007)	Investigation of the observed shifts in NII and its implications on performance	OLS based on data from 15 EU countries small banks in 1997–2003	negative (ROAA, ROAE, RAROAA, RAROAE, Z-Score)
Odesanmi and Wolfe (2007)	Study of benefits of revenue diversification in emerging economies	Systems GMM estimator applied on data from 22 countries	negative (RAROAA, RAROAE)
Goddard, McKillop and Wilson (2008)	Examination of the impact of revenue diversification on financial performance of U.S. credit unions	Instrumental Variable (IV) regression with variables constructed as means or standard deviations of the relevant variables using U.S. credit unions data in 1993–2004	positive (ROAE), insignificant (ROAA, RAROAA, RAROAE)
Chiorazzo, Milani and Salvini (2008)	Study of the link between non-interest revenues and profitability	FE model on panel data from Italian banks in 1993–2003	positive (RAROAA, RAROAE)
Hahm (2008)	Investigation of determinants and consequences of NII diversification in commercial banks	Pooled OLS and random effect model applied on commercial banks in 29 OECD countries	Positive, under some specifications insignificant (ROAA), insignificant (Z-Score)

Lepetit, Nys, Rous and Tarazi (2008)	Study of banks' expansion to fee-based services and its effects on interest margins and loan pricing	Two way FE regression based on 602 European banks in 1996–2002	negative (NIM)
Busch and Kick (2009)	Analysis of the determinants of NII and its impact on financial performance and the risk profile of German banks	FE panel model with lagged variables and Two Stages Least Squares estimator applied on data from German banks in 1995–2007	positive (ROAA, ROAE, RAROAA, RAROAE)
Liu and Wilson (2009)	Analysis of profitability of different types of Japanese banks	System GMM applied on Japanese bank operating in 2000–2007	negative (NIM), positive, negative or insignificant – depends on specification (ROAE, ROAA)
Bailey-Tapper (2010)	Demonstration of empirical linkages between NII, financial performance and macroeconomics	DeYoung's and Rice's (2004a) models estimated by SUR and applied on Jamaican panel data in 1999–2010	positive (ROAA)
Kim and Kim (2010)	Discussion of trends in NII at South Korea banks and its impact on the financial performance of those banks	OLS applied on DeYoung's and Rice's (2004a) models and data from South Korean banks in 1999–2009	insignificant (ROAE), negative (RAROAE)
Dietrich and Wanzenried (2011)	Analysis of profitability of commercial banks in Switzerland using bank specific, industrial and macroeconomic factors	GMM applied on panel data from commercial banks in Switzerland in 1999–2009	positive (ROAA, ROAE, NIM)
Gamra and Plihon (2011)	Examining the link between NII and financial performance of banks in emerging countries	OLS used on banks in 14 Latin-America and East-Asia countries in 1997–2007	negative (RAROAA, RAROAE, Z-Score)

Moshirian, Sahgal and Zhang (2011)	Examination of correlation between concentration, NII and profitability	OLS regression with country and year FE based on data from 20 developed countries in 1996–2010	positive (ROAA)
Sanya and Wolfe (2011)	Describes the effect of revenue diversification on bank performance and risk	System GMM applied on data from 11 emerging economies in 2000–2007	positive, insignificant, negative – depends on specification (RAROAA, RAROAE), positive (Z-Score)
Yang and Wu (2011)	Measure of the link between NII and bank profitability	Regression of NII to total income ratio on ROAE and ROAA for U.S. bank holding companies in 2000–2010	positive (ROAA, ROAE)
Köhler (2012)	Analysis of impact of loan growth and business model on bank risk	System GMM used on banks from 15 EU countries in 2002–2009	positive (RAROAA, Z-Score, RAEAR)
Chunhachinda and Li (2013)	Investigating the impact of Asian banks' income structure on competitiveness, profitability and risk	Cross-sectional OLS applies on panel data from Asian countries in 2005–2011	negative (ROAA, ROAE) – positive for NFCI taken separately
Dumičić and Ridzak (2013)	Analysis of determinants of NIM in CEE countries	System GMM applied on CEE countries in 1999–2010	negative NIM
Karakaya and Er (2013)	Examination of determinants of bank profitability with emphasis on NII	Panel data of Turkish banks in 2005–2010 examined by FE model	positive (ROAE), insignificant (ROAA)
Köhler (2013)	Examines the impact of NII share on risk	Linear and quartile regression applied on German banking sector in 2002–2010	insignificant (RAROAA, RAROAE, Z-Score), positive (RAROAA, RAROAE, Z-Score, RAEAR), negative (RAROAE)

Source: Author based on individual papers

4.2.2 Data and methodology

The final data set is similar to the one used in the previous analysis. It is a balanced panel spanning the period from 2007 to 2012 and including exactly the same set of banks.[38]

Although in literature FE and RE approaches are commonly used for analysis of bank profitability (Stiroh and Rumble, 2006, Chiorazzo et al., 2008, Hahm, 2008), we will apply System GMM framework that is used by many current papers (Odesanmi and Wolfe, 2007, Sanya and Wolfe, 2011, Gürgüz et al., 2013) because of its features that are able to face the endogeneity and lead to more robust estimates when dynamic panel data are faced. The detailed description of System GMM can be found in Section 4.1.2.

The estimation equation representing our model for each of the profitability, risk and risk-adjusted profitability measures is the same as in Section 4.1.2, but uses as dependent variable performance measure of bank i in country c at time t namely ROAA, ROAE, NIM, RAROAA, RAROAE, RANIM, ln(Z-Score) and ln(RAEAR).[39]

4.2.3 Variables

By choosing the proper variables, we follow the papers by Pasiouras and Kosmidou (2007), Kosmidou, et al. (2008), Heffernan and Fu (2010) and DeYoung and Rice (2004a).

The dependent variable captures the bank profitability or the risk measured by:

- Return on average assets *(roaa)*: $ROAA_{i,t} = \frac{Net\ income_{i,t}}{Average\ assets_{i,t}}$,
- Return on average equity *(roae)*: $ROAE_{i,t} = \frac{Net\ income_{i,t}}{Average\ equity_{i,t}}$,
- Net interest margin *(nim)*: $NIM_{i,t} = \frac{Interest\ income_{i,t} - Interest\ expense_{i,t}}{Assets_{i,t}}$,

[38] For more details about the data see Section 4.1.2.

[39] For definition of these variables see the next section. Note that the model stated in Section 4.1.2 is a general model, where necessary, no lags or more lags of the dependent variable will be included.

- Risk-adjusted ROAA *(raroaa)*: $RAROAA_{i,t} = \frac{ROAA_{i,t}}{\sigma(ROAA)_i}$,
- Risk-adjusted ROAE *(raroae)*: $RAROAE_{i,t} = \frac{ROAE_{i,t}}{\sigma(ROAE)_i}$,
- Risk-adjusted NIM *(ranim)*: $RANIM_{i,t} = \frac{NIM_{i,t}}{\sigma(NIM)_i}$,
- Log-transformed Z-Score *(ln_z_score)*: $\ln(Z-Score)_{i,t} = \ln\left(\frac{ROAA_{i,t}+\frac{Equity_{t,i}}{Assets_{t,i}}}{\sigma(ROAA)_i}\right)$,
- Log-transformed risk-adjusted equity to assets ratio *(ln_RAEAR)*: $\ln(RAEAR)_{i,t} = \ln\left(\frac{\frac{Equity_{t,i}}{Assets_{t,i}}}{\sigma(ROAA)_i}\right)$,[40]

where $\sigma(\cdot)_i$ stands for the standard deviation of each variable in bank i, computed over the examined six-year period.

ROAA, ROAE and NIM are standard measures of the bank profitability Still, since there is mostly some risk-return tradeoff it is important to measure the performance adjusted by risk. For this purpose RAROAA, RAROAE and RANIM are constructed.

The literature on bank performance widely uses Z-Score as a measure of risk (Stiroh 2002, Laeven and Levine, 2008, Köhler, 2012). Higher Z-Score indicates lower probability of insolvency, i.e. less risk and higher stability. More precisely, it states how many standard deviations below the expected value the bank's profits (measured by ROAA) must fall in order to eliminate equity (Boyd et al., 1993). Furthermore, we follow Köhler (2012, 2013) and use as risk indicators also individual components of Z-Score that capture the portfolio and the leverage risk. The portfolio risk is measured by RAROAA,[41] while RAEAR stands for the leverage risk. For both measures, higher values indicate increased stability.[42]

[40] The log-transformation is needed due to high skewness of Z-Score and RAEAR. The appropriateness of the log-transformation follows from Laeven and Levine (2009), Díaz and Huang (2013), Köhler (2012) and Strobel (2014).

[41] Note that this component of risk will be ordered among risk-adjusted profitability measures in the rest of the thesis.

[42] We do not use loan-loss provisions or non-performing loans to measure the stability of a bank, because these are not as general as Z-Score that captures besides credit risk also liquidity and market risk. Moreover, they are traditionally backward looking and procyclical (Laeven and Majnoni, 2003, Bikker and Metzemaker, 2005).

The explanatory (independent) variables include besides the lagged value of dependent variable (*lag_DV*) also bank-specific, country-specific, and banking sector-specific variables.

1) Bank-specific explanatory variables

Regarding the bank-specific explanatory variables, we are mainly interested in the effect of the magnitude of NFCI on the bank's profitability and risk.

Net fee and commission income to total operating income ratio (nfci_ti) has an ambiguous coefficient. It should increase profitability, but on the other hand too high fees can discourage clients from using banking services. Diversification should lead to decreased riskiness of the bank. On the other hand, usually higher volatility of NII compared to interest income may have destabilizing effect (Köhler, 2012).

Natural logarithm of total assets (ln_ass) is expected to increase the profitability since it is hypothesized that larger banks are able to produce economies of scale. Furthermore, larger banks should be more stable as they have better diversification opportunities and idiosyncratic risk tends to decrease with size (Baele et al., 2007).

Total customer deposits to asset ratio (depos_ass), where the coefficient depends on the cost of deposits, i.e. the interest rate the bank is paying the clients. Still, we believe that deposits count to rather cheap sources of funds and therefore we expect to find a positive coefficient. On the other hand, since deposits may be withdrawn anytime, deposit financing may be quite risky mainly in times of noisy public signals.

Loan-loss reserves to gross loans ratio (losres_loans) measures the bank asset quality. It reflects how large part of loan portfolio is set aside to cover potential losses. Higher *losres_loans* ratio can signal a poor quality of loans that decreases the interest income and increases provision costs and riskiness which result in lower bank's profitability. Still, with sound quality of loans, higher *losres_loans* may be positively related with bank's performance. Therefore the sign of the coefficient is not clear.

Loans to deposits and short term funding ratio (loans_depos) is a measure of liquidity with higher *loans_depos* meaning lower liquidity. We expect to find a positive relation between this variable and profitability, because higher liquidity is associated with lower returns. Of course, for risk-adjusted profitability measures the coefficient does not need to be positive, due to increased liquidity risk.

Liquid assets to deposits and short term funding ratio (liqass_depos) is another measure used to assess liquidity of a given bank. Higher liqass_depos decreases he probability of failure. The coefficient in profitability models is ambiguous, because both too low as well as too high liquidity may worsen the bank performance.

Total equity to total assets ratio (eq_ass) is due to risk-return hypothesis expected to be negatively related with bank performance in terms of risk and profitability. Nevertheless, banks with high *eq_ass* ratio are less dependent on external funding which may influence the profitability in an opposite way. Hence, the sign of the coefficient in profitability model could be both, positive or negative.

Loans to assets ratio (loans_ass) has ambiguous effect on bank performance because high *loans_ass* may increase interest income but at the same time it can mean a threat to liquidity. Similarly, banks with high *loans_ass* may be more exposed to credit risk, but at the same time they have less securitized assets, which turned out to be risky during the crisis (Köhler, 2012).

Cost to income ratio (cost_inc) is expected to have negative relationship with bank's profitability and risk.

We add the same dummy variables as defined in Section 4.1.3.

2) Banking sector-specific explanatory variables

Herfindahl index (hi) is anticipated to have a positive impact on the profitability, because high competition is expected to lower the profitability. At the same time, competition may increase the probability of failure of a bank or contrary it may lead to better stability since banks will manage the business in a more prudent way.

Banking assets to GDP ratio (ass_gdp) is a measure of the overall level of development of the banking sector and its importance in financing the economy.

We also use the technology variables defined in Section 4.1.3.

3) Country-specific explanatory variables[43]

Real annual GDP growth rate (gdp) is expected to be positively related to performance of banking sector. The impact on risk is not clear, because economic

[43] Country specific variables are included with lagged values and labelled by *lag_dependent variable*. I.e. in the table with results we include *lag_GDP* instead of *GDP*.

downturn may lead to bank failures. On the contrary, banks may find more profitable to diversify rapidly during periods of economic growth which may increase financial instability (Sanya and Wolfe, 2011).

Annual inflation rate (inf) may influence the profitability and risk of banks differently depending on the fact whether the inflation is expected or unexpected. In case of anticipated inflation the interest rates are adjusted in the right direction and at the right time. But in case of unanticipated inflation, banks may inadequately set their interest rates resulting in higher growth of costs than revenues and decrease in profitability and increased risk.

Annual unemployment rate (unem) is expected to decrease the performance of banks because higher unemployment increases the loan default rate.

Long-term annual interest rate (int) see Section 4.1.3.

There is high probability that in the final model not all those explanatory variables will be used. This is due to the fact that some of them are expected to be correlated.

4.2.4 Descriptive analysis

4.2.4.1 Descriptive analysis of dependent variables – NIM, ROAA and ROAE and its relation to NFCI/TI

We start the descriptive analysis by inspecting the dependent variables capturing the profitability, i.e. NIM, ROAA and ROAE. According to Figure 4.9, commercial and savings banks count to the most profitable among the examined groups. Savings banks have highest NIM and ROAA and second highest ROAE, while commercial banks have highest ROAE and also the other two performance measures are relatively high compared to other types of banks. On the contrary, investment banks and bank holdings and holding companies have lowest ROAE among all bank types. Moreover, investment banks are the only group with negative ROAA.[44] Real estate and mortgage banks and cooperative banks reported relatively high ROAE, but below-average NIM and ROAA. Nevertheless, it should be noted that the statistics, especially the average ROAE, was heavily influenced by outliers. This can be concluded based on Figure C.4 in Appendix C.1.2 displaying the median profitability measures by bank type.

[44] This may be partly attributed to the fact that we have only 10 investment banks in our sample. Moreover, seven of them are from PIIGS countries.

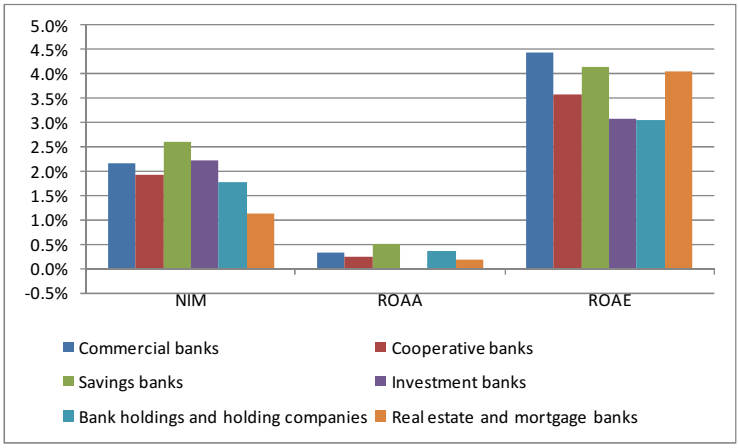


Figure 4.9: Average NIM, ROAA and ROAE by bank type

Source: Author using data from Bankscope

Figure 4.10 displays the evolution of ROAE by bank type between 2007 and 2012. A clear downward trend is observed over the whole period for all bank groups. The fall was caused by the financial crisis that hit the European economy in 2008 and which affected the whole considered period. The most significant decrease in ROAE was observed in 2008. In this year, bank holdings and holding companies had on average ROAE almost -10%, but they began to recover more quickly than other bank types and in 2012, they were the most profitable among the considered groups of banks.

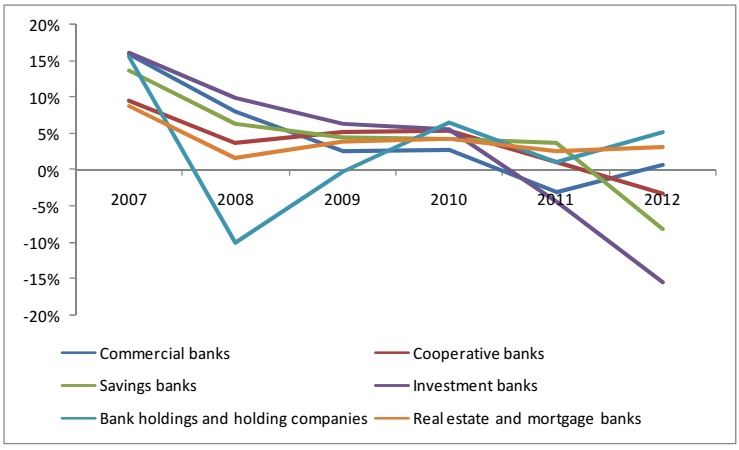


Figure 4.10: Development of average ROAE by bank type between 2007 and 2012

Source: Author using data from Bankscope

Moreover, while between 2009 and 2010 the differences in ROAE among the individual bank types were not so pronounced, in 2012 some bank groups performed significantly better than other. While some of the banks stabilized their ROAE or even reported higher profitability in this year compared 2011, investment, savings and cooperative banks' performance measured by ROAE dropped further to -15.5%,

-8.1% and -3.2%, respectively. Nonetheless, also this figure was largely affected by outliers. In Figure C.5 (Appendix C.1.2) depicting the median ROAE development by bank type an overall declining trend can be seen but ROAE was not negative in any period for any group of banks.

Figure 4.11, Figure 4.12 and Figure 4.13 show the scatter plots depicting the relation between the profitability measures and NFCI/TI. The two left-hand-side outliers in Figure 4.11 are Hypo Real Estate Holding AG in 2008 and National Bank of Greece SA in 2011. Interestingly, the positive outlier with ROAE of more than 200% is also National Bank of Greece SA but in year 2012. The severe consequences of the financial crisis on Greece's banking sector can be seen also in Figure 4.12, where the Investment Bank of Greece had in 2012 ROAA of less than -34%, which is highly below average. Speaking about NIM, three positive outliers, all reported in Bulgarian-American Credit Bank between 2007 and 2009, can be identified.

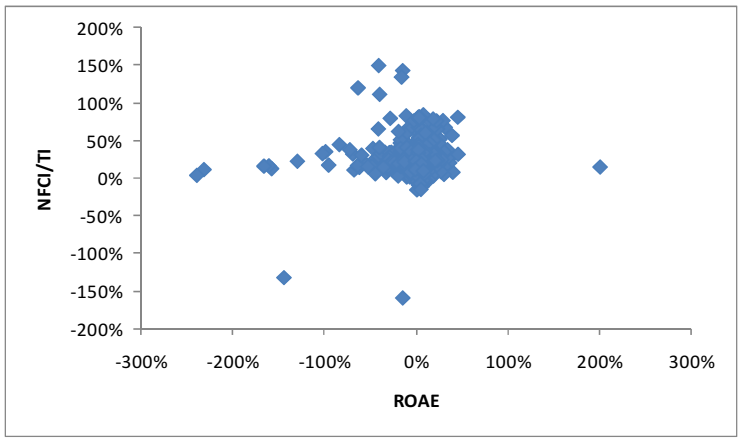


Figure 4.11: ROAE and Net fee and commission income/Total income

Source: Author using data from Bankscope

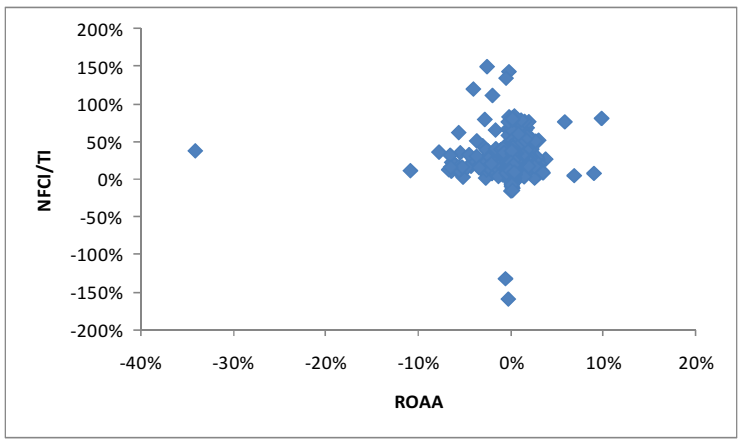


Figure 4.12: ROAA and Net fee and commission income/Total income

Source: Author using data from Bankscope

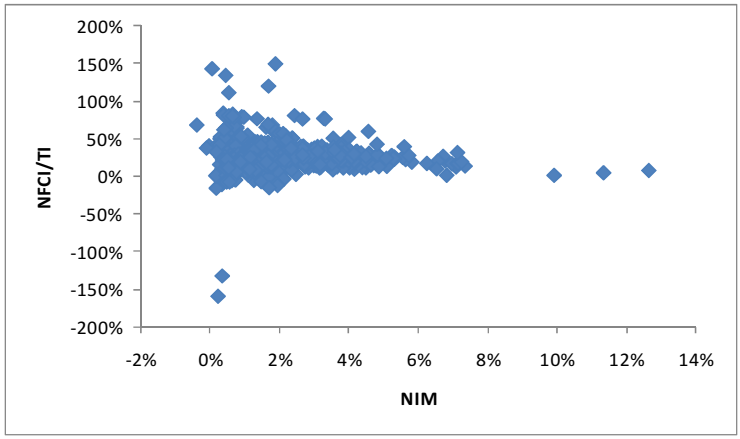


Figure 4.13: NIM and Net fee and commission income/Total income

Source: Author using data from Bankscope

4.2.4.2 Descriptive analysis of dependent variables – RANIM, RAROAA and RAROAE and its relation to NFCI/TI

The average risk-adjusted performances by bank type are depicted in Figure 4.14.[45] Bank holdings and holding companies display the highest risk-adjusted profitability according to all measures. Also commercial banks display superior performance, mainly when measured by RAROAA. On the contrary, risk-adjusted performance of real estate and mortgage banks is below the average measured by all available measures. Altogether, after adjusting for risk the ranking of banks performance changes a lot. The banks which display NIM, ROAA and/or ROAE over average do not necessarily have also risk-adjusted profitability over the mean.

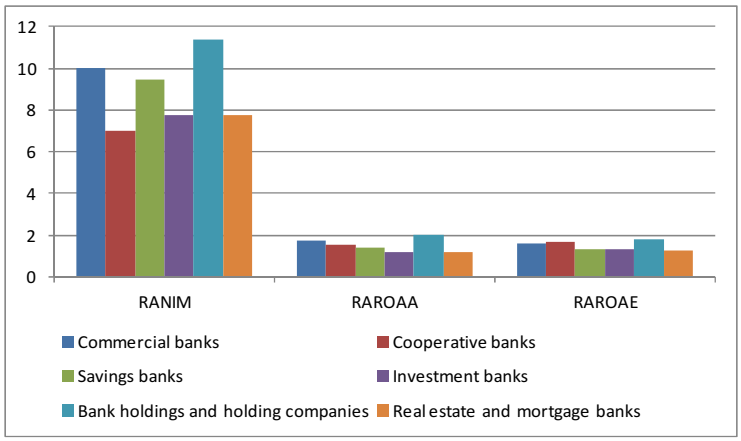


Figure 4.14: Average RANIM, RAROAA, RAROAE by bank type

Source: Author using data from Bankscope

[45] A similar figure depicting the median values is displayed in Appendix C.1.2.

The following three figures show the scatter plots depicting the relationship between the risk-adjusted performance measures and NFCI/TI. The highest RAROAE (above 10) was recorded in Great Britain's holding company Standard Chartered Plc in 2007 and 2008. The same bank holding had also outstanding RAROAA of 14.5 and 13.5 in 2007 and 2010, respectively. Six observations with the highest RANIM are all reported in Czech Komerční banka. In all scatter plots can be seen that at lower levels of risk-adjusted profitability the dispersion of NFCI/TI is higher than at highest levels. Therefore it is crucial to control for heteroscedasticity in our model, i.e. we will use robust standard errors.

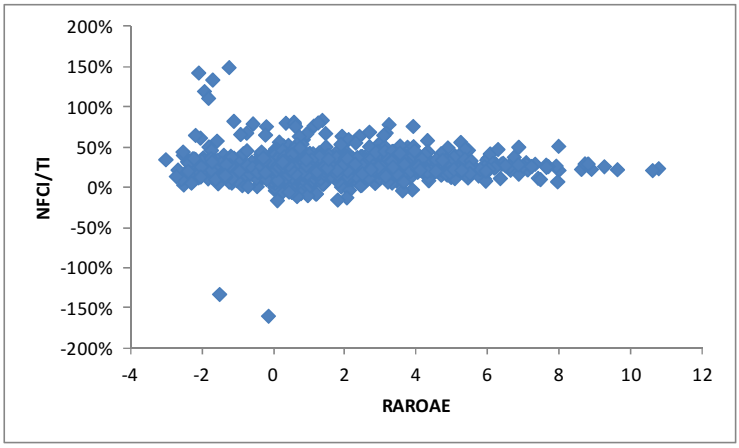


Figure 4.15: RAROAE and Net fee and commission income/Total income

Source: Author using data from Bankscope

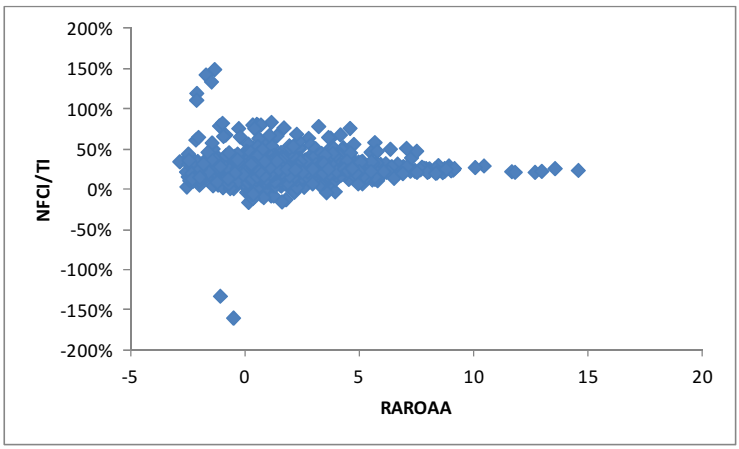


Figure 4.16: RAROAA and Net fee and commission income/Total income

Source: Author using data from Bankscope

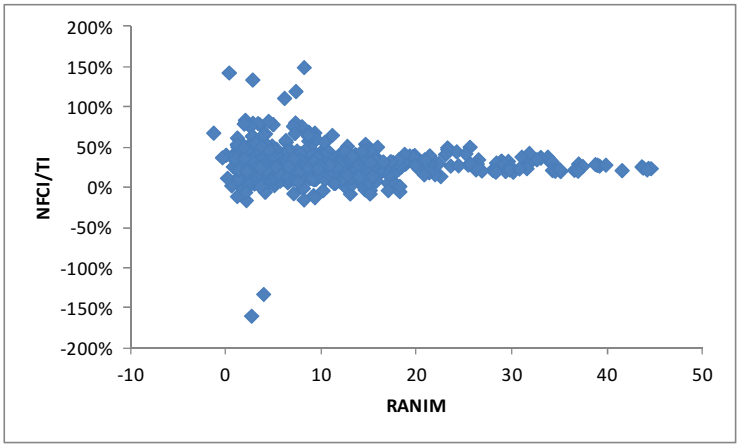


Figure 4.17: RANIM and Net fee and commission income/Total income

Source: Author using data from Bankscope

4.2.4.3 Descriptive analysis of dependent variables – ln(Z-Score) and ln(RAEAR) and its relation to NFCI/TI

Nine banks were excluded from the final dataset for the risk models because they reported negative Z-Score at least in one year and therefore, we were not able to construct the log-transformation. These banks were mainly commercial banks (7 banks) from PIIGS group (6 banks). On the other hand, Austrian Bank Winter & Co. AG showed since 2007 Z-Score above 100 which is far above the 24.2 EU average. Figure 4.18 displays average Z-Score and RAEAR for different bank types after log-transformation. Most stable are cooperative and real estate and mortgage banks according to both measures. This is confirmed by Figure C.7 based on which we can conclude that the averages are not influenced by outliers. On the other hand, according to Figure 4.14, bank holdings and holding companies seem to be the least exposed to portfolio risk.

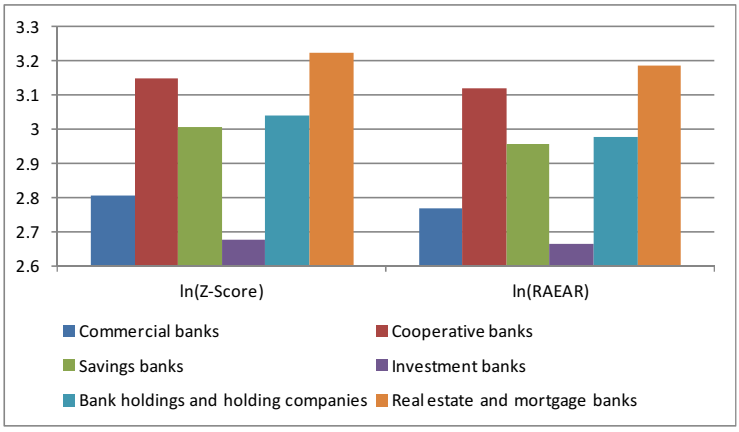


Figure 4.18: Average ln(Z-Score) and ln(RAEAR) by bank type

Source: Author using data from Bankscope

Figure 4.19 and Figure 4.20 depict scatter plots showing the relationship between NFCI/TI and the two risk measures. ln(Z-Score) ranges between -2 and almost 6 and most of the observations are between 2 and 3. On the other hand, ln(RAEAR) takes only positive values and is distributed more equally.

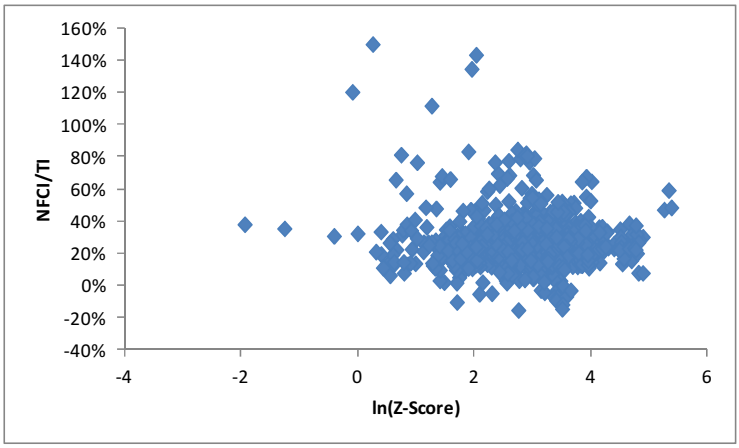


Figure 4.19: ln(Z-Score) and Net fee and commission income/Total income

Source: Author using data from Bankscope

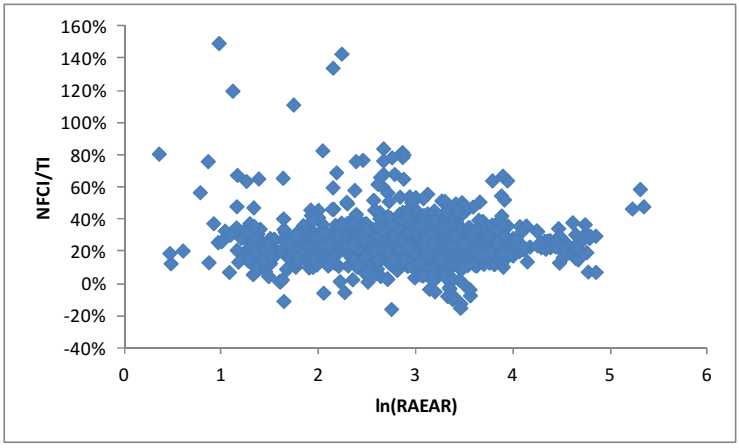


Figure 4.20: ln(RAEAR) and Net fee and commission income/Total income

Source: Author using data from Bankscope

4.2.4.4 Descriptive analysis of banking sector-specific and country-specific variables

The banking sector penetration in each country measured by total banking assets to GDP ratio is displayed in Figure 4.21. It can be seen that there are large differences among the EU-27 countries. The difference between banking sector assets to GDP ratio in Luxembourg (1,474% – the highest one) and in Romania (50% – the lowest one) is more than 1,400%. The lowest banking sector penetration can be found in CEE countries where the ratio does not exceed 130%.

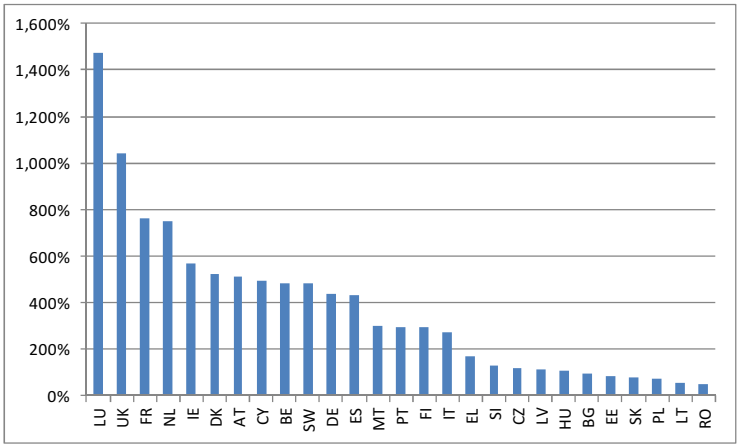


Figure 4.21: Banking sector penetration in 2012 measured by total banking assets to GDP

Source: Author using data from Bankscope and the World Bank

For descriptive statistics of other banking sector-specific and country-specific explanatory variables entering the estimation equation, see Section 4.1.4. Summary statistics of all used variables can be found in Appendix C.1.2.

4.2.5 Results and findings

This section provides the empirical results on link between NFCI/TI and banks' performance. We include also robustness tests to prove the validity of our estimates.

4.2.5.1 Profitability – NIM, ROAA, ROAE

The Wooldridge test (Table 4.8) suggests that ROAA and NIM are both autocorrelated while ROAE is not. We suppose that this is probably caused by the short data set which was largely influenced by the financial crisis. As a consequence, System GMM is not necessary for ROAE estimation and will be used only for the remaining two profitability measures. ROAE will be estimated with Generalized Two Stage Least Squares (G2SLS) RE IV regression and with FE IV regression.

Table 4.8: Wooldridge test for autocorrelation in panel data – ROAA, ROAE, NIM

	roaa	roae	nim
F statistics	4.343	0.001	20.471
	(d.f. 1, 184)	(d.f. 1, 184)	(d.f. 1, 184)
p-value	0.0385	0.9779	0.0000

H0: no first-order autocorrelation, d.f. = degrees of freedom
Source: Author using data from Bankscope

The regression results can be found in Table 4.9. We report two results for each dependent variable. The first one is estimated based on all available data while the second one is estimated only on banks that reported positive NFCI/TI in all examined years. I.e. in the first model we have 185 groups and in the second one 179 because 6 banks operated with negative NFCI/TI during 2007–2012. This reduction of examined banks was necessary to evaluate how the outliers affect the estimation. Two-step System GMM is used for ROAA and NIM estimation. The reported standard errors are robust to heteroscedasticity and autocorrelation and adjusted for 185/179 clusters. Moreover, we apply small sample correction to covariance matrix and Windmeijer correction. ROAE is, as already mentioned, estimated by G2SLS random effect IV and within IV regression.[46]

Some of before defined explanatory variables were excluded from the regression due to their mutual correlation and insignificance.[47] We report the diagnostics tests as in Section 4.1.5. The results do not suggest any misspecification or other problems.[48] We also instrument all endogenous and predetermined variables mainly speaking about the *lag_dv*,[49] *eq_ass*, *nfci_ti*, *loans_depos, losres_loans* and *depos_ass*.

In ROAE models, we report R^2. It can be seen that RE model is able to explain almost 22% of the variation (see Table C.6) while FE model only 4.2% when all banks are included. The F-test that all $\mu_i = 0$ was rejected confirming the presence of within groups effects. In order to test for consistency of RE we have run the Hausman test. The large significant Hausman statistics means that RE is inconsistent, while FE

[46] In Table 4.9, we report only FE IV that turned out to be consistent. G2SLS estimation results can be found in Table C.6 among robustness tests. Moreover, we perform System GMM for ROAE among the robustness tests.

[47] See the correlation matrix in Appendix C.2.

[48] Hansen test for NIM estimated based on 179 banks suggests that overidentification issue might be present, but the p-value is 0.08 which is very close to be insignificant.

[49] In order to test for autocorrelation aside from the fixed effects Arellano and Bond test is applied to the residuals in differences. To check for the first order autocorrelation in the equation in levels, we look for the second order serial correlation in the differenced equation. If $\varepsilon_{i,t}$ is serially correlated in order one, i.e. if Arellano-Bond AR (2) is significant, then $y_{i,t-2}$ is endogenous and cannot be used as instrument (Roodman, 2006). Both AR (1) and AR (2) are significant and negative in our models. Thus, we specify higher lags as instruments.

is consistent but possibly inefficient. Therefore, in this table with main results, we report just the FE models and RE can be found in Appendix C.3.

In all reported System GMMs, the coefficient of *lag_DV* is significant and positive, proving the necessity of application of estimation method suitable for dynamic panel data. In NIM model, we find also a significant second lag which is negative. This rather unexpected feature may be possibly attributed to the crisis. Moreover, significant AR (2) test suggest that there may exist even longer time persistence in NIM as well as in ROAA. This was taken into consideration and tested in robustness tests. On the other hand, *lag_DV* is insignificant when System GMM is applied on ROAE.[50] Therefore, as already mentioned, simpler estimation methods are used.

The effect of NFCI/TI on bank's performance differs with the used profitability measure. While higher NFCI/TI decreases NIM it tend to increase ROAA and ROAE when the estimation is done based on all available banks.[51] After exclusion of banks with negative NFCI/TI, the relationship turned to be insignificant in case of ROAA and ROAE. For NIM, the coefficient did change dramatically neither in its magnitude nor in significance. One percent increase in NFCI/TI leads on average to more than 0.008 percent decrease in NIM in both specifications. Therefore, the outliers seem to play a significant role in case of ROAA and ROAE but their role in NIM is limited.

The coefficient of *losres_loans* is significantly negative for ROAA and ROAE supporting the hypothesis that higher loan-loss reserves are sign of poor quality of loans. On the other hand, the coefficient in NIM model is insignificant. All other bank-specific explanatory variables including the bank type dummies do not seem to play any important role for performance determination.

All banking sector-specific variables are significantly related at least with one profitability measure. Higher market concentration increases ROAE, while the relationship between *hi* and ROAA and NIM is insignificant or negative depending on number of banks included in the study. *Ass_gdp* is negatively related with all profitability measures. The effect is most pronounced by ROAE and insignificant for NIM. NIM is decreasing with number of ATMs in a given country.

[50] See Appendix C.3.

[51] Although those models performed the best in terms of the test statistics we show in robustness check that the found positive relationship between NFCI/TI and ROAA and ROAE is rather exceptional and is not present in models with slightly changed specification.

Table 4.9: Relationship between NFCI share and profitability – Two-step System GMM and FE IV regression results

	Dependent variable					
Independent variables	roaa		roae		nim	
	two-step	two-step	FE-IV	FE-IV	two-step	two-step
lag_DV	0.4642**	0.4613**			1.2083***	1.2417***
	(0.1933)	(0.206)			(0.1063)	(0.1068)
lag2_DV					-0.2889***	-0.3342***
					(0.0888)	(0.0952)
nfci_ti	0.0211*	-0.0141	0.3565*	-0.6619	-0.0087***	-0.0083***
	(0.0117)	(0.0201)	(0.1841)	(0.8155)	(0.0026)	(0.0021)
loans_depos	-0.0001	-0.0039	0.1186	0.2154	-0.0013	-0.0018
	(0.0064)	(0.0089)	(0.1021)	(0.1713)	(0.0009)	(0.0012)
depos_ass	0.6471	0.5234	9.8348	19.7901	0.2659	0.2216
	-0.4921	(0.3174)	(20.0188)	(22.2739)	(0.2335)	(0.2042)
losres_loans	-0.1856***	-0.2088***	-2.9566***	-2.7046***	-0.0057	-0.007
	(0.0374)	(0.0384)	(0.4357)	(0.4411)	(0.005))	(0.0055)
eq_ass	-0.0175	0.0028	-0.8245	-1.1309	-0.0056	-0.0019
	(0.0375)	(0.0334)	(1.0011)	(1.0960)	(0.0072)	(0.0065)
hi	-0.0001	-0.0002**	0.0310**	0.0367**	-0.0001	-0.0001***
	(0.0001)	(0.0001)	(0.0131)	(0.0146)	(0.0000)	(0.0000)
ass_gdp	-0.0007**	-0.0008***	-0.0341	-0.0496**	-0.0000	-0.0000
	(0.0003)	(0.0003)	(0.0208)	(0.0233)	(0.0001)	(0.0001)
atms	-0.0002	-0.0004	0.2831	0.1789	-0.0011***	-0.0009**
	(0.0015)	(0.0016)	(0.1958)	(0.2013)	(0.0004)	(0.0004)
dcom	0.0263	0.3152			0.0767	0.1007
	(0.4790)	(0.3134)			(0.1022)	(0.0822)
dcoop	-0.2617	0.1795			0.0663	0.1026
	(0.4527)	(0.434)			(0.1029)	(0.0847)
dsav	0.1011	0.2415			0.0527	0.1076
	(0.4418)	(0.3742)			(0.0875)	(0.0748)
dinv	0.0744	-0.0167			0.2811	0.3241
	(0.6921)	(0.6241)			(0.2029)	(0.2346)
dhold	0.0741	0.3488			0.0703	0.1121
	(0.5467)	(0.3266)			(0.1268)	(0.0977)
lag_gdp	0.0548	0.0421	1.0884**	1.4395***	0.0080	0.0069
	(0.0335)	(0.0306)	(0.5104)	(0.5392)	(0.0109)	(0.0104)
lag_inf	-0.0739	-0.0821*	-4.4565***	-4.9747***	0.0109	0.0142
	(0.0538)	(0.0467)	(0.8408)	(0.8785)	(0.0194)	(0.0186)
_cons	0.0739	1.4672	-26.1473	3.0226	0.4059*	0.5887***
	(1.5053)	(1.3831)	(30.3067)	(41.3355)	(0.2411)	(0.2216)

Estimation diagnostics						
Number of observations	925	895	740	716	740	716
Number of groups	185	179	185	179	185	179
Observations per group	5	5	4	4	4	4
Number of instruments	53	53	16	16	49	49
F-test	8.52***	9.32***	7.68***	7.38***	113.81***	125.07***
Arellano-Bond AR (1)	-2.29**	-2.04**			-2.68***	-2.79***
Arellano-Bond AR (2)	-2.75***	-2.39**			-2.58**	-2.53**
Hansen test	32.35	37.13			36.17	39.11*
R^2			0.0421	0.0148		

Robust standard errors adjusted for 185/179 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, Hansen test for NIM model with 179 banks has p-value 0.08, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

The coefficient of lagged GDP growth is positive for all dependent variables suggesting that with higher economic growth the banking profitability increases. But the relationship is significant only for ROAE being the dependent variable. An opposite relationship is found for *lag_inf*. In countries reporting higher growth of consumer price index, banks' profitability measured by ROAE and ROAA tends to be lower.

4.2.5.2 Robustness tests – NIM, ROAA, ROAE

Since it is very difficult to stipulate the ideal number of instruments in System GMM, a part of our robustness check form regressions estimating the same model but using other instruments set. We show that the positive significant coefficient of NFCI/TI in ROAA regression found when all available data was used is not robust to different instruments choice. This finding supports our previous statement that there is probably no significant relationship between fee income share and ROAA. On the other hand, a negative coefficient of NFCI/TI was estimated under all specifications for NIM as dependent variable.

Moreover, as already mentioned the significant AR (2) tests in ROAA and NIM regressions suggest that increased number of lags may be significant. This was not

confirmed. In order to have more periods available for the estimation, we performed the regression on NIM with only one lag of the dependent variable. The coefficient of NFCI/TI remained significantly negative.

For ROAE, we show RE IV regression results that are according to Hausman test inconsistent but still the coefficient signs and their significance are very similar to FE IV estimates. Only the coefficient of *eq_ass* was insignificant in FE and is significantly positive in RE regression. Furthermore, we have run two-step System GMM with ROAE as dependent variable. Lagged ROAE turned out to be insignificant which proves the suitability of estimation methods for stationary panel data. All above mentioned results can be found in Appendix C.3 Table C.6.

Table 4.10 shows the results of the previous models estimated by pooled OLS and FE. Those are standardly used to test the correctness of *lag_DV* coefficients that should lie between or sufficiently close to pooled OLS and FE estimates. This is met for both ROAA and NIM. In all models, we used robust and clustered standard errors. Moreover, we included time dummies which are not reported in the table.

Significant F-test indicates a joint significance of used variables in all models. Moreover, according to R^2, NIM models can explain most of the variation in the dependent variable (more than 91% when OLS is applied and over 50% when FE is applied). This is mainly caused by the fact that NIM is highly time persistent and compared to ROAA and ROAE does not respond so heavily on market changes. This is also the reason why the coefficients of lagged NIM are so high. On the other hand, for ROAA models, R^2 is 33% and 50% for FE and OLS respectively, while for ROAE, the model is able to explain less than 20% of the variation.

The coefficients differ from those estimated in Table 4.9 mostly in significance. The difference is most pronounced for *eq_ass* that is positively related with ROAA and ROAE according to OLS and FE. Nevertheless, since this variable is endogenous and was not instrumented within those models, the coefficient is most probably biased. Furthermore, type of bank seems to be an important determinant of NIM. Regarding the estimated coefficients of *nfci_ti*, they turned out to be insignificant in all OLS regressions and significantly negative for ROAE and NIM in FE regressions.

We conclude that the results proved to be stable among different model specification and estimation methods. Together, we can say that all groups of variables, bank-specific, banking sector-specific as well as country-specific variables, are important determinants of banks' profitability. High NFCI/TI is mostly related with lower NIM, while it does not affect the other profitability measures significantly.

Table 4.10: Relationship between NFCI share and profitability – OLS and FE regression results

Independent variables	Dependent variable					
	roaa		roae		nim	
	OLS	FE	OLS	FE	OLS	FE
lag_DV	0.4974***	0.0657			1.0982***	0.6229***
	(0.1088)	(0.1498)			(0.1151)	(0.1315)
lag2_DV					-0.2337*	-0.1749***
					(0.1266)	(0.0626)
nfci_ti	-0.0051	-0.0019	0.0454	-0.1545*	-0.0005	-0.0055**
	(0.0035)	(0.006)	(0.1277)	(0.0915)	(0.0011)	(0.0022)
loans_depos	-0.0008	-0.0024	-0.0015	-0.0031	0.0002	0.0050**
	(0.0007)	(0.0043)	(0.0104)	(0.0255)	(0.0001)	(0.0023)
depos_ass	0.6585**	0.7869	8.6993*	14.5478	0.3303***	-0.8311
	(0.2658)	(1.5345)	(4.9067)	(15.6888)	(0.1121)	(0.6136)
losres_loans	-0.2167***	-0.4873***	-2.3015***	-2.9959***	-0.0052	-0.0178
	(0.0658)	(0.1302)	(0.3703)	(0.5133)	(0.0054)	(0.0143)
eq_ass	0.0110	0.1331***	0.6799**	1.5841**	0.0009	0.0159
	(0.0252)	(0.0433)	(0.2851)	(0.7277)	(0.0044)	(0.0098)
hi	-0.0002***	-0.0006	-0.0016	0.0074	-0.0000*	-0.0001
	(0.0001)	(0.0005)	(0.0014)	(0.0094)	(0.0000)	(0.0001)
ass_gdp	-0.0005***	-0.0022	-0.0052*	-0.0001	0.0000	-0.0006*
	(0.0002)	(0.0016)	(0.0028)	(0.0104)	(0.0001)	(0.0003)
atms	-0.0000	-0.0157**	-0.0007	-0.0075	-0.0009**	-0.0049
	(0.0012)	(0.0065)	(0.0187)	(0.0804)	(0.0003)	(0.0036)
dcom	0.3091		2.0785		0.1347**	
	(0.2886)		(2.3388)		(0.0593)	
dcoop	0.1125		-0.2237		0.0891	
	(0.2661)		(2.5752)		(0.0665)	
dsav	0.1405		-2.2648		0.1336*	
	(0.3234)		(3.5167)		(0.0789)	
dinv	-0.3478		-0.6321		0.3777**	
	(0.4368)		(5.2501)		(0.1461)	
dhold	0.2934		1.2912		0.1827**	
	(0.2527)		(4.6830)		(0.0901)	
lag_gdp	0.0712**	0.0490	1.2259***	1.0401**	0.0146	0.0196**
	(0.0356)	(0.0407)	(0.4279)	(0.442)	(0.009)	(0.0096)
lag_inf	-0.0671*	-0.2235***	-0.6218	-2.5122***	0.0181	0.0242
	(0.0390)	(0.0584)	(0.6259)	(0.871)	(0.0172)	(0.0155)
_cons	0.4540	4.0506***	4.8238	1.0541	0.0271	1.8871***
	(0.4472)	(1.3915)	(9.5058)	(17.5950)	(0.1315)	(0.5032)

Estimation diagnostics						
Number of observations	925	925	1110	1110	740	740
Number of groups		185		185		185
Observations per group		5		6		4
F-test	16.59***	15.20***	12.37***	20.07***	241.47***	9.24***
R^2	0.5017	0.3285	0.1976	0.1288	0.9122	0.5023

Robust standard errors adjusted for 185 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

4.2.5.3 Risk-adjusted profitability – RANIM, RAROAA, RAROAE

According to Table 4.11, first-order autocorrelation was found in all risk-adjusted profitability measures and therefore System GMM represents the most suitable estimation method for our data.

Table 4.11: Wooldridge test for autocorrelation in panel data – RAROAA, RAROAE, RANIM

	raroaa	raroae	ranim
F statistics	57.695	57.172	158.843
	(d.f. 1, 184)	(d.f. 1, 184)	(d.f. 1, 184)
p-value	0.0000	0.0000	0.0000

H0: no first-order autocorrelation, d.f. = degrees of freedom
Source: Author using data from Bankscope

We estimated three different models (RAROAA, RAROAE RANIM) to investigate the effects of fee income magnitude on risk-adjusted bank performance. The results are reported in Table 4.12. Similarly to the previous models, we performed two-step System GMM with robust standard errors adjusted for 185/179 clusters,[52] with small sample correction to covariance matrix and Windmeijer correction.

We also show the standard diagnostics tests. The model is not misspecified and the used instruments are valid.[53] In RANIM, higher lags were used as instruments

[52] One model was estimated based on all available data (185 banks). In the second one we excluded all banks with negative NFCI/TI in order to be able to evaluate the effect of outliers.

[53] For more information about the diagnostics tests see Section 4.1.5.

because significant AR (2) made the second lag of the dependent variable endogenous. Furthermore, the significant AR (2) in RANIM suggests that further lags of the dependent variable may be significant. This possible feature was tested among the robustness tests.

The lagged dependent variable is significant in all models proving the appropriateness of the estimation method suitable for dynamic panel data. Most time persistent is RANIM which coefficient on first lag is almost 0.88 and the second lag is also positive and significant. Later on, we tested for presence of third-order autocorrelation which in fact turned out to be significant as well (with inclusion of third lag the second one changed its sign). But since our data contain only six years period, the estimation with three lags is based on quite small number of observations, therefore we report model with only two lags among the main results.[54] On the other hand, models where RAROAA and RAROAE are used as dependent variables are well behaved with only one significantly positive lag that is in absolute terms lower than one. In fact, this behaviour was expected by all profitability measures, but the crisis seems to have major impact on the data and the persistence of the profitability measures.

The coefficient on *nfci_ti* is negative in all cases meaning that an increase in fee and commission income share leads to a decrease in risk-adjusted profitability. The coefficients are significant for RAROAA and ROROAE when estimated using both the full sample of banks as well as only those that reported positive NFCI/TI in all examined years. But it can be seen that after exclusion of outliers the coefficients almost doubled in both models. On the other hand, the relationship between fee income share and RANIM is negative but insignificant when all banks are included in estimation. After exclusion of banks with negative NFCI/TI, the negative coefficient becomes significant. Therefore, high levels of fee income tend to either decrease the profitability or to increase the risk or both at the same time.

The coefficients of *depos_ass*, are significantly positive for RAROAA in both models and RANIM when all banks are included. This means that more traditionally oriented banks perform better in terms of RAROAA as well as in terms of RANIM, but do not seem to perform better or worse in terms of RAROAE.

[54] The second reason why we included only two lags is that when the model with three lags was estimated by pooled OLS and FE the third lag was insignificant. But of course those estimates were biased.

Table 4.12: Relationship between NFCI share and risk-adjusted profitability – System GMM regression results

	Dependent variable					
Independent variables	raroaa		raroae		ranim	
	two-step	two-step	two-step	two-step	two-step	two-step
lag_DV	0.5284***	0.5437***	0.3411***	0.3043***	0.8782***	0.8754***
	(0.0476)	(0.0506)	(0.0692)	(0.068)	(0.0313)	(0.0334)
lag2_DV					0.1062***	0.1105***
					(0.0323)	(0.0349)
nfci_ti	-0.0085*	-0.0176***	-0.0191**	-0.0319***	-0.0109	-0.0229***
	(0.0049)	(0.0049)	(0.0081)	(0.0072)	(0.0078)	(0.0055)
loans_depos	-0.001	0.0011	0.0023	0.0059	0.0016	-0.0022
	(0.0019)	(0.0025)	(0.0027)	(0.0037)	(0.0014)	(0.0019)
depos_ass	2.3410***	1.7831***	0.7868	0.2405	0.5885*	0.0205
	(0.5291)	(0.5520)	(0.6212)	(0.8452)	(0.3003)	(0.3489)
losres_loans	-0.1556***	-0.1485***	-0.1662***	-0.1656***	-0.0150	-0.0202
	(0.0244)	(0.0238)	(0.0303)	(0.0287)	(0.011)	(0.0127)
eq_ass	0.0574***	0.0519***	0.0664***	0.0607**	0.0189	0.0201
	(0.0189)	(0.0164)	(0.0256)	(0.0262)	(0.0118)	(0.0125)
hi	-0.0002**	-0.0003**	-0.0002	-0.0003	-0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
ass_gdp	-0.0001	0.0000	0.0001	0.0002	0.0004***	0.0003***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
atms	-0.0088***	-0.0076***	-0.0043**	-0.006***	-0.0017	-0.0017
	(0.0026)	(0.0024)	(0.0021)	(0.0021)	(0.0014)	(0.0014)
dcom	0.5956**	0.7721***	0.8974***	0.7714**	0.1706	-0.0084
	(0.3002)	(0.2835)	(0.2909)	(0.3727)	(0.2008)	(0.1672)
dcoop	0.4162	0.5371	0.8085**	0.4676	-0.0725	-0.1609
	(0.3494)	(0.3336)	(0.3571)	(0.4734)	(0.2294)	(0.186)
dsav	-0.2001	0.0090	0.3508	0.1847	-0.1466	-0.2455
	(0.4130)	(0.3582)	(0.4012)	(0.4235)	(0.2183)	(0.1891)
dinv	0.4679	0.5705	0.7164	0.3765	0.5327**	0.2914
	(0.4290)	(0.3872)	(0.5574)	(0.7106)	(0.2596)	(0.236)
dhold	0.6649*	0.8964**	0.8689*	0.8147*	0.0008	-0.1169
	(0.3975)	(0.3637)	(0.4449)	(0.4268)	(0.2351)	(0.2338)
lag_gdp	-0.0042	0.0027	0.0005	0.0084	0.0299	0.0427**
	(0.0201)	(0.0201)	(0.022)	(0.0234)	(0.0218)	(0.0217)
lag_inf	-0.1054***	-0.1028***	-0.0961**	-0.1137***	-0.0098	-0.0258
	(0.0334)	(0.0373)	(0.0377)	(0.0403)	(0.0350)	(0.0323)
_cons	0.2024	0.3063	0.5031	1.395	-0.5124	1.1411**
	(0.6256)	(0.7259)	(0.8145)	(0.9409)	(0.5115)	(0.4672)

Estimation diagnostics						
Number of observations	925	895	925	895	740	716
Number of groups	185	179	185	179	185	179
Observations per group	5	5	5	5	4	4
Number of instruments	163	163	96	96	163	163
F-test	22.38***	21.05***	15.56***	13.54***	2230.75***	2469.38***
Arellano-Bond AR (1)	-7.08***	-6.99***	-5.83***	-5.75***	-4.33***	-4.08***
Arellano-Bond AR (2)	-0.11	-0.45	-0.52	-1.02	-3.24***	-2.96***
Hansen test	156.43	156.11	88.91	83.06	157.08	154.79

Robust standard errors adjusted for 185/179 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

Both *losres_loans* and *eq_ass* are important determinants of RAROAA and RAROAE but their effect is opposite. While higher *losres_loans* decrease those two performance measures, *eq_ass* is positively related with RAROAA and RAROAE. This finding may be attributed to the fact that poor quality of loans that is measured by *losres_loans* tend to cut down the interest income decreasing the overall income. On the other hand, lower capital risk (higher *eq_ass*) increases the risk-adjusted profitability because it enables cheaper financing.

Within the bank types, commercial banks and bank holdings and holding companies seem to perform better than other types of banks in terms of RAROAA and RAROAE. This is in line with Figure 4.14 and Figure C.6. Furthermore, when all banks are taken into consideration, cooperative banks display above average RAROAE and investment banks display above average RANIM. All other dummy variables on bank type are insignificant.

Among the banking sector-specific variables, higher market concentration tends to decrease RAROAA while it does not influence the other performance measures significantly. On the contrary, RANIM is positively related *ass_gdp*, while the other measures do not respond to *ass_gdp* significantly. The number of ATMs in a given country that is a proxy for technological development of the banking sector is negatively related to RAROAA and RAROAE.

From the macroeconomic conditions, the coefficient on *lag_inf* is significantly negative in RAROAA and RAROAE models. On the other hand, economic growth is in most cases insignificant. Higher lagged GDP growth is positively related with RANIM but only in the model that does not include banks with negative NFCI/TI.

4.2.5.4 Robustness tests – RANIM, RAROAA, RAROAE

Again, we provide two parts of the robustness tests. First one consists of re-estimation of the model by System GMM under different specification of instruments. Moreover, we provide also RANIM model with three lags of dependent variable. These results are reported in Appendix C.3 Table C.7. The second part contains the standard tests, namely pooled OLS and FE regressions of the models.

The System GMM results differ from those estimated in Table 4.12 mostly in their significance. It can be seen that RANIM is highly persistent. All three lags are significant, the coefficient of *lag_DV* is 0.88 which is pretty the same as in the model with two lags. The coefficient on the second lag changed from 0.11 to -0.23 in the latter specification. The third lag is again positive, more precisely 0.26. NFCI/TI is negatively related with all performance measures, only when all three lags are included in RANIM the coefficient of *nfci_ti* is insignificant. Also in those models after exclusion of the outliers the effect of *nfci_ti* on risk-adjusted profitability measures is almost twice as pronounced as in regressions with all banks.

Under at least one specification, a significant relationship between all risk-adjusted profitability measures and *atms*, *depos_ass*, *losres_loans* and *eq_ass* was found. While the coefficient of *atms* and *losres_loans* was always negative, for *depos_ass* and *eq_ass* the opposite holds true. This is in line with the results in Table 4.12. The type of a bank is important especially for determination of RAROAA where the coefficients of *dcom*, *dcoop*, *dinv* and *dhold* are significant. Under some specifications, *loans_depos* is significant and positive in RAROAA regression. Among macroeconomic variables, *lag_inf* decreases the risk-adjusted profitability.

In Table 4.13, we provide the estimation results obtained by pooled OLS and FE. The F-tests suggest that the used regressors are jointly significant and R^2 provides the goodness of fit. The very basic robustness test of the validity of estimated coefficients on lagged dependent variables is that the System GMM estimate should lie between or sufficiently close to those obtained from OLS and FE regressions. Furthermore, low R^2 of FE models compared to OLS suggests that the true value of the coefficient of *lag_DV* should lie closer to OLS estimates. This holds true for our System GMM estimates.

Table 4.13: Relationship between NFCI share and risk-adjusted profitability – OLS and FE regression results

	Dependent variable					
Independent variables	raroaa		raroae		ranim	
	OLS	FE	OLS	FE	OLS	FE
lag_DV	0.8238***	-0.0776**	0.7932***	-0.0440	0.8641***	0.1339***
	(0.0278)	(0.0311)	(0.0255)	(0.0325)	(0.0304)	(0.0366)
lag2_DV					0.1249***	-0.2307***
					(0.0313)	(0.0279)
nfci_ti	-0.0067***	-0.0184***	-0.0069***	-0.0196***	-0.0056	-0.0222***
	(0.0019)	(0.0065)	(0.002)	(0.007)	(0.0041)	(0.0068)
loans_depos	-0.0006	0.0046***	-0.0011*	0.0038***	-0.0002	0.0100***
	(0.0005)	(0.0014)	(0.0006)	(0.0013)	(0.0006)	(0.0029)
depos_ass	0.4853***	1.9171**	0.3519*	0.7205	-0.2693	1.5726*
	(0.1708)	(0.7925)	(0.2017)	(0.9094)	(0.1744)	(0.847)
losres_loans	-0.0776***	-0.1347***	-0.0744***	-0.1074***	-0.0082	0.0024
	(0.0113)	(0.0281)	(0.012)	(0.0251)	(0.0101)	(0.0252)
eq_ass	0.0345***	0.0864***	0.0281***	0.0625***	0.0024	0.0368*
	(0.0089)	(0.0229)	(0.009)	(0.0212)	(0.0075)	(0.0189)
hi	-0.0001***	-0.0000	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0001)	(0.0004)	(0.0001)	(0.0005)	(0.0001)	(0.0004)
ass_gdp	0.0000	-0.0007	0.0000	-0.0006	0.0003***	-0.0017
	(0.0001)	(0.0011)	(0.0001)	(0.0012)	(0.0001)	(0.0011)
atms	-0.0029***	0.0019	-0.0027***	-0.0071	-0.0031***	0.0159**
	(0.0008)	(0.0079)	(0.0008)	(0.0075)	(0.0009)	(0.0072)
dcom	0.2192*		0.094		-0.0669	
	(0.1211)		(0.1381)		(0.1399)	
dcoop	0.0051		-0.0198		-0.3231**	
	(0.1359)		(0.1540)		(0.1498)	
dsav	-0.1181		-0.1791		-0.2285	
	(0.1521)		(0.1540)		(0.1469)	
dinv	0.0712		0.0318		0.2676	
	(0.1916)		(0.2388)		(0.2144)	
dhold	0.1949		0.0877		-0.2737	
	(0.1531)		(0.1658)		(0.1884)	
lag_gdp	0.0042	0.0303*	-0.0051	0.0365**	0.0492**	0.0210
	(0.0162)	(0.0165)	(0.0169)	(0.0174)	(0.0201)	(0.0146)
lag_inf	-0.0715***	-0.0599**	-0.0692***	-0.0749**	-0.0311	0.0749***
	(0.0228)	(0.0303)	(0.0224)	(0.0325)	(0.0289)	(0.0273)
_cons	-0.2972	0.9268	0.061	2.5897**	0.7263**	8.0774***
	(0.2988)	(1.2427)	(0.3241)	(1.2879)	(0.3238)	(1.2345)

Estimation diagnostics						
Number of observations	925	925	925	925	740	740
Number of groups		185		185		185
Observations per group		5		5		4
F-test	87.17***	9.09***	91.25***	8.62***	3497.69***	12.72***
R^2	0.7481	0.0088	0.7034	0.0179	0.9761	0.2097

Robust standard errors adjusted for 185 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

The estimated coefficients have with few exceptions the same sign as in System GMM. The greatest difference between the results can be found by *loans_depos* which turned out to be significant in most of the models. In all FE models, the coefficient is positive and significant while in OLS we obtained negative estimate for RAROAE. Nevertheless, we cannot be sure about the validity of those estimates, since we assume that *loans_depos* is endogenous and was not instrumented within OLS and FE regressions.

To conclude, the results proved to be very stable under different model specifications as well as under different estimation methods. High NFCI/TI is mostly related with poorer risk-adjusted performance, but also other bank-specific, banking sector-specific as well as macroeconomic conditions play an important role by performance determination.

4.2.5.5 Risk – ln(Z-Score), ln(RAEAR)

Both ln(Z-Score) and ln(RAEAR) are autocorrelated according to Wooldridge test (Table 4.14). Therefore, System GMM will be used for the estimation.

Table 4.14: Wooldridge test for autocorrelation in panel data – ln(Z-Score), ln(RAEAR)

	ln_z_score	ln_raear
F statistics	15.638	57.120
	(d.f. 1, 175)	(d.f. 1, 175)
p-value	0.0001	0.0000

H0: no first-order autocorrelation, d.f. = degrees of freedom
Source: Author using data from Bankscope

Table 4.15 reports the regression results estimated with both, one-step and two-step System GMM with robust standard errors adjusted for 176[55] clusters, with small sample correction to covariance matrix and Windmeijer correction. The diagnostics tests do not suggest any misspecification of the model. In ln(RAEAR) models AR (2) is significant therefore *lag2_DV* is endogenous and higher lags are used as instruments.[56] All other potentially endogenous variables are adequately instrumented. The appropriateness of System GMM is confirmed by positive and significant coefficients of lagged dependent variables. Both ln(Z-Score) and ln(RAEAR) are highly time-persistent, because the coefficients of *lag_DV* are close to one. Moreover, in ln(RAEAR) models also the second lag is significantly positive.

The coefficient of *nfci_ti* is negative and highly significant in all reported models, suggesting that higher shares of NFCI are connected with higher probability of insolvency and higher leverage risk. Moreover, since the coefficient in ln(Z-Score) models is higher in absolute value than in ln(RAEAR), we can conclude that with increasing reliance on NFCI besides the leverage risk also portfolio risk needs to raise. This is in line with results of RAROAA models in Section 4.2.5.3.

Among the bank-specific variables *loans_depos*, is negatively related with both risk measures. With higher ratio of loans to deposits, liquidity risk increases, which in turn raises the overall probability of failure. Similarly, higher *losres_loans* increases the riskiness of a bank, based on which we conclude that high reserves accumulated to cover potential losses reflect rather poor quality of loans than sound risk management. On the other hand, as expected, higher *eq_ass* increases the bank's stability. Interestingly, bank type does not seem to influence the riskiness of a bank heavily. All coefficients on the bank type, except *dinv* in one-step System GMM, are insignificant. Other bank-specific variables turned out to be insignificant.

High competition seems to lead to increased resiliency of banks in the given market. This might be caused by the fact that when facing higher competition the bank needs to manage its risks in a more prudent way and diversify sufficiently. On the other hand, market concentration does not seem to mitigate or deteriorate the leverage risk. Use of technology (measured by *atms*) decreases ln(Z-Score), while in more developed banking sectors the banks have lower leverage risk (positive coefficient of *ass_gdp* in ln(RAEAR) models).

[55] 9 banks with negative Z-Score at least in one year were excluded from the data sample.

[56] For more information about the diagnostic tests see Section 4.1.5.

Table 4.15: Relationship between NFCI share and risk – System GMM regression results

	Dependent variable			
	ln_z_score		ln_raear	
Independent variables	two-step	one-step	two-step	one-step
lag_DV	0.7828***	0.7764***	0.8354***	0.8267***
	(0.0410)	(0.0409)	(0.0497)	(0.0484)
lag2_DV			0.1248**	0.1307***
			(0.0485)	(0.0472)
nfci_ti	-0.0078***	-0.0078***	-0.0021***	-0.0021***
	(0.0015)	(0.0014)	(0.0007)	(0.0007)
loans_depos	-0.0010	-0.0011*	-0.0005*	-0.0005*
	(0.0006)	(0.0006)	(0.0003)	(0.0003)
depos_ass	0.1958	0.1874	-0.0873	-0.0771
	(0.143)	(0.1346)	(0.0653)	(0.0628)
losres_loans	-0.0516***	-0.0523***	-0.0118***	-0.0123***
	(0.0121)	(0.0119)	(0.0035)	(0.0035)
eq_ass	0.0165***	0.0168***	0.0119***	0.0122***
	(0.0036)	(0.0035)	(0.0019)	(0.0019)
hi	-0.0001***	-0.0001***	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ass_gdp	0.0000	-0.0000	0.0001**	0.0001**
	(0.0000)	(0.0001)	(0.0000)	(0.0000)
atms	-0.0012*	-0.0011*	0.0000	-0.0000
	(0.0006)	(0.0006)	(0.0003)	(0.0003)
dcom	0.0549	0.0403	0.0423	0.0382
	(0.0807)	(0.0808)	(0.0427)	(0.0401)
dcoop	0.0743	0.0363	-0.0407	-0.0365
	(0.1011)	(0.0902)	(0.0489)	(0.0428)
dsav	-0.0391	-0.0508	0.0133	-0.0074
	(0.1115)	(0.1042)	(0.0523)	(0.0475)
dinv	-0.1290	-0.1511	-0.1095	-0.1168*
	(0.1206)	(0.1145)	(0.0681)	(0.0591)
dhold	0.0869	0.0733	0.0354	0.0269
	(0.0794)	(0.0822)	(0.0419)	(0.0406)
lag_gdp	-0.0131**	-0.0137**	-0.0055	-0.0058
	(0.0055)	(0.0055)	(0.0037)	(0.0038)
lag_inf	-0.0235**	-0.0253**	0.0031	0.0023
	(0.0115)	(0.0114)	(0.0061)	(0.0061)
_cons	1.0152***	1.0594***	0.2073**	0.2134**
	(0.2442)	(0.2362)	(0.0948)	(0.0964)

Estimation diagnostics				
Number of observations	880	880	704	704
Number of groups	176	176	176	176
Observations per group	5	5	4	4
Number of instruments	163	163	151	151
F-test	134.31***	147.83***	467.18***	484.05***
Arellano-Bond AR (1)	-3.04***	-3.47***	-3.07***	-3.92***
Arellano-Bond AR (2)	0.09	0.10	-3.11***	-3.11***
Hansen test	157.57	157.57	144.86	144.86

Robust standard errors adjusted for 176 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

lag_gdp decreases ln(Z-Score) which suggests that banks take on higher risk in times of economic booms. Higher GDP growth can fuel credit expansion and wrongly chosen diversification strategies. Also higher inflation increases the probability of bank's insolvency, because it can erode the value of assets and worsen the balance sheet position of a bank (Sanya and Wolfe, 2011).

4.2.5.6 Robustness tests – ln(Z-Score), ln(RAEAR)

In Appendix C.3 Table C.8 we re-estimated the models with different sets of instruments. Moreover, for ln(RAEAR) model, where Arellano-Bond AR (2) test was significant, we estimated the model also with three lags of dependent variable. In this model *lag2_DV*, *lag3_DV* and most of the other dependent variables turned out to be insignificant, therefore we believe, that the proper model should include only two lags. In order to increase the number of observations per group ln(RAEAR) model was estimated also with only one lag of dependent variable. The results are robust to different definition of instrumental variables. The differences are mainly in significances. Only in ln(Z-Score) models the coefficient of *depos_ass* resulted positive and significant, which was not the case in the main model reported in Table 4.15.

In Table 4.16 we provide the results of pooled OLS and FE regressions. The true coefficients of lagged dependent variables should lie between those estimated by pooled OLS and FE. It can be seen that there is very large space between the coefficients of *lag_DV* (*lag2_DV*) estimated by OLS and FE in which the true coefficients must fit. But based on the significance as well as R^2 we conclude that the estimate should be closer to the values reported in pooled OLS models. This condition is met in our models.

Table 4.16: Relationship between NFCI share and risk – OLS and FE regression results

Independent variables	Dependent variable			
	ln_z_score		ln_raear	
	OLS	FE	OLS	FE
lag_DV	0.9338***	0.0029	0.8233***	0.1746***
	(0.0221)	(0.0619)	(0.0479)	(0.0560)
lag2_DV			0.1353***	-0.0466
			(0.0464)	(0.0303)
nfci_ti	-0.0044***	-0.0047***	-0.0016**	0.0009
	(0.0009)	(0.0015)	(0.0006)	(0.0006)
loans_depos	-0.0002**	0.0001	-0.0001	0.0001
	(0.0001)	(0.0003)	(0.0001)	(0.0002)
depos_ass	0.0066	0.8182***	-0.0691*	0.4996***
	(0.0461)	(0.2775)	(0.0360)	(0.1294)
losres_loans	-0.0319***	-0.0494***	-0.0112***	-0.0053**
	(0.0104)	(0.0126)	(0.0029)	(0.0023)
eq_ass	0.0142***	0.0882***	0.0108***	0.0584***
	(0.0027)	(0.0210)	(0.0019)	(0.0144)
hi	-0.0001***	0.0001	-0.0000**	0.0001*
	(0.0000)	(0.0001)	(0.0000)	(0.0001)
ass_gdp	0.0000	-0.0004	0.0001***	-0.0002*
	(0.0000)	(0.0002)	(0.0000)	(0.0001)
atms	-0.0003	0.0014	-0.0002	0.0035***
	(0.0003)	(0.0014)	(0.0002)	(0.0011)
dcom	0.0855**		0.0736**	
	(0.0386)		(0.0312)	
dcoop	0.0184		-0.0124	
	(0.0437)		(0.0360)	
dsav	0.0167		0.0197	
	(0.0561)		(0.0415)	
dinv	-0.0877		-0.0601	
	(0.0671)		(0.0506)	
dhold	0.0825**		0.0655**	
	(0.0361)		(0.0327)	
lag_gdp	-0.0067	0.0027	-0.0019	-0.0035
	(0.0056)	(0.0044)	(0.0034)	(0.0024)
lag_inf	-0.0144*	-0.0122	-0.0013	0.0002
	(0.0086)	(0.0091)	(0.0054)	(0.0039)
_cons	0.2524*	2.1041***	0.1706**	1.5021***
	(0.1315)	(0.2676)	(0.0684)	(0.2037)

Estimation diagnostics				
Number of observations	880	880	704	704
Number of groups	176	176	176	176
Observations per group		5		4
F-test	568.38***	20.64***	581.37***	29.46***
R^2	0.8996	0.0069	0.9588	0.0299

Robust standard errors adjusted for 176 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

Also in OLS and FE models the coefficient's signs remained almost always the same as in System GMM. The differences are mainly in significances. Based on these basic models and without necessary instrumentation of endogenous and predetermined variables, NFCI share seems to play not so meaningful role in determining the probability of insolvency and leverage risk as in the System GMM models, where the coefficients are larger in absolute value. Still, the link is inverse.

According to OLS *loans_depos* decreases ln(Z-Score). *depos_ass* that resulted insignificant in System GMM is significant according to OLS and FE, but the signs differ among individual estimation methods. Similarly as the *nfci_ti* coefficient, *losres_loans* remained negatively related with both risk measures, but its effect is without instrumentation underestimated. High *eq_ass* is confirmed to improve the stability of the bank. According to OLS commercial banks and bank holdings and holding companies report lower risks, though it was not proved in System GMM.

The results of banking sector-specific variables are highly dependent on the model. Compared to System GMM macroeconomic conditions seem to play only limited role by determining the riskiness of banks in OLS and FE models.

We conclude that the results are robust. Higher shares of fee income are connected with higher probability of insolvency as well as with higher leverage and portfolio risk (see Section 4.2.5.3). Still, there are other factors influencing the stability of banks (mainly speaking about bank-specific features) that need to be considered.

4.2.5.7 Summary and comparison of results

In Table 4.17, we provide the comparison of results found in our study and the current literature. +/- stands for positive/negative coefficient significant at least at

10% level. 0 indicates that the estimated coefficient is insignificant. Unlike in most of the other academic papers, we examined the impact of NFCI and not NII as a whole on the bank performance. Still, we believe that the results may be compared because, as already mentioned, NFCI represents the greatest part of NII in most of the banks.

On the first sight can be seen that the literature is not unanimous about the link between fee income and profitability and riskiness of banks. The greatest disunity is found by ROAA, ROAE and Z-Score where all possible outcomes were found in similar quantity. Therefore, the relationship is probably highly dependent on other internal and external condition the bank faces. In our study, the link between NFCI/TI and ROAA and ROAE is insignificant in most of the cases. Under some specifications, we have found a positive coefficient which nevertheless never reached 5% significance level or better. Moreover, after exclusion of the outliers the coefficient was always insignificant. On the other hand, NFCI/TI consistently increased insolvency and leverage risk, which is against evidence from Köhler (2012, 2013) and Sanya and Wolfe (2011), but in line with all other papers.[57]

NIM as well as RAROAA and RAROAE are in most cases found to be negatively affected by high NII shares. A positive relation between NII share and NIM was found only by Dietrich and Wanzenried (2011) who performed the analysis based on Swiss banks. Similarly, positive coefficient in RAROAA and RAROAE regressions were found only when the study was based on individual countries data (Chiorazzo et al. (2008) used data from Italian banks and Busch and Kick (2009) used data from German banks). Sanya and Wolfe (2011) analysed the link in emerging economies and they found that the result is heavily dependent on the exact model specification. Most of the other studies were based on U.S. data or included banks from different countries. Our results are in line with those that show that the relationship between fee income share and RAROAA and RAROAE is negative. The effect is much stronger when only banks with positive NFCI/TI are included in the study.

Interestingly, none of the papers listed below tested the impact of NII or fee income share on RANIM. This may be due to the fact that NIM is compared to other profitability measures more stable and therefore risk-adjusting may be not so important. Nevertheless, we constructed the RANIM measure and found that fee income not only decreases NIM but possibly also decreases RANIM. The effect is insignificant when all banks are included but becomes significantly negative after exclusion of banks with negative NFCI/TI.

[57] Except from Hahm (2008) who found no real evidence of link between NFCI/TI and Z-Score.

Table 4.17: Comparison of our results about the impact of NFCI/TI on different profitability measures with existing literature

	Dependent variable							
Authors	ROAA	ROAE	NIM	RA-ROAA	RA-ROAE	RA-NIM	Z-Score	RA-EAR[58]
Stiroh (2002)		0			-		-	
Gischer and Jüttner (2003)	-		-					
DeYoung and Rice (2004a)		+			-			
Stiroh (2004)				-/0	-		-/0	
Craigwell and Maxwell (2005)	+							
Stiroh and Rumble (2006)	0	0		-	-		-	
Mercieca, Schaeck and Wolfe (2007)	-	-		-	-		-	
Odesanmi and Wolfe (2007)				-	-			
Goddard, McKillop and Wilson (2008)	0	+		0	0			
Chiorazzo, Milani and Salvini (2008)				+	+			
Hahm (2008)	+/0						0	
Lepetit, Nys, Rous and Tarazi (2008)			-					
Busch and Kick (2009)	+	+		+	+			
Liu and Wilson (2009)	+/-/0	+/-/0	-					
Bailey-Tapper (2010)	+							
Kim and Kim (2010)		0			-			
Dietrich and Wanzenried (2011)	+	+	+					
Gamra and Plihon (2011)				-	-		-	
Moshirian, Sahgal and Zhang (2011)	+							
Sanya and Wolfe (2011)				+/-/0	+/-/0		+	
Yang and Wu (2011)								
Köhler (2012)				+		+	+	
Chunhachinda and Li (2013)	+	+						
Dumičić and Ridzak (2013)			-					
Karakaya and Er (2013)	0	+						
Köhler (2013)				+/0	+/-/0		+/0	+
This study (2014)	+/0	+/0	-	-	-	-/0	-	-

+/- indicates a statistically positive/negative coefficient at the 10% level or better, 0 indicates insignificant coefficients, in case of absence of the variable in the given study the cell is left blank
Source: Author based on individual papers and own results

[58] Only some authors used log-transformed Z-Score and RAEAR. We compare our results also to those who did not used ln(Z-Score) and ln(RAEAR) but simply Z-Score and RAEAR.

4.2.6 Further research opportunities

The further research should mainly aim to increase the data set available for the study as well as focus on more detailed models and adequate application of new estimation methods. The main future research opportunities that were identified during the work are listed below.

Firstly, the relationship between NFCI/TI and the banking performance might be estimated more precisely if the data set will be enlarged. This may be done by adding more banks, i.e. countries, in the study, by allowing the data set to be unbalanced which would be necessary to consider also in the used methodology or by adding time periods. The last possibility will be the most welcomed one, because our data set covers only six years period which is reduced by the inclusion of the lagged dependent variable in the model. For NIM, RANIM and ln(RAEAR) that are highly persistent, the estimation is done based on only four periods. Furthermore, many of the included variables and especially the profitability measures were heavily affected by the financial crisis. Therefore, inclusion of more time periods in the analysis is highly suggested.

Secondly, besides the profitability measures used in the diploma thesis, new performance measures such as Economic Value Added can be further studied. We also suggest examining the relationship of fee income magnitude on standard deviation of profitability measures separately. Furthermore, we suspect nonlinear relationship between NFCI/TI and profitability. Consequently, NFCI/TI squared may be added to explanatory variables.

Thirdly, as was shown, the banking strategy heavily influences the choice of fee income magnitude and also profitability. Thus, a further research could provide the analysis for different bank types separately.

Lastly, fee income is significantly dependent on market concentration. In countries with high competition, the banks tend to exhibit higher fee income shares in order to remain profitable. For this reason, the link between NFCI/TI and profitability could be different in highly and lowly concentrated markets. We propose to study the relationship between fee income and banks' performance separately for banks facing low, moderate and high concentration.

5 Conclusion

This thesis focused on both theoretical and practical aspects of banking fee and commission income in the European Union with a special emphasis on the Czech Republic. Since fee income represents the largest part of non-interest income earned by banks, it remains a major challenge for bank management to set and maintain an appropriate fee policy. Nevertheless, solving for the optimal fee structure has not yet been accomplished either on a theoretical level, or in actual practice.

In the empirical part on macro level, we analysed banking fee income in EU-27 banking sectors based on three different indicators: the magnitude of net fee and commission income relative to total operating income, to total assets and to gross domestic product. Our results show that the Czech banking sector was not abnormally dependent on fee income compared to other EU countries in the period 2007–2012. As a result, we argue that the high profitability of Czech banks cannot be attributed solely to abnormal banking fees and commission income, but rather that other factors should be considered (e.g. banks' sound risk management, good strategy of cost optimization, high liquidity and capital buffers).

We also concluded that the market concentration of the Czech banking sector is moderate despite it declined during last years (measured by the decrease of Herfindahl index). The rise in competition was caused mainly by new entrants we refer to as 'low-cost banks' that offer a limited product portfolio and provide a large part of their services without fees and commissions. Consequently, we have determined that the business models of some low cost banks in the Czech Republic are not sustainable from a longer term perspective.

In the empirical part on micro level, we firstly analysed the determinants of fee and commission income magnitude. The study was performed on balanced panel data form 185 EU-27 banks spanning the period from 2007 to 2012. Unlike in the existing studies, we have used dynamic panel data and System GMM estimation method. Different bank-specific, banking sector-specific as well as macroeconomic factors were considered. Our results suggest that the magnitude of fee income is highly dependent on the bank business strategy as well as on market conditions. We were primarily concerned about the potential relationship between market concentration and fee income magnitude which in fact turned out to be present. The analysis suggests that banks facing higher competition tend to expand into potentially riskier

non-traditional activities more aggressively and therefore they also exhibit higher shares of fee and commission income. On the other hand, macroeconomic conditions seem to play only secondary role by fee income determination.

Secondly, we examined the link between the share of income represented by fees and the financial performance of banks. We concluded that the effect differs with the used profitability measure. While return on average assets and return on average equity do not seem to be significantly influenced by fee income share, net interest margin is negatively related with fee and commission income magnitude.

Thirdly, since the bank managers are not primarily concerned about the impact of their decisions solely on financial profitability but rather on risk-adjusted profits, we performed the analysis based also on risk-adjusted performance measures. Those were constructed by the ratio of the simple performance measure divided by its own standard deviation. Negative and significant relationship between fee income share and risk-adjusted profitability measures was found in all cases.

Lastly, we analysed the relationship between fee income share and insolvency risk, leverage risk and portfolio risk (measured by risk-adjusted ROAA). We have concluded that higher shares of fee income tend to increase the riskiness of a bank according to all used measures.

Together, our first hypothesis – High profitability of Czech banking sector can be attributed to high fee income share. –, third hypothesis – Higher shares of fee income are connected with higher profitability and risk-adjusted profitability of banks in the European banking sector. – and fourth hypothesis – Higher shares of fee income are connected with lower probability of insolvency and lower leverage risk in banks in the European banking sector. – were rejected. The second hypothesis – Banks facing high competition tend to have higher shares of income represented by fee. – was not rejected.

Our results are in line with most of the current literature. Nevertheless, there remain studies that have concluded opposite links between fee income and performance in terms of both, profitability and risk. Therefore, further research that should mainly aim to capture the banking market fragmentation better is strongly encouraged.

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www.bankovnipoplatky.com

www.cnb.cz

www.helgilibrary.com

www.imf.org

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www.airbank.cz

www.csas.cz

www.csob.cz

www.equa.cz

www.fio.cz

www.gemoney.cz

www.kb.cz

www.rb.cz

www.unicreditbank.cz

www.zuno.cz

Appendix A: List of countries

EU-27

Austria (AT)
Belgium (BE)
Bulgaria (BG)
Cyprus (CY)
Czech Republic (CZ)
Denmark (DK)
Estonia (EE)
Finland (FI)
France (FR)
Germany (DE)
Greece (EL)
Hungary (HU)
Ireland (IE)
Italy (IT)
Latvia (LV)
Lithuania (LT)
Luxemburg (LU)
Malta (MT)
Netherlands (NL)
Poland (PL)
Portugal (PT)
Romania (RO)
Slovakia (SK)
Slovenia (SI)
Spain (ES)
Sweden (SW)
United Kingdom (UK)

EU-17

Austria (AT)
Belgium (BE)
Cyprus (CY)
Estonia (EE)
Finland (FI)
France (FR)
Germany (DE)
Greece (EL)
Ireland (IE)
Italy (IT)
Luxemburg (LU)
Malta (MT)
Netherlands (NL)
Portugal (PT)
Slovakia (SK)
Slovenia (SI)
Spain (ES)

CEE

Bulgaria (BG)
Czech Republic (CZ)
Hungary (HU)
Poland (PL)
Romania (RO)
Slovakia (SK)
Slovenia (SI)

PIIGS

Portugal (PT)
Ireland (IE)
Italy (IT)
Greece (EL)
Spain (ES)

Appendix B: Empirical analysis on macro level – Additional data

B.1 Total operating income decomposition on the EU banking sector

This section shows the decomposition of total operating income of the EU-27 banking sector. We split up total income into 3 parts: net interest income, NFCI and net other income. We provide the decomposition of total operating income in absolute numbers (Figure B.1) as well as in relative values (Figure B.2). The following figures clearly show that interest income is the most important part of total operating income of banks in EU-27 countries. Furthermore, this pattern is constant, i.e. interest income remains the most important part of the income in every considered year. On average, net interest income is about 59% of total operating income. The remaining 41% are divided between NFCI (on average about 25% of total operating income is represented by net fee and commission income) and other income (on average 16% of total operating income). It can be concluded that fee and commission income is the second most important income of banks and therefore an appropriate magnitude of fees and convenient fee management is essential.

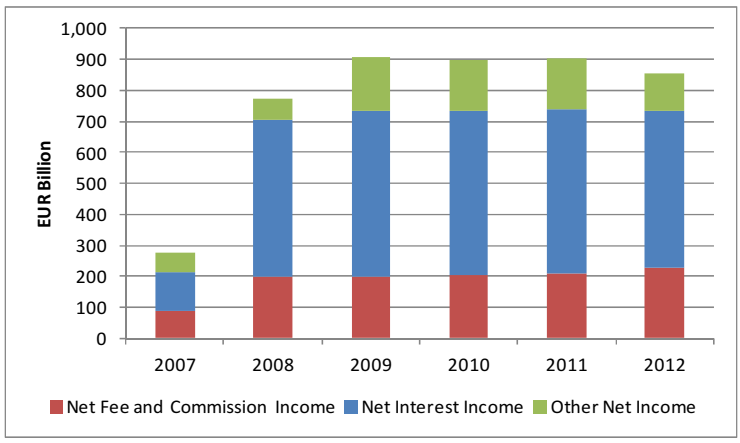

Figure B.1: EU-27 – Total operating income decomposition 2007–2012 in EUR Billions[59]

Source: Author using data from the ECB

[59] The large increase in total income from 2007 to 2008 is due to the fact that for some countries we have data first starting from 2008.

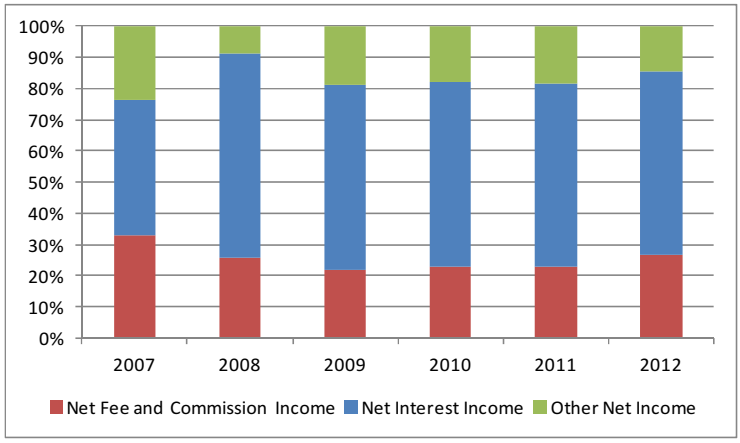

Figure B.2: EU-27 – Total operating income decomposition 2007–2012 in Percent of Total income

Source: Author using data from the ECB

B.2 NFCI ratios for different groups of EU countries – evolution 2007–2012

Figure B.3 indicates that the NFCI/TI for most of the countries followed a similar pattern and did not change significantly during 2007–2012. The changes in the ratio were mainly caused by changes in total operating income; NFCI was more stable over the analysed years.

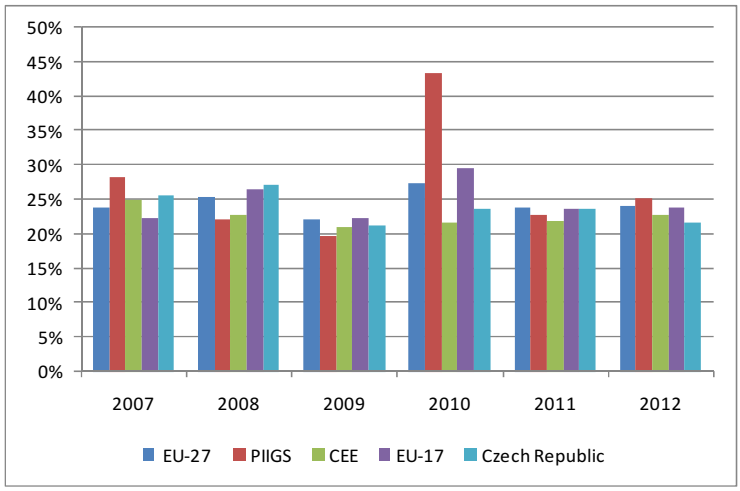

Figure B.3: Net fee and commission income/Total income ratio for different groups of EU countries from 2007 to 2012

Note: The large increase of NFCI/TI ratio in PIIGS countries in 2010 was caused mainly by Ireland which had NFCI/TI ratio of nearly 118% in 2010
Source: Author using data from the ECB

The highest levels of NFCI/TI can be observed in 2010. In this context, we speak especially about PIIGS which ended up at more than twice as high levels of NFCI/TI as in previous years. This was influenced mainly by Ireland, which experienced severe financial crisis and which total operating income dropped by more than EUR 15 billion (decline about 90%) from 2009 to 2010. Moreover, the NFCI remained in Ireland almost the same in those two years. The resulting NFCI/TI ratio was nearly 118% in Ireland in 2010 which influenced the statistics of all PIIGS countries. After 2010, NFCI/TI decreased again in most of the countries and stabilized at levels around 23%. The figure also indicates that NFCI/TI is lower in the Czech Republic compared to other researched groups. In 2007 and 2008 it was slightly above the average, but in 2012 it remained about 2% lower than in an average EU country.

Figure B.4 shows that NFCI/TA is a stable indicator since it remained at almost the same levels during the whole researched period.[60] The differences can be seen mainly between individual countries, but within particular countries the ratio does not fluctuates as heavily as NFCI/TI as banks' assets are less volatile than banks' operating income.

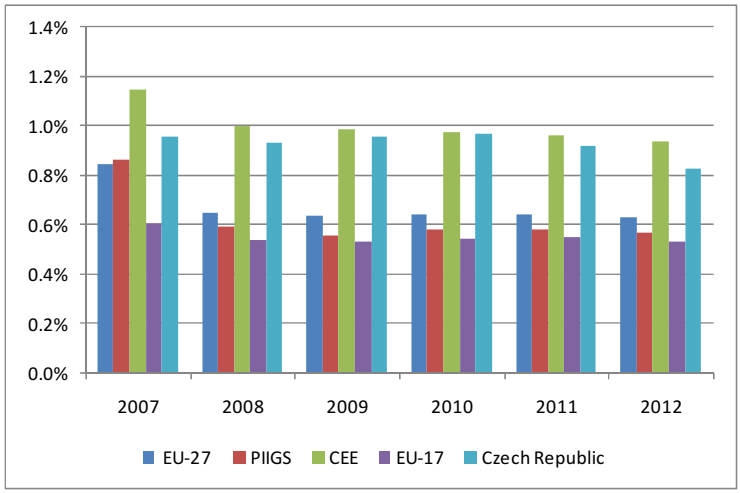

Figure B.4: Net fee and commission income/Total assets ratio for different groups of EU countries from 2007 to 2012

Source: Author using data from the ECB

[60] There can be seen one jump in the NFCI/TA ratio from 2007 to 2008. The fall was caused mainly by the change in the set of countries included in the statistics. In 2007 not all EU-27 countries were included in the analysis. For example in PIIGS group we have in 2007 data just for Italy and Portugal, which have both quite high NFCI/TA ratios over the whole examined period. In 2008, after including Greece, Spain and Ireland the average NFCI/TA ratio in PIIGS dropped, because those countries, especially Ireland which has NFCI/TA ratio about 0.15%, have much lower NFCI/TA ratios.

Figure B.5 indicates that the NFCI/GDP oscillated around 1% in the Czech Republic as well as in CEE during the whole period while EU-17 countries saw a peak in 2008 (2.5%) and then gradually decreased to 2% in 2012, what was caused primarily by a change in a GDP level rather than a fee level.

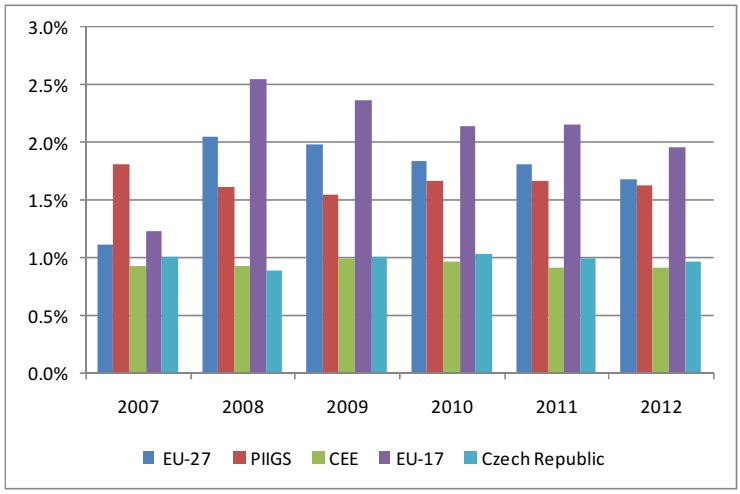

Figure B.5: Net fee and commission income/GDP ratio for different groups of EU countries from 2007 to 2012

Source: Author using data from the ECB[61]

B.3 Market concentration – Additional data

The exact changes in the HI between 2007 and 2012 can be seen in Figure B.6. In most of the examined groups of European countries the HI dropped from 2007 to 2012. This means that the banking sector became more competitive. Only by PIIGS, the HI increased by about 200, but still the competition in those countries remains higher than in the average EU-27 country. The changes were not very large (as can be seen already on the previous figure), all countries remained within the same market concentration group (CZ, EU-27, PIIGS and CEE banking sectors face moderate concentration in both considered years, the EU-17 displays a high banking market concentration in 2007 as well as in 2012).

[61] The initial jump (between 2007 and 2008) in EU-17 as well as in EU-27 was caused mainly due to increased sample of included countries. Especially Luxembourg played an important role, because it has NFCI/GDP of more than 17% in 2008. After 2008 NFCI/GDP was steadily decreasing in most of European countries.

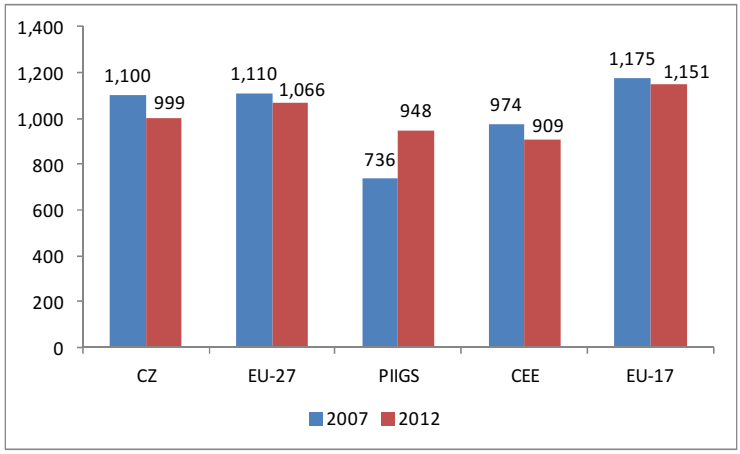

Figure B.6: Comparison of 2007 and 2012 Herfindahl index in different groups of European countries

Source: Author using data from the ECB

Appendix C: Empirical analysis on micro level – Additional data

In this section we provide additional data to the empirical analysis on bank level. Extensions to descriptive analysis as well as to estimation results and robustness tests can be found below.

C.1 Additional data to descriptive analysis

C.1.1 Median NFCI/TI and median NFCI/TA by bank type and by concentration and its development

In Figure C.1 can be seen that measured by median cooperative banks have highest share of fee income in their income statements, while real estate and mortgage banks the lowest one measured by both NFCI/TI and NFCI/TA. Median NFCI/TI is by all bank types except from bank holdings and holding companies lower than its average counterparts, but the differences are rather small.

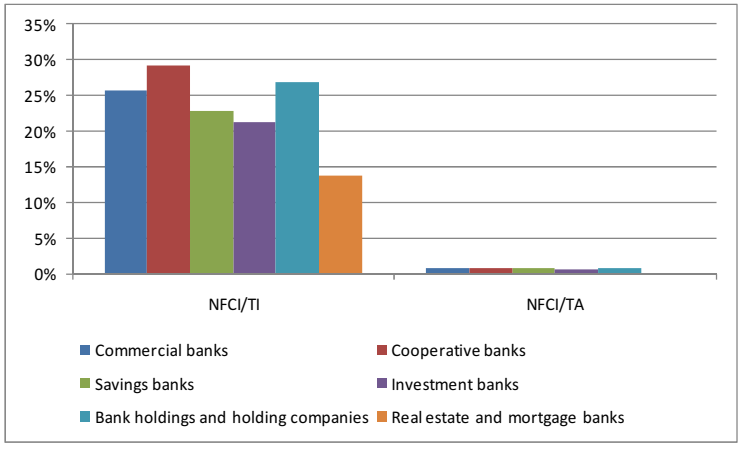

Figure C.1: Median Net fee and commission income/Total income and Net fee and commission income/Total assets by bank type

Source: Author using data from Bankscope

Higher discrepancies can be found by comparing the Figure C.2 with Figure 4.2 showing the same relation based on average values. In Figure C.2 the variability of NFCI/TI within a bank type is not as high as shown in Figure 4.2, which points at the problem of outliers that significantly influence the average results. On the other hand,

in both figures is preserved the fact that individual types of banks applying different business strategies have different optimal levels of NFCI/TI. Both figures show that while real estate and mortgage banks operate with lowest NFCI/TI shares, cooperative banks report highest levels of NFCI/TI (compared to real estate and mortgage banks they have more than twice as large share of income represented by fee income).

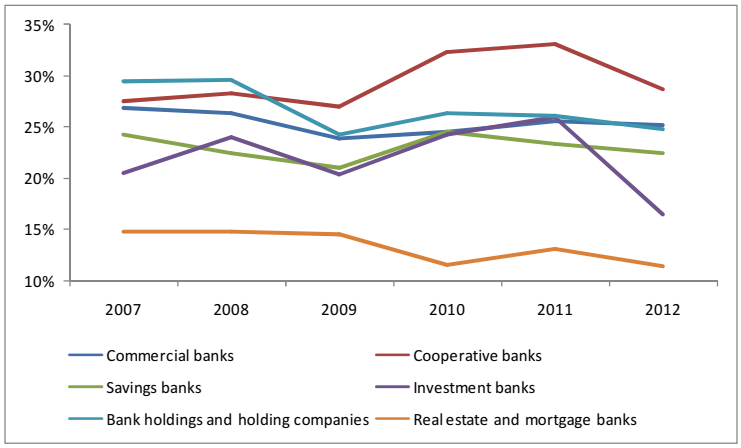

Figure C.2: Development of median Net fee and commission income/Total income by bank type between 2007 and 2012

Source: Author using data from Bankscope

As already mentioned in the main text, Figure C.3 is very similar to its mean peer. The differences among individual concentration groups are slightly more pronounced when NFCI/TI is measured by median, but the order of the curve lines remains the same.

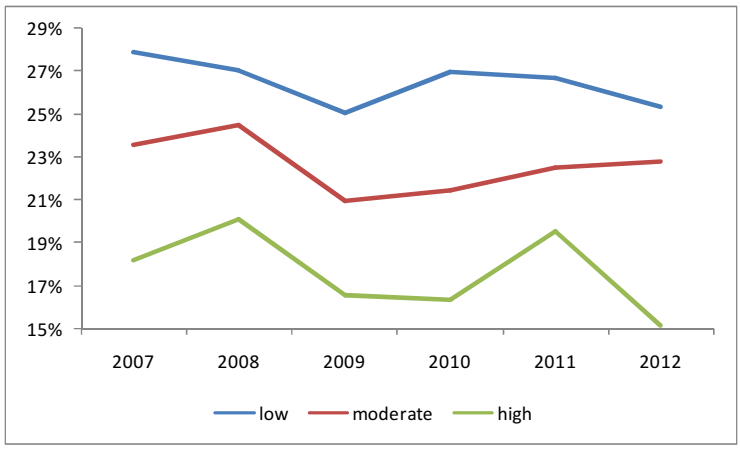

Figure C.3: Development of median Net fee and commission income/Total income by market concentration

Source: Author using data from Bankscope and the ECB

C.1.2 Median (risk-adjusted) NIM, ROAA and ROAE by bank type and its development

Figure C.4 depicts the median NIM, ROAA and ROAE by bank type. The NIM and ROAA results do not differ from the average results in Figure 4.9 heavily. Median ROAE is higher in all bank types compared to the average measure. For bank holdings and holding companies the difference is more than 4%. Again, the outliers seem to play a significant role. This is supported also by Figure C.5 that shows the development of median ROAE by bank type from 2007 to 2012. A declining trend can be identified, but there are no values of ROAE below 0% which was the case in Figure 4.10. We can also see that while in 2007 the difference between the least and the most profitable bank type was about 8% in 2012 it was less than 4%. When measured by averages the opposite was truth, in 2007 the difference between the least and the most profitable bank type was 8%, in 2012 it was almost 21%.

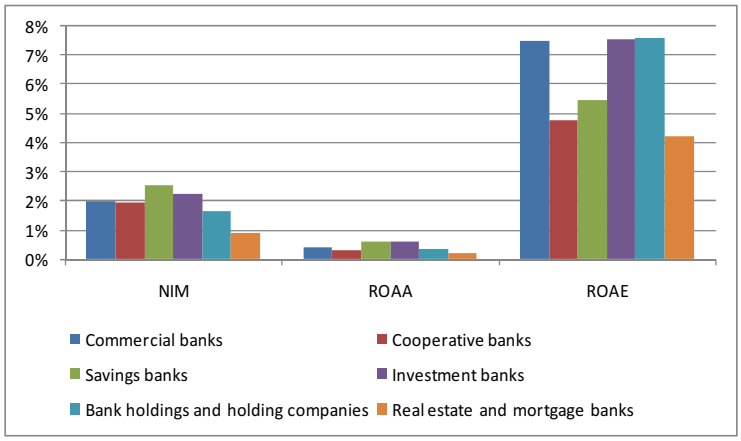

Figure C.4: Median NIM, ROAA and ROAE by bank type

Source: Author using data from Bankscope

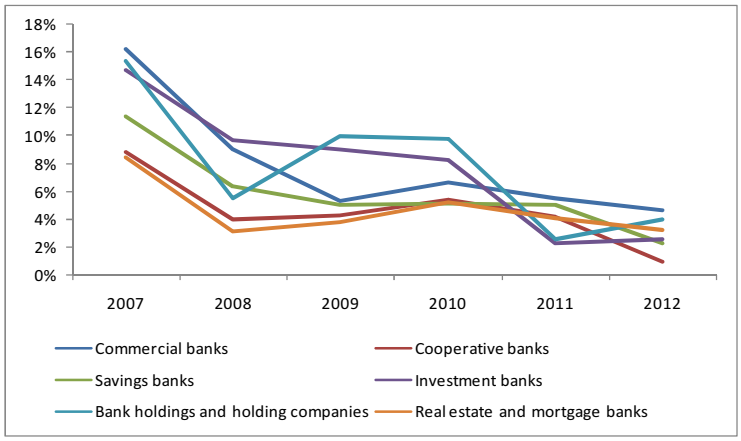

Figure C.5: Development of median ROAE by bank type between 2007 and 2012

Source: Author using data from Bankscope

Median risk-adjusted performances are lower than its average peers by all bank types and all applied measures. Therefore, the distribution of risk-adjusted performance measures seems to be skewed, because the mean and median values are, at least by some bank groups, considerably different.

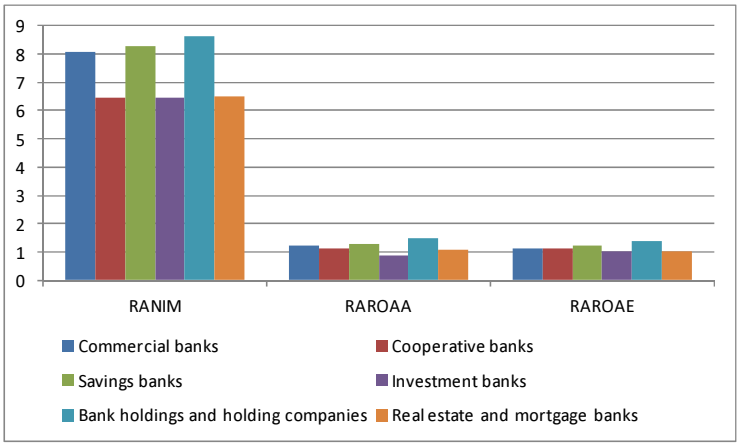

Figure C.6: Median RANIM, RAROAA and RAROAE by bank type

Source: Author using data from Bankscope

C.1.1 Median ln(Z-Score) and ln(RAEAR)

The following figure shows the median ln(Z-Score) and ln(RAEAR). It can be seen that the median does not largely differ from the average (Figure 4.18) in most of the cases. Only by investment banks the average was compared to median underestimated.

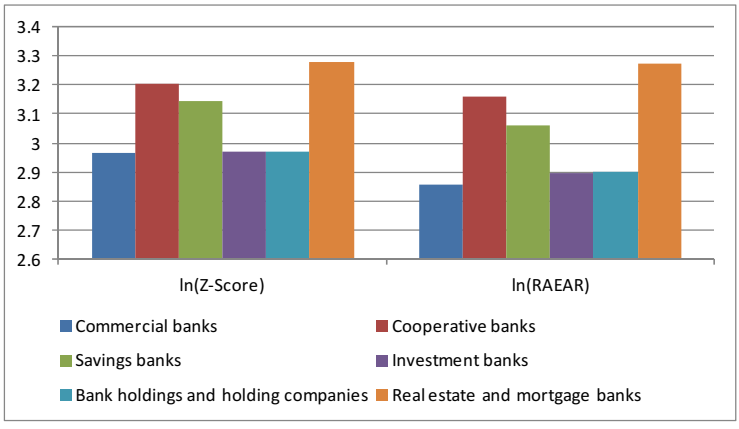

Figure C.7: Median ln(Z-Score) and ln(RAEAR) by bank type

Source: Author using data from Bankscope

C.1.2 Summary statistics

Table C.1: Summary statistics of used variables

Variable	Mean	Std. Dev.	Min	1st quartile	Median	3rd quartile	Max
ass_gdp	484.1%	348.5%	49.7%	224.4%	382.2%	729.3%	2,345.9%
atms	97	34	35	67	99	122	194
cashless	82	62	1	26	55	130	230
cost_inc	64.4%	31.8%	13.8%	51.7%	60.7%	69.1%	513.1%
depos_ass	0.5%	0.2%	0.0%	0.3%	0.5%	0.6%	0.9%
eq_ass	7.2%	4.9%	-1.8%	4.5%	6.4%	8.6%	55.9%
hi	786	579	183	410	563	1,077	3,700
lag_gdp	1.1%	3.5%	-17.7%	-0.6%	1.7%	3.3%	11.0%
lag_inf	2.6%	1.6%	-1.7%	1.7%	2.3%	3.3%	15.3%
lag_int	4.4%	1.4%	2.6%	3.7%	4.3%	4.6%	15.8%
lag_unem	7.8%	3.0%	3.1%	6.0%	7.6%	8.4%	21.7%
liqass_depos	31.8%	29.8%	0.1%	12.9%	23.5%	40.6%	450.1%
ln_ass	17.3	2.1	11.6	16.1	17.2	18.8	21.7
ln_leverage_risk	2.9	0.8	0.4	2.4	2.9	3.4	5.3
ln_z_score	2.9	0.9	-1.9	2.4	3.0	3.4	5.4
loans_ass	58.6%	19.2%	0.5%	47.6%	62.6%	72.6%	99.0%
loans_depos	95.6%	67.9%	0.7%	69.0%	87.7%	106.8%	761.8%
losres_loans	3.4%	3.5%	0.1%	1.2%	2.5%	4.0%	41.9%
nfci_ta	0.8%	0.9%	-0.3%	0.4%	0.7%	1.0%	12.8%
nfci_ti	26.4%	16.3%	-159.5%	19.4%	25.3%	32.1%	149.6%
nim	2.1%	1.3%	-0.4%	1.2%	1.9%	2.7%	12.6%
npl_loans	5.9%	6.5%	0.0%	2.1%	4.3%	7.0%	65.1%
ranim	9.5	7.0	-1.3	5.0	7.8	11.8	44.6
raroaa	1.6	2.3	-2.9	0.3	1.2	2.7	14.6
raroae	1.6	2.1	-3.0	0.3	1.1	2.8	10.8
roaa	0.3%	1.7%	-34.0%	0.1%	0.4%	0.8%	9.8%
roae	4.1%	21.5%	-239.2%	2.2%	6.5%	12.1%	200.3%
tier1	12.5%	15.9%	-6.7%	8.6%	10.4%	13.0%	376.2%

Source: Author using data from Bankscope, Eurostat, the ECB, HelgiLibrary and the World Bank

C.2 Correlation matrix

Table C.2: Correlation matrix – part 1

	ass_gdp	atms	cashless	cost_inc	dcom	dcoop	depos_ass	dhold	dinv	dsav	eq_ass
ass_gdp	1										
atms	0.2988*	1									
cashless	0.6130*	0.0047	1								
cost_inc	0.0880*	0.0187	0.0677*	1							
dcom	-0.1381*	-0.1519*	-0.0677*	0.012	1						
dcoop	-0.1252*	0.012	-0.1508*	0.0133	-0.3940*	1					
depos_ass	-0.0468	-0.1301*	-0.0841*	-0.053	0.0096	-0.0855*	1				
dhold	0.2265*	0.1773*	0.0936*	0.0298	-0.3940*	-0.1012*	-0.0888*	1			
dinv	-0.0165	0.0732*	-0.0914*	-0.0879*	-0.2961*	-0.0760*	-0.1133*	-0.0760*	1		
dsav	-0.1121*	-0.0699*	0.0672*	-0.0249	-0.3544*	-0.0910*	0.2054*	-0.0910*	-0.0684*	1	
eq_ass	-0.2529*	-0.1129*	-0.1621*	-0.1342*	-0.0372	-0.0247	0.1626*	-0.1209*	0.2788*	0.1388*	1
hi	-0.1424*	-0.3501*	0.3037*	-0.0564	0.1646*	-0.0696*	-0.0136	-0.0993*	-0.0283	0.0017	0.0845*
lag_gdp	-0.1194*	-0.1559*	-0.0798*	-0.0317	0.0572	-0.0647*	0.0657*	-0.0161	-0.0382	0.0395	0.0124
lag_inf	-0.1093*	-0.0898*	-0.1277*	-0.1263*	0.1264*	-0.0993*	0.1097*	-0.0408	-0.011	-0.0524	0.1744*
lag_int	-0.3464*	-0.0814*	-0.4124*	-0.0289	0.1158*	-0.0325	0.1069*	-0.0765*	0.0641*	-0.0241	0.2048*
lag_unem	-0.2763*	0.1871*	-0.1823*	-0.0088	0.0185	0.0031	0.0022	-0.1056*	0.0386	0.1474*	0.1659*
liqass_depos	0.1372*	0.0107	0.1695*	0.1025*	0.0663*	-0.0473	-0.5052*	0.0241	0.1133*	-0.1697*	-0.1155*
ln_ass	0.2450*	0.2039*	0.1115*	0.0192	0.0443	0.1223*	-0.4287*	0.2060*	-0.1873*	-0.1943*	-0.5435*
ln_raear	0.1274*	0.0184	0.1287*	-0.1754*	-0.1388*	0.1242*	0.0326	0.0446	-0.0926*	0.008	-0.0138
ln_z_score	0.1165*	0.0135	0.1020*	-0.2419*	-0.1342*	0.1092*	0.0566	0.0417	-0.0821*	0.0222	-0.05
loans_ass	-0.1957*	-0.1394*	-0.0899*	-0.1569*	-0.1412*	0.0651*	0.2792*	-0.1124*	-0.1135*	0.1583*	0.1206*
loans_depos	-0.0665*	-0.1042*	0.0957*	-0.0746*	-0.1790*	0.0596*	-0.2748*	-0.0432	-0.0820*	0.0153	-0.0358
losres_loans	-0.2487*	-0.0893*	-0.2905*	0.0914*	0.1159*	-0.042	0.1115*	-0.0682*	0.0537	0.0312	0.3345*
nfci_ta	-0.1132*	-0.0399	-0.1730*	-0.0392	-0.0193	-0.0142	0.2693*	0.0747*	0.1486*	-0.0045	0.3387*
nfci_ti	0.0069	0.0674*	-0.0474	0.3375*	0.0954*	0.0807*	0.0357	-0.0211	-0.0125	-0.0487	0.0750*
nim	-0.3676*	-0.2622*	-0.3683*	-0.2177*	0.1040*	-0.037	0.4498*	-0.0710*	0.0313	0.1179*	0.4373*
npl_loans	-0.1990*	-0.1122*	-0.2624*	0.1128*	0.0651*	-0.0062	0.0505	-0.0681*	0.0838*	-0.0132	0.2647*
ranim	-0.1064*	-0.1728*	-0.049	-0.1452*	0.0878*	-0.1142*	0.1686*	0.0855*	-0.0594*	-0.0024	0.0291
raroaa	0.0193	-0.1193*	-0.0068	-0.2838*	0.0502	-0.0154	0.1730*	0.0517	-0.0465	-0.0298	0.022
raroae	0.0273	-0.1169*	0.0341	-0.2906*	0.0272	0.0101	0.1183*	0.0405	-0.0248	-0.0342	-0.0026
roaa	-0.0791*	-0.0467	-0.0486	-0.2840*	0.0169	-0.0121	0.1119*	0.01	-0.0494	0.0355	0
roae	-0.0427	-0.0344	-0.02	-0.3052*	0.0195	-0.0079	0.0787*	-0.0158	-0.0116	0.0004	0.049
tier1	0.0105	0.0479	0.014	-0.0189	0.0101	-0.0586	-0.0321	-0.0367	0.1183*	-0.0191	0.2847*

* indicates significance at 5% level
Source: Author using data from Bankscope, Eurostat, the ECB, HelgiLibrary and the World Bank

Table C.3: Correlation matrix – part 2

	losres_loans	nfci_ta	nfci_ti	nim	npl_loans	ranim	raroaa	raroae	roaa	roae	tier1
	1										
nfci_ta	0.0756*	1									
nfci_ti	-0.0081	0.4720*	1								
nim	0.2945*	0.3426*	-0.0729*	1							
npl_loans	0.9165*	0.0087	-0.0441	0.2349*	1						
ranim	0.0236	0.0842*	-0.0126	0.1916*	-0.0628*	1					
raroaa	-0.3010*	0.1249*	0.0099	0.1763*	-0.3553*	0.2845*	1				
raroae	-0.3247*	0.1137*	0.0033	0.1464*	-0.3665*	0.1868*	0.9428*	1			
roaa	-0.5071*	0.2142*	0.0114	0.2412*	-0.5401*	0.1089*	0.4436*	0.4446*	1		
roae	-0.3409*	0.1505*	0.0684*	0.1503*	-0.3670*	0.1203*	0.4850*	0.5131*	0.6471*	1	
tier1	-0.0089	0.0228	0.0638*	-0.0595*	-0.0255	-0.0649*	0.0900*	0.0684*	-0.0005	0.0058	1

* indicates significance at 5% level
Source: Author using data from Bankscope, Eurostat, the ECB, HelgiLibrary and the World Bank

Table C.4: Correlation matrix – part 3

	hi	lag_gdp	lag_inf	lag_int	lag_unem	liqass_depos	ln_ass	ln_raear	ln_z_score	loans_ass	loans_depos
	1										
lag_gdp	0.0589*	1									
lag_inf	0.0503	0.2990*	1								
lag_int	0.0474	-0.1447*	0.2595*	1							
lag_unem	-0.0299	-0.1467*	-0.1056*	0.3019*	1						
liqass_depos	-0.0612*	0.0348	-0.0822*	-0.2110*	-0.0767*	1					
ln_ass	-0.0962*	-0.0511	-0.2030*	-0.1856*	0.0356	0.2047*	1				
ln_raear	-0.1340*	0.0051	-0.0941*	-0.1936*	-0.1105*	0.0631*	0.0367	1			
ln_z_score	-0.1275*	0.0226	-0.0972*	-0.1880*	-0.0849*	0.0563	0.0558	0.9771*	1		
loans_ass	0.1085*	-0.019	0.1094*	0.1733*	0.0186	-0.5750*	-0.2140*	-0.0809*	-0.0878*	1	
loans_depos	0.0616*	-0.0158	-0.0231	-0.0333	-0.047	0.1655*	0.0583	0.0244	0.0114	0.4922*	1
losres_loans	0.0057	-0.1670*	0.1024*	0.4336*	0.2530*	-0.1153*	-0.2284*	-0.3225*	-0.3813*	0.0721*	-0.0921*
nfci_ta	-0.0950*	0.0579	0.0607*	0.1029*	0.0165	-0.1090*	-0.2789*	-0.0236	-0.0071	-0.0097	-0.1403*
nfci_ti	-0.1508*	0.0196	-0.0876*	-0.0214	0.0319	0.0941*	-0.0317	0.0263	0.0105	-0.2297*	-0.2324*
nim	0.0235	0.1458*	0.3341*	0.2866*	0.0109	-0.3225*	-0.4168*	-0.0618*	-0.0341	0.2868*	-0.0382
npl_loans	-0.0254	-0.2392*	0.0928*	0.4272*	0.2125*	-0.1149*	-0.2012*	-0.3175*	-0.3915*	0.1138*	-0.045
ranim	0.0247	0.0895*	-0.0468	-0.0306	-0.0776*	-0.1360*	-0.011	0.1576*	0.1569*	0.1285*	0.0778*
raroaa	-0.0131	0.1626*	-0.0321	-0.1161*	-0.1026*	0.025	0.0396	0.6682*	0.7085*	-0.1039*	-0.0854*
raroae	0.0333	0.1638*	-0.0354	-0.1126*	-0.1146*	0.0415	0.0394	0.6649*	0.7066*	-0.1276*	-0.0951*
roaa	-0.0248	0.2593*	0.036	-0.2567*	-0.1360*	0.0015	-0.0086	0.2804*	0.3786*	-0.032	-0.0144
roae	-0.0128	0.1746*	-0.0133	-0.0983*	-0.0921*	0.0499	0.0143	0.4156*	0.4874*	-0.0454	-0.0135
tier1	-0.0028	-0.0128	0.018	-0.0376	-0.0063	0.1180*	-0.1993*	0.1569*	0.1339*	-0.1677*	-0.0855*

* indicates significance at 5% level
Source: Author using data from Bankscope, Eurostat, the ECB, HelgiLibrary and the World Bank

C.3 Extended robustness check

Table C.5: Robustness tests – Relationship between NFCI share and HI – System GMM regression results

	Dependent variable					
Independent variables	nfci_ti			nfci_ta		
	two-step	one-step	two-step	two-step	one-step	two-step
lag_DV	0.4719***	0.4686***	0.4338***	0.6694***	0.6678***	0.6725***
	(0.1215)	(0.1202)	(0.1531)	(0.0261)	(0.0257)	(0.0186)
nim	-0.1628	-0.1431	-1.0821**	-0.0000	0.0021	0.0176*
	(0.8064)	(0.8464)	(0.4207)	(0.0181)	(0.0173)	(0.0105)
eq_ass	0.3891**	0.4178***	0.3752***	0.0085*	0.0085*	0.0086***
	(0.1594)	(0.1567)	(0.1011)	(0.0048)	(0.0048)	(0.0031)
npl_loans	0.0058	-0.0082	-0.1648	-0.0014	-0.0016	-0.0035**
	-0.28	(0.2713)	(0.1087)	(0.0029)	(0.0029)	(0.0016)
cost_inc	0.1081	0.1068	0.1450**	0.0000	-0.0000	0.0001
	-0.0823	(0.0836)	(0.0579)	(0.0005)	(0.0004)	(0.0001)
depos_ass	9.9781*	10.708	5.3206*	0.2504**	0.2571**	0.1913***
	-5.9346	(6.7512)	(2.8979)	(0.1176)	(0.1149)	(0.0478)
tier1	0.0338***	0.0325***		-0.0003	-0.0003	
	-0.0106	(0.0112)		(0.0002)	(0.0003)	
loans_ass	-0.0559	-0.0594		0.0020*	0.0021**	
	-0.0592	(0.0651)		(0.0010)	(0.0011)	
roae	0.1386	0.1379		0.0013	0.0012	

	-0.1095	(0.1071)		(0.0009)	(0.0008)	
hi	-0.0018*	-0.0017*	-0.0024**	-0.0001***	-0.0001***	-0.0000***
	(0.0010)	(0.0010)	(0.0011)	(0.0000)	(0.0000)	(0.0000)
atms	0.0157	0.0204		0.0000	-0.0000	
	-0.0218	(0.0142)		(0.0003)	(0.0003)	
cashless	0.0083	0.0073		-0.0001	-0.0001	
	-0.0155	(0.0124)		(0.0002)	(0.0002)	
lag_gdp	-0.4237**	-0.4888***	-0.1636*	0.0000	0.0001	-0.0019
	(0.1718)	(0.1838)	(0.0979)	(0.0036)	(0.0037)	(0.0028)
lag_inf	0.0639	0.0005	0.1035	-0.0001	-0.0003	-0.0037
	(0.3030)	(0.3093)	(0.1834)	(0.0052)	(0.0056)	(0.0040)
dcom	5.6329	6.0864*	9.1732***	0.1920***	0.1720**	0.1367***
	(4.5010)	(3.5757)	(3.0624)	(0.0713)	(0.0679)	(0.0435)
dcoop	7.7982*	8.3964**	10.7679***	0.1737**	0.1559**	0.1515***
	(4.0250)	(3.2849)	(3.1155)	(0.0725)	(0.0665)	(0.0441)
dsav	1.8757	2.7344	6.2180**	0.1052	0.0857	0.0933*
	(4.4645)	(3.5802)	(3.1004)	(0.0696)	(0.0703)	(0.0501)
dinv	2.8977	2.8475	8.6049**	0.1225	0.1138	0.1028*
	(5.1984)	(4.3689)	(3.4506)	(0.0833)	(0.0786)	(0.0567)
dhold	3.1515	3.5525	7.5605	0.1835**	0.1656**	0.1398***
	(4.9893)	(4.1767)	(4.7760)	(0.0741)	(0.0707)	(0.0472)
_cons	-0.4841	-0.4387	-2.0010	-0.2291*	-0.2089*	-0.0859**
	(5.9735)	(5.7765)	(2.1311)	(0.1279)	(0.1250)	(0.0413)
Estimation diagnostics						
Number of observations	925	925	925	925	925	925
Number of groups	185	185	185	185	185	185
Observations per group	5	5	5	5	5	5
Number of instruments	156	156	92	156	156	32
F-test	48.67***	53.04***	50.46***	399.04***	483.33***	186.03***
Arellano-Bond AR (1)	-1.95*	-1.7*	-1.61	-1.54	-1.59	-1.51
Arellano-Bond AR (2)	-1.51	-1.4	-1.40	0.08	0.08	0.05
Hansen test	142.5	142.5	76.84	149.76	149.76	13.16

Robust standard errors adjusted for 185 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, p-value of Arellano-Bond AR (1) in nfci_ta models with all explanatory variables is 0.124 in two-step model and 0.112 in one-step model and 0.13 in the limited two-step model, time dummies included in the regression are not reported in the table, *_cons* stands for constant
Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

Table C.6: Robustness tests – Relationship between NFCI share and profitability – Two-step System GMM and G2SLS RE IV regression results

	Dependent variable						
Independent	roaa		roae		nim		
variables	two-step	two-step	two-step	RE-IV	two-step	two-step	two-step
lag_DV	0.4690**	0.4753***	0.0821		1.5942***	1.0552***	1.185***
	(0.1888)	(0.119)	(0.1131)		(0.1637)	(0.0892)	(0.1034)
lag2_DV		-0.0591			-0.542***		-0.320***
		(0.0975)			(0.1242)		(0.0887)
lag3_DV							0.0695
							(0.0697)
nfci_ti	0.0055	0.0067	0.1227	0.0122	-0.013***	-0.006***	-0.0069*
	(0.0048)	(0.0044)	(0.1087)	(0.0819)	(0.0027)	(0.0018)	(0.0039)
loans_depos	-0.0017	-0.0038	0.0191	-0.0154	-0.0021**	-0.0012	-0.0014
	(0.0068)	(0.0046)	(0.0269)	(0.0154)	(0.0010)	(0.0018)	(0.0012)
depos_ass	0.5337	0.3653	9.1432*	6.3869	-0.1317	-0.0662	0.205
	(0.4925)	(0.3711)	(5.1981)	(4.0763)	(0.1717)	(0.2553)	(0.2016)
losres_loans	-0.201***	-0.2372***	-2.4856***	-2.4925***	-0.0053	-0.0091	-0.0083
	(0.0346)	(0.0628)	(0.4866)	(0.2342)	(0.0051)	(0.0081)	(0.0052)
eq_ass	-0.0066	0.0008	0.7574	0.5494***	-0.0276	-0.0356	-0.0061
	(0.0355)	(0.0298)	(0.6287)	(0.1990)	(0.0188)	(0.0304)	(0.0112)
hi	-0.0001**	-0.0001*	-0.0013	-0.0018	-0.0000	-0.0000	-0.0000
	(0.0001)	(0.0001)	(0.0011)	(0.0015)	(0.0000)	(0.0000)	(0.0000)
ass_gdp	-0.0007**	-0.0008*	-0.0057**	-0.0067**	0.0001	0.0001	-0.0000
	(0.0003)	(0.0004)	(0.0026)	(0.0026)	(0.0001)	(0.0001)	(0.0001)
atms	-0.0005	-0.0008	-0.0149	-0.0059	-0.0003	-0.0007	-0.0004
	(0.0014)	(0.0013)	(0.0170)	(0.0268)	(0.0005)	(0.0005)	(0.0006)
dcom	0.1229	0.0445	2.0665	-0.6487	-0.0415	0.0066	0.0619
	(0.4862)	(0.4338)	(3.5302)	(3.512)	(0.1156)	(0.1466)	(0.0876)
dcoop	-0.0837	-0.2188	-1.8007	-2.4092	0.0017	-0.0002	0.0422
	(0.4415)	(0.4118)	(3.9079)	(4.3022)	(0.1088)	(0.1395)	(0.0971)
dsav	0.0987	-0.0313	-1.5246	-4.4565	0.0082	0.0374	0.0586
	(0.4427)	(0.4511)	(4.6105)	(4.3835)	(0.0902)	(0.1300)	(0.0828)
dinv	-0.1327	-0.6519	1.7331	-5.1395	0.1381	0.1423	0.3131
	(0.7341)	(0.7163)	(5.7366)	(5.0602)	(0.1881)	(0.2446)	(0.2362)
dhold	0.1219	0.1179	1.598	1.0328	-0.0366	-0.0015	0.1026
	(0.5782)	(0.4663)	(4.0724)	(4.0838)	(0.1341)	(0.1638)	(0.1095)
lag_gdp	0.0493	0.0143	0.5961*	1.0254***	0.0172	0.0167	0.0201
	(0.034)	(0.0366)	(0.307)	(0.3922)	(0.0109)	(0.0122)	(0.0124)
lag_inf	-0.0738	-0.1112**	-1.2804*	-1.2480**	0.0032	-0.0137	0.0251
	(0.0496)	(0.0433)	(0.5861)	(0.5823)	(0.0168)	(0.0191)	(0.0236)
_cons	0.7391	1.8737	0.2503	14.6069**	0.6800**	0.4718	0.2429

	(1.4845)	(1.1827)	(6.4939)	(7.265)	(0.2782)	(0.4411)	(0.3721)
Estimation diagnostics							
Number of observations	925	740	925	740	740	925	555
Number of groups	185	185	185	185	185	185	185
Observations per group	5	4	5	4	4	5	3
Number of instruments	58	69	53	21	41	37	47
F-test	9.76***	10.20***	14.02***		300.93***	134.07***	169.72***
Arellano-Bond AR (1)	-2.24**	-1.90*	-1.36		-3.15***	-3.51***	-2.35**
Arellano-Bond AR (2)	-2.53**	-1.28	-1.83*		-2.48**	-2.59**	
Hansen test	39.05	57.42	24.54		10.75	19.39	30.93
R^2				0.2158			

Robust standard errors adjusted for 185 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant

Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

Table C.7: Robustness tests – Relationship between NFCI share and risk-adjusted profitability – Two-step System GMM regression results

	Dependent variable							
Independent	raroaa			raroae			ranim	
variables	two-step	two-step	two-step	two-step	two-step	two-step	two-step	two-step
lag_DV	0.51***	0.38***	0.34***	0.522***	0.43***	0.54***	0.87***	0.88***
	(0.0482)	(0.0582)	(0.0588)	(0.0563)	(0.0561)	(0.0587)	(0.0339)	(0.1111)
lag2_DV							0.0685*	-0.227**
							(0.0366)	(0.1117)
lag3_DV								0.26***
								(0.0729)
nfci_ti	-0.0096*	-0.0151*	-0.03***	-0.0099**	-0.0088*	-0.02***	-0.03***	0.0042
	(0.0053)	(0.0078)	(0.0073)	(0.0050)	(0.0051)	(0.0048)	(0.0068)	(0.0134)
loans_depos	-0.0001	0.006*	0.01***	-0.0023	-0.0015	-0.0012	-0.0022	-0.0029
	(0.0019)	(0.0031)	(0.0036)	(0.0022)	(0.0021)	(0.0024)	(0.0022)	(0.0055)
depos_ass	1.89***	1.698**	1.2117	1.768***	1.58***	1.173**	-0.1678	1.940**
	(0.5064)	(0.7056)	(0.8297)	(0.5543)	(0.5610)	(0.5663)	(0.3828)	(0.8348)
losres_loans	-0.12***	-0.17***	-0.17***	-0.14***	-0.12***	-0.14***	-0.0236*	-0.0119
	(0.0227)	(0.0291)	(0.0282)	(0.0241)	(0.0237)	(0.0237)	(0.0139)	(0.0446)
eq_ass	0.051***	0.077***	0.0633**	0.043**	0.0304*	0.0431**	0.0286**	-0.0096
	(0.0185)	(0.028)	(0.0277)	(0.0169)	(0.0168)	(0.0169)	(0.0145)	(0.0312)

hi	-0.0002	-0.0002	-0.000**	-0.0001	-0.0001	-0.0002	-0.0001	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
ass_gdp	0.0001	0.0003	0.0003	0.0000	0.0001	-0.0001	0.0003	0.001**
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)
atms	-0.01***	-0.004**	-0.01***	-0.01***	-0.01***	-0.01***	-0.0021	-0.02***
	(0.0025)	(0.002)	(0.0021)	(0.0026)	(0.0032)	(0.0024)	(0.0020)	(0.0066)
dcom	0.6124**	1.322***	1.267***	0.2640	0.3176	0.4518	0.2167	-0.1028
	(0.2665)	(0.3285)	(0.3821)	(0.3043)	(0.3274)	(0.2822)	(0.1922)	(0.5375)
dcoop	0.4346	1.070***	0.777*	0.1419	0.3582	0.3688	-0.0678	-0.5099
	(0.3216)	(0.3641)	(0.4445)	(0.3998)	(0.3976)	(0.3674)	(0.1969)	(0.5692)
dsav	-0.1231	0.4899	0.3539	-0.3649	-0.3338	-0.1664	-0.0203	-0.6582
	(0.3846)	(0.4241)	(0.4197)	(0.3920)	(0.4124)	(0.3682)	(0.2385)	(0.6369)
dinv	0.4608	0.9995**	0.9052	0.3127	0.4291	0.3801	0.3367	0.6051
	(0.3824)	(0.4743)	(0.5658)	(0.4528)	(0.4985)	(0.4496)	(0.2686)	(0.7234)
dhold	0.6568*	1.0391**	1.0731**	0.3758	0.3852	0.6481*	0.1226	0.1760
	(0.3665)	(0.4393)	(0.4396)	(0.3858)	(0.4318)	(0.3393)	(0.2735)	(0.6022)
lag_gdp	0.0111	-0.0044	0.0022	-0.0174	0.0019	-0.0063	0.0427**	0.0269
	(0.0207)	(0.0217)	(0.0237)	(0.0212)	(0.0197)	(0.0217)	(0.0203)	(0.0371)
lag_inf	-0.085**	-0.12***	-0.13***	-0.10***	-0.087**	-0.10***	-0.0278	-0.1014
	(0.0386)	(0.0359)	(0.0390)	(0.0315)	(0.0378)	(0.0329)	(0.0327)	(0.0821)
_cons	0.0671	-0.9597	-0.1855	1.0938	1.0681	1.2737*	1.606***	1.7673
	(0.6176)	(0.8556)	(0.9948)	(0.6921)	(0.7348)	(0.6956)	(0.5863)	(1.7194)
Estimation diagnostics								
Number of observations	925	925	895	925	925	895	716	555
Number of groups	185	185	179	185	185	179	179	185
Observations per group	5	5	5	5	5	5	4	3
Number of instruments	155	96	96	163	132	163	149	61
F-test	17.95***	17.26***	14.85***	26.02***	15.49***	21.56***	193.9***	101.05
Arellano-Bond AR (1)	-7.14***	-6.53***	-6.37***	-6.69***	-6.62***	-6.67***	-4.33***	-3.56***
Arellano-Bond AR (2)	-0.18	-0.22	-0.71	-0.01	-0.18	-0.42	-2.58**	
Hansen test	149.09	90.07	83.15	160.71	127.71	159.63	144.87	45.92

Robust standard errors adjusted for 185/179 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant

Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank

Table C.8: Robustness tests – Relationship between NFCI share and risk– System GMM regression results

	Dependent variable					
Independent variables	ln_z_score			ln_raear		
	two-step	one-step	two-step	two-step	two-step	two-step
lag_DV	0.7493***	0.7173***	0.7554***	0.8925***	0.8587***	0.9288***
	(0.0500)	(0.0483)	(0.0399)	(0.0236)	(0.0572)	(0.1384)
lag2_DV					0.1052*	-0.0138
					(0.0556)	(0.0934)
lag3_DV						0.066
						(0.0566)
nfci_ti	-0.0086***	-0.0085***	-0.0078***	-0.0032***	-0.0022***	-0.0024
	(0.0017)	(0.0016)	(0.0015)	(0.0006)	(0.0007)	(0.0019)
loans_depos	-0.0006	-0.0006	-0.0004	-0.0004	-0.0006*	-0.0003
	(0.0006)	(0.0007)	(0.0005)	(0.0003)	(0.0003)	(0.0003)
depos_ass	0.4123*	0.4627**	0.1769	-0.0107	-0.0845	-0.116
	(0.2205)	(0.1966)	(0.1455)	(0.0697)	(0.0653)	(0.1189)
losres_loans	-0.0573***	-0.0618***	-0.0608***	-0.0166***	-0.0116***	-0.0052
	(0.0119)	(0.0113)	(0.0112)	(0.0035)	(0.0036)	(0.01)
eq_ass	0.0204***	0.0211***	0.0271***	0.0095***	0.0122***	0.0085***
	(0.0066)	(0.006)	(0.0062)	(0.0016)	(0.0021)	(0.0027)
hi	-0.0001***	-0.0001***	-0.0001***	-0.0000**	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ass_gdp	0.0000	0.0000	0.0000	0.0000	0.0001**	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0001)
atms	-0.0007	-0.0007	-0.0008	-0.0004	0.0000	-0.0003
	(0.0006)	(0.0006)	(0.0007)	(0.0003)	(0.0003)	(0.0003)
dcom	0.1242	0.1002	0.0937	0.0425	0.0409	0.0321
	(0.1032)	(0.0979)	(0.0883)	(0.0412)	(0.0458)	(0.0579)
dcoop	0.1535	0.1115	0.0814	0.0082	-0.0431	-0.0439
	(0.1157)	(0.1100)	(0.1171)	(0.0495)	(0.0501)	(0.0737)
dsav	-0.0379	-0.0399	-0.008	0.0156	0.0048	0.0123
	(0.1421)	(0.1194)	(0.122)	(0.0568)	(0.0543)	(0.0600)
dinv	0.0155	-0.092	-0.1844	-0.0565	-0.1147	-0.0395
	(0.1399)	(0.1529)	(0.1422)	(0.0553)	(0.0703)	(0.0647)
dhold	0.1548	0.1387	0.1178	0.0485	0.0333	0.0046
	(0.1175)	(0.1036)	(0.089)	(0.0432)	(0.0439)	(0.0587)
lag_gdp	-0.0121**	-0.0165***	-0.0138**	-0.0056*	-0.0057	-0.0041
	(0.0054)	(0.0053)	(0.0056)	(0.0033)	(0.0037)	(0.0037)
lag_inf	-0.0242**	-0.0334***	-0.0278**	-0.0014	0.0027	0.0059
	(0.0107)	(0.0114)	(0.0115)	(0.0057)	(0.0059)	(0.0118)
_cons	0.8888***	1.0051***	0.9698***	0.3936***	0.1940**	0.1894

	(0.2253)	(0.2658)	(0.2355)	(0.1096)	(0.0936)	(0.1643)
Estimation diagnostics						
Number of observations	880	880	880	880	704	528
Number of groups	176	176	176	176	176	176
Observations per group	5	5	5	5	4	3
Number of instruments	96	96	170	158	147	61
F-test	69.62***	74.28***	106.14***	289.71***	470.52***	110.05***
Arellano-Bond AR (1)	-3.04***	-3.66***	-2.99***	-6.27***	-3.09***	-2.82***
Arellano-Bond AR (2)	0.05	0.09	0.18	-2.47**	-3.02***	
Hansen test	85.99	85.99	169.16	151.09	141.67	49.26

Robust standard errors adjusted for 176 clusters in index are in parentheses, ***/**/* indicates significance at 1%/5%/10%, time dummies included in the regression are not reported in the table, *_cons* stands for constant

Source: Author using data from Bankscope, Eurostat, the ECB and the World Bank